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1. AGRICULTURAL SCIENCES

Flowering Plant Parasites (Phanerogams)

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Most of the diseases are caused by fungi bacteria and viruses. There are few seeds plants called flowering parasites (Phanerogams) which are parasitic on living plants. Some of these attack roots of the host, while some parasites on stem. Some are devoid of chlorophyll and entirely dependent on their host for food supply, while other have chlorophyll and obtain only mineral constituents of food from host by drawing nutrition and water they are called as Holoparasites or complete or total parasite. They have haustoria as absorbing organs, which are sent deep into the vascular bundle of the host to draw nutrients, water and minerals.

Flowering Plant Parasites

There are two types of parasites.

1. Root Parasites:
   a. Striga (Partial root parasite)
   b. Orobanche (Complete root parasite)
2. Stem Parasites:
   a. Dodder (Cuscuta) (Complete stem parasite)
   b. Loranthus (Partial Stem parasite)

Root Parasites

1. **Total or Complete or Holoparasite**Orobanche (Broom rape or Tokra)It is annual flashy flowering plant growing to height of about 15-50 cm long, yellow or brownish colour and covered by small thin scaly leaves. Flowers appears in the axil of leaves are white or tubular. Fruits appears in the axil of leaves are white or tubular. Fruits are capsule containing and seeds are very small, black in colour remain viable for several years. The hausteria of parasite penetrates into the roots of hosts and draw its nourishment. The growth of the plant is retarded, may die some times. It attacks tobacco, tomato, brinjal, cabbage, cauliflower.

2. **Hemi Partial or Semi Root Parasite**Striga (Witch Weed or Turfula or Talop)Family ScrophulariaceaeIt is a small plant with bright green leaves grows upto height 20-60 cm leaves beers chlorophylls and developed in clusters of 10-20 % host plant. They are obligate parasites therefore; do not obtain all their nutrient from their host root. Flowers are pink in colour; seed are very minute and produce in grate number 5000 to 100000 seeds plant per years. One flower contain 1200-1500 seeds and remains viable upto 12-40 years. Dissemination takes place with rain water, flood, wind and irrigation water. It causes yellowing and wilting of host leaves. It attacks sugarcane jowar, Maize, cereals and millets.

Stem Parasites

1. **Total or Complete or Holoparasite**Cuscuta or dodder (Amarvel, Lovevine) Family cuscutaceae.Genus– Cuscuta: It is non chlorophyllous, leaf less parasitic seed plant.

It is yellow pink or orange in colour and attached to the host. They do not bear leaves but bear minute function less scale leaves is produces flower and fruits. Flowers are white, pink or yellowish in colour and found in clusters. Seed are form in capsules. A single plant may be produce 3000 seeds.

The first appearances of parasites is noticed as thread like leaf less stem which devoid of green pigment and twine around the stem or leaves of the host .When stem of parasitic plant comes in contact with host, the minute root like organs. i.e. hausteria penetrates into the host and absorbs. When the relation ship of the host is firmly established, the dodder plant looses the contact from soil.

These affect plant get weakened and yield poorly the seeds spread by animals, water and implements and remain viable when condition are unfavorable.
It attacks berseem alfalfa, clover, flax, onion, potato, ornamental and hedge plants.

2. **Partial, Semi or Hemi Stem Parasites:**

   Loranthus
   Family-Loranthaceae.
   It is a partial parasite of tree trunks and branches with brown stem, dark green leaves but no roots.

   a. Stem is thick and flattened of the node; appear in clusters at the point of attack which can be easily spotted on the trees.
   b. At the point of attachment with the tree, it shows swellings or tumourous growth where the haustoria are produced. It produces flowers which are long, tabular, greenish, white or red colour and found in clusters. It produces fleshy berries with single seed.
   c. The affected host plant becomes stunted in growth and dispersal of seed is mostly through the birds and animals. It attacks mango, citrus, apple, and guava.

Integrated Management of Phanerogamic Plants

Cultural Practices: Use of catch crop and trap crop. e.g. - Cotton and groundnut are used as trap crops for *Strigaasiatica*.

- Sudan grass is a trap crop for *Strigahermonthica*.
- *Carumajowan* is a trap crop for *Orbanchecernua*.
- Hand weeding is also very much effective to control Orobanche.
- The parasite should be systematically pulled out from the host before seed set and later it should be destroyed properly. Sometimes cut down of diseased branches are very much beneficial.

Physical Method: Solar sterilization in the hot dry areas by soil mulching with polyethylene film is useful in controlling striga seed germination.
Biological Method: An insect Sciara sp. eats seedling and stem of orobanche. Agromyzid fly and phytophthora also attack orobanche.

- Alternariadestruence reduce Cuscutagronovii infestation up to 90% in carrot and cranberry.

Resistant Cultivars: There are many sorghum and sugarcane varieties which are resistant to striga such as IdonMakhaho, Ex- Dapchi, Ex-Pulka and War-warabashi, SAR 1 and 2 improved varieties, ICVS 1002 and ICVS 1007 resistance to *Strigahermonthica* and several sunflower varieties like VB 24, VB 24 and VB 368 which are shows resistant against *orobanchecumana*.

Chemical Method:

1. Use of herbicide like 2, 4 –D, MCPA etc. after 30 days of sorghum planting is very much effective against striga.
2. Fumigation with methyl bromide useful for sterilized soil and kill striga seed.
3. Mixture of 7g of copper sulphate and 1 g of 2, 4-D is applied on loranthus by making a hole at the bottom of the loranthus.
4. 40% emulsion of diesel oil is prepared in water containing 0.005 percent washing soap as an emulsifying agent and sprayed on loranthus.

2. AGRICULTURAL SCIENCES

Plant Growth Promoting Rhizobacteria

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PGPR promote plant growth due to their abilities in phytohormone production, nitrogen fixation, and phosphorus solubilization; produce several substances which are related to pathogen control, i.e., exhibiting competition with plant pathogens, synthesis of antibiotics, antifungal metabolites and defense enzymes, and secretion of iron-

chelating siderophores; and trigger induced systemic resistance (ISR) via methyl jasmonateand methyl salicylate in plants. The ISR resembles pathogen-induced systemic acquired resistance (SAR) through the salicylic acid-dependent SAR pathway under conditions where the inducing bacteria and the challenging pathogen remain spatially separated. The use of PGPR combinations of different mechanisms of action, i.e., induced resistance and antagonistic PGPR, might be useful in formulating inoculants leading to a more efficient use for biological control strategies to improve crop productivity.

Plant Growth-Promoting Rhizobacteria (PGPR)

What is PGPR?

Plant growth-promoting rhizobacteria are the soil bacteria that colonize plant roots. They have the ability to:

- Reduce the insects and disease damage.
- Facilitate plant growth directly or indirectly.
- Decrease the global dependence on hazardous agricultural chemicals.
- Stimulate plant growth through mobilizing nutrients in the soil.

History of PGPR

- Kloepper and Schroth (1981) first time use the term to demonstrate the microbial population in the rhizosphere which is beneficial, colonize the roots of plants and show plant growth-promoting activity.
- The concept of Rhizobacteria was the first time given by Hiltner (1904) to detect the zone of soil that surrounds the roots where the microbial populations are accelerated by root activities.

Characteristics of PGPR

The ideal characteristics of PGPR are that they have the ability to

- Colonize the root surface
- They can survive, multiply and compete with other microbiota.
- Promote plant growth.

Classification of PGPR

The classification of PGPR r depends on functional activities because the can act as biofertilizers, biostimulator, rhizomediator, and biopesticides.

1. Extracellular PGPR (ePGPR)
2. Intracellular PGPR (iPGPR)

ExtracellularPGPR

Extracellular PGPR may exist in the rhizosphere and in the rhizoplane or in the spaces of cells of the root cortex. The bacterial genera such as*Agrobacterium, Arthobacter, Bacillus, Caulobacter, Erwinia, Micrococcus, Pseudomonas*and*Serratia*.

IntracellularPGPR

They locate inside the specialized nodular structure of root cells. They belong to the family of*Rhizobacteriaceae*includes*Allorhizobium, Bradyrhizobium*,*Mesorhizobium,*and*Frankia*.

Mechanism of action of PGPR

1. Direct plant growth promotion (Biofertilizer activity)
2. Indirect plant growth promotion (Biocontrol activity)

DirectMechanism

It facilitates nutrient uptake and nutrient availability. Direct mechanism includes

1. Nitrogen fixation
2. Phosphate solubilization
3. Potassium solubilization
4. Siderophore production
5. Phytohormone production

Nitrogen Fixation

PGPR fix atmospheric nitrogen and provides it to plant. Nitrogen is changed to ammonia by nitrogen-fixing microorganism using a complex enzyme system known as nitrogenase which consists of dinitrogenase and dinitrogenasereductase.

PGPR provides nitrogen to plant by two mechanisms

Symbiotic Nitrogen Fixation: This is a mutual relationship between microbe and plant such as Rhizobacteria and Frankia.

Non Symbiotic Nitrogen Fixation: Is carried out by free-living, associative and endophytes such as Cyanobacteria, Azotobacteria

NodulationProcess:

- Rhizobial attachment with root cells
- Extraction of nod factors by rhizobia causing the root hair curling
- Rhizobia penetrate root hair by form an infection thread through which they penetrate the cortical cells and form bacterial state and thereby nodules are formed.

PhosphateSolubilization

Phosphate is another key element in the nutrition of plants. Phosphorous is abundantly available in the soils but the amount of available forms to plant is generally low as in the majority of soil phosphorus is present. The plant absorbs phosphorus in two basic forms monobasic ion and dibasic ions. Organisms bind with phosphate solubilizing activity and termed as phosphate solubilizing microorganisms and provide the available form of phosphorus to plants and thus constitute to chemical phosphatic fertilizers.

PotassiumSolubiloization

PGPR are able to solubilize the potassium through the production and secretion of organic acid. Potassium solubilization PGPR areAcidothiobacillus, Burkholderia and Pseudomonas.

SiderophoreProduction

They are microbial chelating compounds. Kloepper (1980) first time describe the importance of siderophore production by PGPR in the enhancement of plant growth for example Bacillus, Azotobacter

PhytohormoneProduction

Phytohormone such as auxin, gibberellins, cytokines effect on cell proliferation

INDOLE ACETIC ACID PRODUCTION: IAA produced by PGPR. It has a positive effect on root growth and helps in cell division and differentiation. Biosynthesis of various metabolites and resistance the stressful condition.*Pseudomonas, Enterobacter,*and*Klebsiella*plays role in indole acetic acid production.

Cytokines and Gibberalines: PGPR also produce cytokines and gibberellins for plant growth promotion such as*Azotobacter*spp, Bacillus subtilis.

IndirectMechanism

Indirect mechanism includes

1. Antibiotic Production
2. Hydrolytic Enzyme Production
3. Induced Systemic Resistance
4. Exopolysaccharide Production

AntibioticProduction

PGPR produce antibiotics against phytopathogens. It is a biocontrol mechanism. A variety of antibiotics have been identified including compounds such as phenazine, tropolone.

LyticEnzymes

PGPR produce enzyme such as chitinase, dehydrogenase, beta-glucanase, lipase, etc. they exhibit hypersensitivity activity, attacking pathogens by secreting cell wall hydrolases. It protects from biotic and abiotic stresses.

InducedSystemicResistance

It is defined as the physiological state of enhancing defensive capacity in response to specific environmental stimuli and as a result plant, innate defenses are potentiated against subsequent biotic changes. Many individual bacterial components induce systemic resistance such as lipopolysaccharide, siderophore, and volatile compound, etc.

ExopolysaccharideProduction

EPS production is important in biofilm formation and colonization.it helps to hold free phosphorus and circulating essential nutrients. The function performed by EPS producing microbe is shielding from desiccation.

3. HORTICULTURE: POST HARVEST TECHNOLOGY

E-sensing Techniques in Evaluation of Food Quality

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Introduction

It has always been the tradition of consumers to pay great attention to the sensory characteristics of food such as smell, taste, and appearance. In practice, the conventional method of sensing food sample is done with the help of consumer panels and expert tasters which is a subjective method and sometimes do not reflect the true condition of a product. Therefore, companies that specialise in the processing and product development are put under increasing pressure to find new solutions that would parallel sensory evaluation of food products. Such conflicting pressures are the impetus behind evolving trends to improve the current sensory quality assurance methods through the introduction of alternative or complementary methods to imitating human senses with devices known as electronic senses.

Electronic Sensing/E-Sensing

"E-sensing" refers to the capability of reproducing human senses using sensor arrays andpattern recognition systems (Sayeed and Shameem, 2011).

Different Types of E-Sensing Devices Include:

1. Electronic nose/e-nose
2. Electronic tongue/e-tongue
3. Electronic eye/e-eye

E-Nose

E-nose is an intelligent gas array sensor system that mimics the mammalian olfactory system (Glatz and Bailey-Hill, 2011).

E-Tongue

E-tongue is an analytical device employing an array of non-selective chemical sensors with partial specificity to different samples and an appropriate pattern recognition instrument, capable of recognizing quantitative and qualitative composition of simple and complex samples (Szczurek*et al*., 1999).

E-Eye

E-eye is computer vision technology converting optical images into digital imagesandituses an image sensor to collect images of objects and employs computer simulation criteria to identify the images (Liu *et al*., 2018).

Application of E-senses in Food Analysis

- Freshness evaluation
- Shelf-life investigation
- Product development
- Process monitoring
- Product traceability
- Authenticity assessment

Challenges

- E-sensors can only identify a standard set of odors/tastes/vision which are stored in their databases
- Though they are effective, they can't precisely mimic the complex human olfactory system
- They have shorter lifetime because of the sensors employed in them
- The artificial senses cannot be integrated to give the unified effect like the human senses

Conclusion

With the remarkablegrowth in food industry, the use of electronic senses is of vital importance to safeguard the quality of products. As food industry never stops its processes, it needs fast, reproducible, consistent,robustandconvenient evaluation systems. Hence, e-senses look promising with their wide commercial applications.

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4. AGRONOMY - CROP MANAGEMENT

Salicylic Acid -A Plant Hormone for Increasing Crop Productivity

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Salicylic acid (SA) is obtained from the bark of the willow tree which is the substance used to be obtained is a monohydrobenzoic acid, a type of phenolic acid and a beta hydroxyl acid. White willow (*Salix alba*) is a natural source of salicylic acid. This colorless crystalline organic acid is widely used in organic synthesis and functions as a plant hormone. It is derived from the metabolism of salicin.

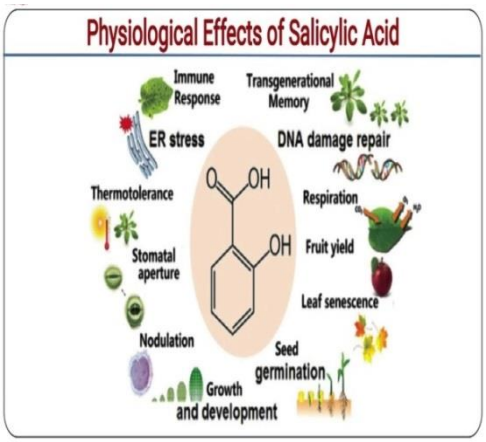
Salicylic acid (SA) is an important phenolic compound presently considered as a plant growth regulator which improves plant responses towards drought stress (Farooq*et al.,*2009). SA has an important role in transpiration, ion uptake, translocation of solutes, photosynthesis, induction of flowering and protein.

Two Pathways for SA Production

1. Isochorismate (IC) pathway
2. Phenylalanine Ammonia-Lyase(PAL) pathway.

Significance of Salicylic acid

- Salicylic acid induces specific changes in leaf anatomy and chloroplast structure.
- Salicyclic is involved in endogenous signaling, mediating in plant defense against pathogens.
- It plays a role in the resistance to pathogens by inducing the production of pathogenesis-related proteins.
- It is involved in the systemic acquired resistance in which a pathogenic attack on one part of the plant induces resistance in other parts.
- Exogenous application of SA enhanced the level of endogenous phenolics in the roots.
- The application of SA minimized adverse effects of drought stress on leaf relative water content and increased the content of total soluble proteins in leaves.
- SA influences seed germination, seedling establishment, cell growth, respiration, stomatal closure, senescence- associated gene expression, nodulation in legumes and fruit yield



Rajeshwari and Bhuvaneshwari (2017)

Impact of Salicylic Acid on Different Crops

Crop	Impact
Rice	Plant defense mechanism and enhancing the yield
wheat	Increases in grain yield (35.19%) Enhanced Chemical constituents like N,P,K content and protein content of leaves and grains with improved total soluble sugars, total carbohydrates, chlorophyll b and total carotenoids content in leaves

Maize	Improved proline concentration, amino acid accumulation, relative water and chlorophyll content
Mung Bean	Yield attributes
Cowpea	Alleviate the inhibitory impact of salinity stress on the growth, physiological and anatomical features and the productivity

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5. HORTICULTURE: POST HARVEST TECHNOLOGY

OsmodehydrationTechnique in Fruits

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Drying or dehydration refers to the process of removal of water and it is a practice that has been adopted for centuries for the preservation of food. However, it has some limitations such as high processing cost, effect on texture and flavour, rehydration difficulty and development of enzymatic browning. Osmotic dehydration (OD) is a well-known dehydration and preservation technique that involves partial dehydration of fruits by osmosis in a concentrated sugar solution or syrup. The fruit is reduced to about 50 per cent of its original weight, after which it is drained and either frozen or dried further (Srilakshmi, 1997).

Pre-treatment activities such as blanching, in combination with other agents such as sodium sulphate, citric acid, potassium metabisulphiteetc, have been shown to be useful in maintaining the physical and chemical characteristics of dehydrated products (Gomez *et al*., 2022; Suresh Kumar and Sagar, 2014). After all the pre-treatment activities are done, the solution is drained off and the fruit is either frozen or dried to produce a shelf-stable product containing low water activity in the range of 0.65-0.90 (15-40% moisture), which is referred to as the Intermediate Moisture Fruit (IM) fruit (FAO, 2003). This method is used for preserving semi- moist fruits e.g. mango, papaya, and berries, which are soft in texture and shelf stable without a need for refrigeration or thermal processing.

Advantages of Osmodehydration

1. **QualityImprovement**
   - Heat damage to colour and flavour is reduced because products are not exposed to high temperatures for an extended period of time.
   - Prevent fresh fruit flavour loss.
   - The high concentration of sugar surrounding the fruit pieces prevents enzymatic oxidative browning of the fruit.
2. **EnergySaving**
   - Osmotic dehydration can be performed at low temperatures, and therefore it is a less energy-intensive process.
   - The high solute content of osmotically treated products reduces water activity and preserves them, avoiding an energy-intensive drying process.
3. **ChemicalTreatmentnotRequired**
   - The sugar used for osmodehydration has been shown to be effective against biochemical reactions that hasten product deterioration, such as inhibition of polyphenoloxidase, the enzyme which catalyses oxidative browning of fruits and vegetables.
4. **ProductStabilityduringStorage**

- The dehydrating effect of osmodehydration decreases water activity, which in turn decreases chemical reactions and the growth of toxin-producing microorganisms in food.

Disadvantages of Osmodehydration

1. **ProductQuality**
   - The saltiness or sweetness of the product may increase during the osmotic process, or the acidity may decrease, which is not always desirable.
   - Microbial contamination, which grows in proportion to the number of times the osmotic solution is recycled.
2. **OsmoticSolutionManagement**
   - Industrialists face a challenge in managing osmotic solutions, which includes solution concentration and composition, recycling, solute addition, waste disposal, and re-use.

Conclusion

The use of osmodehydration as a dehydration technology for shelf-stable products has demonstrated improved product characteristics and efficient energy use.

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6. ENVIRONMENTAL SCIENCE

Properties of Nanomaterials for Environmental Applications

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Introduction

Over the past decade, nanomaterials have been the subject of enormous interest. These materials, notable for their extremely small feature size, have the potential for wide-ranging of applications (Buzea*et al.,* 2007). Nanomaterial is a field which takes a materials science-based approach to nanotechnology. It studies materials with morphological features on the nanoscale, and especially those which have special properties stemming from their nanoscale dimensions. Nanomaterials describe, in principle, materials of which a single unit is sized (in at least one dimension) between 1 to 1000 nanometres (10^{-9} meter) but usually is 1 to 100 nm (the usual definition ofnanoscale). Nanomaterials research takes amaterials science-based approach tonanotechnology, leveraging advances in materialsmetrologyand synthesis which have been developed in support ofmicrofabricationresearch. Materials with structure at the nanoscale often have unique optical, electronic, or mechanical properties. Nanomaterials are slowly becoming commercialized and beginning to emerge as commodities

Classification of Nanomaterials

Nanomaterials are classified as one dimension, two dimensions and in three dimensions nanoscales (Rao and Murthy, 2007).

- Nanoscales in one dimension are thin films, layers and surface coatings. They are used for decades in the fields such as electronic device manufactures.
- Nanoscales in two dimensions are nanotubes and nanowires have generated considerable interest because of their novel electrical and mechanical properties, for example, carbon nanotubes.
- Nanoscales in three dimensions (nanoparticles) are less than 100 nm in diameter which can be spherical, tubular, or irregularly shaped and can exist in fused, aggregates or agglomerated forms. Nanoparticles are of interest because of the properties such as chemical and optical behavior that they exhibit compared with larger particles of the same material. For example titanium oxide and zinc oxide become transparent at the nanoscale level, and are able to absorb and reflect the UV light and found to have many industrial applications. Nanoparticles have larger surface area and enhanced activity in potential application such as catalysis.

Manufacturing of Nanomaterials

- Nanomaterials are not simply another step in the miniaturization of materials. They often require very different production approach. Nanomaterials can be produced through 'top down' and 'bottom up' approaches (Rao and Murthy, 2007) (Figure1).
- The bottom-up approach refers to the buildup of a material from the bottom,
  i.e., atom-by-atom, molecule-by-molecule or cluster-by-cluster. The colloidal dispersion is a good example of bottom up approach in the synthesis of nanoparticles. Nanolithography and nanomanipulation techniques are also a bottom-up approach. These techniques have been widely used in the formation of structural composite nanomaterials. Top-down approach involves starting with a block bulk material and designing or milling it down to desire shape. This technique is similar to the approach used by the semiconductor industry in forming devices, utilizing pattern formation (such as electron beam lithography). Both approaches play very important roles in modern industry and most likely in nanotechnology as well.
- There are advantages and disadvantages in both approaches. The main challenge for top-down approach is the creation of increasingly small structure with sufficient accuracy whereas in bottom-up approach, the main challenge is to make structure large enough and of sufficient quality to be of useful as materials (Fendler, 1998). Bottom-up approach promises a better chance to obtain nanostructures with less defects, more homogeneous chemical composition, and better short and long range ordering. This is because the bottom-up approach is driven mainly by the reduction of Gibbs free energy, so that nanostructures and materials such produced are in a state closer to a thermodynamic equilibrium state. On the contrary, top-down approach most likely introduces internal stress, in addition to surface defects.

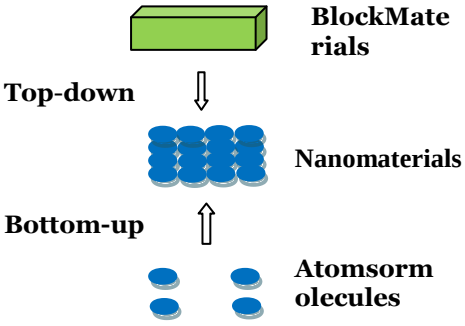

Figure1. Top-down and Bottom-up methods forproduction of nanomaterials

Properties of Nanomaterials

- The properties of material can be different at the nanoscale for two main reasons: increased relative surface area and quantum effects. These two factors can change or enhance properties such as reactivity, strength and electrical characteristics (Rathi, 2009).
- Nanomaterials have a relatively large surface area as compared to the same mass of materials produced in a larger form. As the particle size decrease, a greater proportion of atoms are found at the surface compared to those inside. For example, a particle size of 30 nm has 5 per cent of its atoms on its surface, at 10 nm 20 per cent of its atoms and at 3 nm 50 per cent of its atoms. Thus, nanoparticles have a much greater surface area per unit mass compared to larger particles. As growth and catalytic chemical reactions occurs at surface, this means that a given mass of material in nanoparticulate form will be much more reactive than the same mass of material made up of larger particles. In addition, with surface area quantum effects begin to dominate the properties of the matter as size is reduced to the nanoscale. These can affect the optical, thermal, mechanical and magnetic behavior of materials particularly as particle size approach towards the nanoscale. The nanomaterials exploit these effects include quantum dots and quantum well lasers for optoelectronics. The important properties of nanomaterials are listed below.

Optical Property

For last few decades, metallic nanoparticles have fascinated researchers due to their colourful colloidal solutions. Mie was the first to explain the red color of gold nanoparticle in 1908 by solving Maxwell's equation for an electromagnetic light wave interacting with small metallic spheres. The colour exhibited by metallic nanoparticles is due to the coherent excitation of all the "free" electrons within the conduction band, leading to an in-phase oscillation and is known as surface plasmon resonance. Thus, the colour of metallic nanoparticles may change with their size due to surface plasmon resonance.

Unique optical property of nanomaterials may also be due to quantum size effect, which arises primarily because of confinement of electrons within particles of dimension smaller than the bulk electron delocalization length. This effect is more pronounced for semiconductor nanoparticle, where the band gap increases with a decreasing size. The same quantum size effect is also shown by metal nanoparticles, when the particle size is less than 2 nm.

Magnetic Property

Magnetic properties of nanostructured materials are distinctly different from that of bulk materials. Ferromagnetic particles become unstable when the particle size reduces below a certain size as the increase in surface energy provides a sufficient energy for domains to spontaneously switch polarization directions and become paramagnetic.
But this transformed paramagnetism behaves differently from the conventional paramagnetism and thus is referred to as superparamagnetism (Frankel and Dorfman,1990).In other words, ferromagnetism of bulk materials disappears and gets transferred to superparamagnetism in the nanoscale due to the high surface energy.

Mechanical Property

The mechanical properties of nanomaterials increase with the decrease in size. Most of the studies have been focused on the mechanical properties of one dimensional structure such as nanowire. The enhanced mechanical strength of nanowires or nanorods is ascribed to the high internal perfection of the nanowires. Generally, imperfections such as dislocations, micro-twins and impurities in crystals are highly energetic and should be eliminated from the perfect crystal structures. The smaller the cross-section of nanowires, the less is the probability of finding in it any imperfections as nanoscale dimension makes the elimination of such imperfections possible.

Thermal Property

Metal and semiconductor nanoparticles are found to have significantly lower melting point or phase transition temperature as compared to their bulk counterparts. The lowering of the melting points is observed when the particle size is less than 100 nm and is attributed to increase in surface energy with a reduction of size. The decrease in the phase transition temperature can be ascribed to the changes in the ratio of surface energy to volume energy as a function of size.

Types of nanomaterials

Nanomaterials can be divided into natural and anthropogenic particles (Table 1). The particles can be further separated based on their chemical composition into carbon coating and inorganic nanomaterials (Nowack and Bucheli, 2007).

Table 1. Types of nanomaterial based on their origin and compositions

S.No	Origin	Classification	Formation	Particles	Examples
1	Natural	C- containing	Biogenic	Organic colloids	Humic, Fulvic acid
			Geogenic	Soot	Fullerens
			Atmospheric	Aerosols	Organic acids
			Pyrogenic	Soot	CNT, Fullerenes
		Inorganic	Biogenic	Oxides, Metals	Magnetite, Ag, Au
			Geogenic	Oxides, Clay	Fe-oxides, allophane
			Atmospheric	Aerosols	Sea salts
2	Anthropogenic (Engineered)	C- containing	By products	Combustion by-products	CNT, Nanoglobules
			Engineered	Soot	Carbon block, Fullerenes
				Polymeric	Polyethylene glycol
		Inorganic	By products	Combustion by-products	Platinum group metals
			Engineered	Oxides	TiO2, SiO2
				Metals	Ag, Fe
				Salts	Metal-phosphates
				Alluminosilicate	Zeolites, Clay

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7. HORTICULTURE

Special Horticultural Practices in Flower Crops

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Rose

Bending: Bending is a major horticultural practice followed in rose in 3 month old age plants under greenhouse conditions. The place of bending is as close to the original bush as possible (maximum 5 cm), without breaking the branches. To avoid breaking, it is advisable to do the bending in the afternoon and to create two 45 degree bends rather than one 90 degree bend.Bending results in the reversal of sap flow which helps in building a strong framework of the bush.

Thinning: Removal of the undesirable growth like inward growth, weak stems, blind shoots and crowded growth.

De-Suckering:Removal of suckers from root stock i.e. the shoots produced below the bud union on rootstocks has to be removed.

De-Shooting: Generally followed in HT roses. Young vegetative shoots developing from the axils of leaves of basal and lateral shoots are removed to allow only one terminal shoot.It is important to produce increased stalk length.

Wintering: Wintering is keeping the plant uniformly cold and frozen in all winter and it prevents the damaging effects of alternate freezing and thawing. Prior to covering, remove foliage or other debris that might harbor disease for the next season. The most common method is used in wintering is to 'hill-up'; a loose well drained soil/ compost mix around and over the plant a depth of about 10-12 inches. Wintering is commercially practiced in Maharashtra.

Chrysanthemum

Pinching: Removal of a part of terminal growing portion of stem is called pinching. It is done to reduce the plant height and to promote auxiliary branching.Pinching of blind shoot is beneficial to increase flowering.

Disbudding: Removal of undesirable buds is known as disbudding.Keeping only the central bud side buds are removed to produce a quality bloom in standard Chrysanthemum.Removal of central bud for spray chrysanthemum.

De-Suckering: During the vegetative growth phase, plants grow upwards. New suckers continue to develop from base of plants. For proper and vigorous growth of plants, suckers are removed from time-to-time.

Supplementary Lighting: It is provided to chrysanthemums grown in green house for normal growth of plants during periods of inadequate natural light. Each bed is provided with overhead cables to facilitate illumination. 730 meter cable with 400 lamps of 100 watt each, requiring load of 25kw is adequate to supplement light for 0.4 hectare area. High pressure mercury fluorescent lamps are used for lightening, recently LED bulbs replaced these.A minimum of 10 Foot Candles is supplied using 60 watt lamps, 4 feet apart and 2 feet above the plants.

Darkening / Shading: Whendaylength is too long for bud initiation, artificial shade is provided to create short day conditions. Black polythene sheet of 150 gauges is used for shading.Shading is done from 6 PM to 7 AM by covering sheet over inverted U frames.

Carnation

Pinching

- **Single pinch**: Pinching is done only once at 5 node stage for obtaining early crop.
- **Pinch and a half**: Single pinch the main stem and pinch half of the resulting shoots; provides steady production of flowers.

- **Double pinch**: Single pinching followed by pinching of all the resulting shoots when they are 6-8 cm long; not followed commercially, results in poor quality flowers.

Netting: It is an important horticultural practice followed in carnation to get quality flower stalks. During netting the bottom net should be at a height of 10 x 10 cm, a second layer of 12.5 x 12.5 cm and the upper most layers can be 15 x 15 cm.

Supplementary Lighting: It is very effective for increasing stem length, flower size and early flower production and should be given with 100W incandescent bulbs hung at 1.5m above the beds at 1m spacing during November–January from dusk to 9 pm or from 10 pm to 2 am when light intensities are poor.

Disbudding: Removal of undesirable buds is known as disbudding.Keeping only the central bud, all the side buds are removed to produce a quality bloom in standard carnation. Removal of central bud in case of spray carnations.

Anthurium

Leaf pruning: Leaf pruning by retaining 4-6 leaves per plant has to be taken up at regular intervals to avoid diseases and to promote flowering.

Desuckering: For preventing improper and vigorous growth of plant, suckers are removed from time to time. Without Desuckering, the plant will lose its vigour and becomes week.

Gladiolus

Staking: Large flowered varieties should be staked to avoid lodging.

EarthingUp: When the shoots are about 20 cm high they are covered by heaping the soil up to a height of 10 to 15 cm. This enables the plants to grow erect despite high winds and rains and suppresses weed growth. Earthing up the soil is a must in case of light soils.

Jasmine

Pruning: It encourages growth of new healthy shoots and influences flower yield. In *J. grandiflorum*, pruning in mid-December at 90cm length from the ground retaining 10 shoots and striping out all leaves is most beneficial under Bangalore condition. In *J. auriculatum*, pruning during December and January encouraged higher flower yield & Nadia (West Bengal), while pruning of this species during January-end is better at Coimbatore.In*J. sambac*pruning of plants, during October-end is beneficial under Bangalore conditions, while *J. sambac* should be pruned once again after 6 months of first pruning during lean season of flowering under Coimbatore conditions.

Pinching: Pinching of new shoots after pruning helps to regulate flowering in *J. auriculatum* and *J. grandiflorum* which delays onset of flowering. The overall growth of laterals produced after pinching is more which delays the flower bud formation by 14 days in *J. auriculatum* and 17 days in *J. grandiflorum*. This delay in flowering of laterals produced after pinching helps to stagger the peak productivity.

Removal of Water shoot: In jasmine, water-shoots are produced which grow faster and yield only a few flowers. Removal of such unproductive shoots is supposed to direct the energy towards productive shoots.

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8. SOIL SCIENCE

Nano Fertilizer –A Novel Approach to Crop Production

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Introduction

Nanotechnology is the revolutionary technology where the particle size ranges between 1 and 100 nm at least in one dimension. Due to their high surface area and high reactivity better penetration into the cell these can activate

plant and microbial activities resulting in more nutrient use efficiency. Nanoparticles may trigger enzymes and polysaccharide release and act as effective catalysts in plant and microbial metabolism.Nano fertilizers are the salient tools that give fruitful results in agriculture by increasing crop growth, yield, and quality parameters with increased nutrient use efficiency, reducing wastage of fertilizers and cost of cultivation, which helps the rural farmer to achieve high success rates. Nano-fertilizers are very effective for site-specific and precise nutrient management in precision agriculture by matching the crop growth stages for nutrients and may provide nutrients throughout the crop growth period. Nano fertilizers improve crop growth up to maximum concentrations, but further increase in concentration may inhibit crop growth due to the toxicity levels of nutrients. Nano-fertilizers furnish more surface area for different metabolic reactions and enzyme production in the plant which increases the rate of photosynthesis and produces more dry matter and yield of the crop. It also helps plants to become resistant to different biotic and abiotic stress.

What is Nano Fertilizer?

Nano fertilizers are synthesized or modified designs of traditional fertilizers, fertilizers bulk materials, or extracted from different reproductive or vegetative parts of the plant by different chemical, physical, mechanical, or biological methods with the help of nanotechnology used to improve soil productivity, fertility, and quality of agricultural produce. Nanoparticles can also be manufactured from fully bulky materials. At the nanoscale, physical and chemical properties are different than bulk material. Rock phosphate is used in nano form which increases the uptake level of Phosphorus to the plant because direct application of rock phosphate particles on the crop may intercept the fixation in the soil. Moreover, there is no silicic acid, iron, or calcium for fixation of the phosphorus hence increasing the ease of phosphorus availability to the crop at higher rates.

Important Properties of Nano Fertilize

1. The nano-fertilizers have a higher surface area it is mainly due to the very less size of particles which provide sites site to facilitate the different metabolic processes in the plant system result production of more photosynthates. The solubility is higher in a different solvent such as water. The particle size of nano-fertilizers is lesser than 100 nanometres which facilitate more penetration of nanoparticles into the plant system from an applied surface such as soil, roots, or leaves.
2. They have a large surface area and particle size less than the pore size of the root and leaves of the plant which can increase penetration into the plant from the applied surface and ameliorate uptake and nutrient use efficiency of the nano fertilizer.
3. Fertilizers encapsulated in nanoparticles will increase the availability and uptake of nutrients to the crop plants.
4. Zeolite-based nano-fertilizers are capable to release nutrients slowly to the crop plant which increases the availability of nutrients to the crop throughout the growth period.
5. The main reason for high-interest in fertilizers is mainly their penetration capacity, size, and higher surface area which usually differs from the same material found in bulk form.

Types of Nano-fertilizer

1. NitrogenNano-Fertilizer

To overcome the problems associated with nitrogen leaching during fertilization, different approaches such as polyolefin resin-coated urea, neem coated urea, sulphur coated urea were taken to control the N release. However, slow-releasing fertilizers are often expensive and the release of N is slow at the time of high nitrogen. N

loss can also be reduced using cation exchangers as additives in fertilizer to control NH_4^+ release. The retention and timely release of needed nutrients by zeolite improve overall crop yield. Clinoptilolite zeolite (CZ), a porous mineral with high cation exchange capacity (CEC, up to 300cmol (p^+) kg^{-1}) and with a great affinity for NH_4^+, has been used to reduceNH_3 emission from farm manure and to eliminate NH_3 toxicity to plants.

2. PhosphaticNano-Fertilizer

Phosphatic fertilizers are mainly manufactured from rock phosphate ores. In India, out of 260 million tonnes (MT) of recoverable reserves of rock phosphate approximately 20, Mt only have been estimated to be of high grade which is being mined by different government agencies for commercial purposes. The depletion of high-grade phosphate ores has brought about a search for suitable economically viable techniques/processes for beneficiating available low-grade phosphate reserves. Given this, rock phosphate (HGRP3 and Stone 3) nanoparticle was prepared by grinding them in a high-energy ball mill.

3. PotassicNanofertilizer

The slow and steady release of K from nano-zeolite gave the reason that it may be due to the ion exchangeability of the zeolites with selected nutrient cations, zeolites can become an exceptional plant growth medium for supplying plant roots with additional pivotal nutrient cations and anions. Zeolite can be"recharged" by the inclusion of more dissolved nutrients. Their selectivity of ion exchange on zeolite was determined in an order of **$K^+ > NH_4^+ > Na^+ > Ca^{2+} > Mg^{2+}$.**

4. Secondary nutrients Nano fertilizer

Application of MgO nanoparticles sprays on maize plants (*Zeamays*L.) enhanced the enzymatic activities like root phytase and phosphatase, particularly in P-deficient situations. The application of both P-doses and MgO nanoparticles spray increases the different growth parameters of plants like root length, root volume, dry weight of shoot and root, etc. irrespective of soils.

5. Micronutrients Nano-fertilizer

Zinc oxide Nanoparticles are shown to enter the root tissue of ryegrass and improve germination and also the yield of plants.

Organic Nano-Fertilizers for Organic India

1. Telangana-based Prathista Industries has launched India's and the world's first organic Nano fertilizers. Prathista Industries Ltd entered into a licensing agreement with the Indian Council of Agriculture Research for the commercialization of Nano nutrients for crops that are developed under the NAIP program.
2. Scientists have developed Nano nutrients technology through the biological process after extensive research both in the lab and in the fields, involving a consortium of ICAR institutions and Agricultural Universities. Prathista is the first company to commercialize the ICAR Nano nutrients innovative technology.
3. Research data reveals that the Nano nutrients doses are just in ppm level to meet the nutrient requirement for crops, against 150 to 200 kgs traditional fertilizer dose per acre. To have acceptance of ICAR innovation, Prathista incorporated the Nano nutrients technology with their 3G Lacto-gluconates technology. The cost of these nutrient fertilizers is at par with subsidized fertilizers and computable to use with all traditional fertilizers. The scalability of technology is commercially and economically feasible and nano nutrients are 100% safe for humans & livestock and 100% eco-friendly.

4. By using them farmers would gain an average of 20 percent additional yields coupled with an increase in microorganism levels in the soil by shifting to these nutrient fertilizers, while they can avoid using the traditional murate of potash (MOP) and diammonium

phosphate (DAP) fertilizers.

5. ICAR has developed a nanotechnology-based on chemicals. The Nano Nitrogen developed by them has its origins in urea. Prathista has developed organic Nano Nitrogen, Nano Potash, Nano Phosphorus, and Nano NPK. They are all required only in very small quantities. Therefore it is cost-effective for the farmers. They can effectively replace chemical fertilizers.

Nano Based Urea by IFFCO.

- It effectively fulfills crop nitrogen requirement, increases leaf photosynthesis, root biomass, effective tillers & branches,
- Enhances Farmer's income by an increase in crop productivity and reduction in input cost.
- Because of higher efficiency, it can reduce the requirement of conventional Urea by 50 % or more.
- It helps conserve soil, air and water quality.
- It contains 4.0 % total nitrogen (w/v) evenly dispersed in water.
- Application of 1 bottle of Nano Urea can effectively replace at least 1 bag of Urea.
- When sprayed on leaves, Nano Urea easily enters through stomata and other openings and is assimilated by the plant cells. It is easily distributed through the phloem from source to sink inside the plant as per its need.
- Unutilized nitrogen is stored in the plant vacuole and is slowly released for proper growth and development of the plant.

Advantages of Nano-fertilizer over Traditional Fertilizers

- Nano fertilizers are more beneficial than conventional fertilizers as they increase soil fertility yield and quality parameters of the crop.
- They are non-toxic and less detrimental to the environment and humans.
- They minimize cost and maximize profit.
- Nanoparticles increase nutrient use efficiency and minimize the costs of environmental protection.
- Enhancement in the nutritional content of crops and the quality of the taste.
- Optimum use of iron and increased protein content in the grain of wheat.
- Enhance plant growth by resisting disease infestations and improving the stability of the plants by anti-bending and deeper rooting of crops.

Comparison of Nano Fertilizers with Conventional Fertilizers

A Comparison of cost of cultivation of Nano P with SSP and DAP for pearl millet.

Fertilizer (Rate of application)	Cost of Cultivation (Rs/ha)	Yield Status (kg/ha)
SSP (80 kg/ha)	640	950
DAP (80 kg/ha)	2000	963
Nano P (720 mg/ha)	352	1093

Nanotechnology Fertilizers	Conventional Fertilizers
Micronutrients formulated through nanotechnology may improve and increase bioavailability by reducing soil absorption and fixation.	Less solubility due to macroscopic nature.
Because of nano-dimension, it might improve nutrient uptake and efficiency of fertilizers.	It increases efficiency and bulk amount is not available to plant roots.
They reduce the loss of fertilizer nutrient into the soil	They show high nutrient losses due to leaching, rain off and drift.

Nanofertilizer can extend effective duration of nutrient supply of fertilizers into soil.	Chemical fertilizers used by the plant ath the time of delivery, the rest are converted into insoluble salts in the soil.
The yield increases upto20% in case of application of nanotech fertilizers.	They yield may gets deduced upto15% due to application of excess fertilizers and also wastage of fertilizer due to insolubility and volatilization.
Through encapsulation, nutrient release inclosing both rate and pattern can be controlled for water soluble fertilizers.	The excess release of fertilizers results in toxicity and cause soil ecological imbalance.
These are cheaper as compared to convention fertilizers.	These are expensive in comparison with Nanotech fertilizers.

Conclusion

The application of different nano fertilizers has a greater role in enhancing crop production this will reduce the cost of fertilizer for crop production and also minimize the pollution hazard. Balanced fertilization of the crop plant may be achieved through nanotechnology fertilizers. The application of nano-fertilizers in agriculture has a greater concern to Indian farmers. Fertilizer nutrient use efficiency in crop production can be enhanced with the effective use of nano-fertilizers. Nano fertilizers improve the crop growth and yield up to optimum applied doses and concentration but they also have an inhibitory effect on crop plants if the concentration is more than the optimum which result reduces the growth and yield of the crop.

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www.iffco.in

ICAR – Nanotechnology Fertilizer Concept.

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9. AGRICULTURE

Review on Prickly Pear Fruit-Combat Malnutrition

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Introduction

Opuntiaficusindica of sub species opuntiaaciculata is often referred to as prickly pear or nopal cactus, is a member of cactaceae family. It is native crop of America Mexico, particularly the central and western regions, as well as the Caribbean islands, are rich in prickly pear species (West Indies). Prickly pears are native to dry, barren deserts, and drought-prone areas of the Western and SouthCentral United States, including the lower altitudes of the Rocky Mountains and the southern Great Plains.The prickly pear fruit is fleshy berry with an elongated, oval shape reminiscent to an oval pear or apple. The prickly pear fruit grows up to 2.5cm height. The weight of the fruit ranges between 67 and 216grams. These fruits come in a variety of appealing hues in the market, notably green, yellow, white, purple, red and orange which vary in correlation to proportion of betalain pigment.

Prickly pears have a limited life span ranging from 2-3 weeks maximum up to 4 weeks respectively. Throughout the food processing sector prickly pear are regarded as significant fruit. Furthermore, because of capacity to increase water retention, prickly pear fruits contain mucilage with high level of dietary fibre (galacturonic acids), which could also serve as thickening agent. In order to retain essential heat sensitive components in food products, novel non-thermal processing techniques which includes high pressure homogenization, pulsed

electric fields, high pressure processing and ultrasounds can be effective. Pear waste and by products create an advantageous benefit by managing both societal health and bio-waste management. Prickly pear fruit is also used in single cell production (genetically modified amino acid composition) in the presence of candida utilis protein synthesis was carried out both in batch and continuous cultures by utilizing prickly pear juice. The optimal specific growth rate and substrate yield coefficient in batch culture altered as per the sugar concentrations. Substrate yield and growth rate were 42.6% and 0.47/hour at 1% sugar, with the best yield happening in chemostat at temperature 30°C of pH around 3.5-4.5 respectively. Although pear juice comprises of fermentable sugars like glucose and fructose which could be used as base material for the production of baker's yeast. Due to the presence of high level of minerals and vitamins in pear fruit juice, encourages the proliferation of yeast cells. It is also employed as pharmaceutical agent and it has wide range of clinical and industrial applications.

Fruit is employed in production of value-added products like squash, pickles, jams and wine, but along with fruit stems and seeds are also used. These fruit acts as a natural colorant and flavoring agent because of its outstanding functional benefits and health related features.

Phyto-chemical derivatives, vitamins, polyphenols and carotenoids can be found in pear fruit. The fruit contains phyto-chemical derivatives such as catechins, betalains, indicaxanthin, vanillic acid, betanin and gallic acid in substantial amounts. The phenolic contentof(164.6e218.8 mg GAE/100 g) of fruit remains high, although flavanoids derivatives are essential. The fruit is abundance source of isorhamnetin (31.7e18.8%) in the form of five divergent of di and tri glycosides. Chemo preventative and anti-inflammatory activities are responsible for excellent health benefits. The gallic acid is efficient against prostate and lung cancer causing solid tumors.

Prickly pear fruit contains bioactive substances like phenolic compounds and carotenoids, along with that vitamins A,E,B1,B2,C and minerals iron, phosphorus, calcium, magnesium and potassium. Amino acids like alanine, arginine and asparagine's can also recognized in prickly pear fruit. Beta-carotene, vitamin E,C,K detected in prickly pear fruit have anti-oxidant properties which helps to improve consistency of fatty oil. The vitamin C and K content ranges from 180-300mg/kg and 0.5-1g/kg proportions change according to the region respectively. Due to hypolipidemic and hypoglycemic qualities it is used as medicine. Prickly pear fruit assist to avoid gastrointestinal problems by raising body bulk and lowering blood sugar levels. It also used for curing diabetes, heart diseases, obesity, cancer and other. Fruit increases the plate count, homeostasis and used to reduce risk of atherosclerosis.Type 2 diabetes it is a complex conditions with hereditary inheritance of individuals. Hypoglycemic process is triggered by prickly pear fruit consumption, inhibits the glucose absorption and raises the food viscosity in gut. It also has ability to boost the pancreatic cells which is used in insulin production. It also has anti-inflammatory, ulcer prevention properties.

Many other countries used this fruit in treatment of burns, bronchial, asthma and indigestion. The fruit is also used to alleviate hangover symptoms. When it is consumed before alcohol consumption reduces the alcohol effect. Dry mouth, anorexia and nausea also reduced. Loss of appetite also noticed when pear fruit is consumed. However, it has little effects on other symptoms of hangover like vomiting and headache. Although various non-traditional extraction techniques used for recovering lipids, colorants, phenolics, polysaccharides and other have proved very effective. These fruit is also employed in biochemical activities associated with enzymes as an acid like peroxidase, pectin esterases and fructofuranosidase respectively.

Conclusion

The prickly pear fruit is a possible source for animals and people especially in semi-arid and dry climates of regions. However, many obstacles restricting the spread of plantation of crop are of low productivity, quality, poor value of harvest and limited consumption. To promote the commercial potential of cosmetics, pharmaceuticals and foods still more study is needed. There is need of awareness among the

population regarding the nutritional and health benefits of prickly pear fruits across the world.

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10. CROP IMPROVEMENT

Allele Mining: Prospects in Genetic Improvement of Crops

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Abstract

With the sheer number of accession numbers that are collected by genebanks, genetic resources collections tend to be a source of undisclosed alleles. The challenge is how to identify these variations. In genetic resources collections, allelic variation is used to identify relevant traits. The 'tiling strategy' can be used to screen genetic resources collections for allelic variation for identified genes of known functions and DNA sequences. Having identified the allelic variants of interest, an optimized approach can be designed by focusing on targeted sets of polymorphisms, such as using SNP detection methods.

Keywords: allele, SNP, mining, variation

Introduction

As a result of the rapid accumulation of desirable alleles from a vast array of plant genetic resources available around the world, plant breeding for the development of superior and high-yielding agricultural crop types has become easier. Furthermore, several of these valuable or superior genes were left behind during evolution and domestication, and thus were not utilized. Many of the genetic variation found in wild relatives and land races of crop plants could be used to produce agronomically superior cultivars. Several independent studies of novel alleles from crop plants' wild relatives into cultivated varieties have demonstrated that certain alleles, or their combinations, can affect the expression of traits in a way that outperforms genetic bottlenecks that previously limited the introduction of alleles into cultivars (McCouch et al., 2007).

True Allele Mining

True allele mining accounts for the proportion of various factors influencing the genes as well as the sequence changes in non-coding and regulatory regions of candidate genes of agronomically essential genes (Ramkumar et al., 2015). Because of the relevance of allele mining for identifying regulatory variants, gene promoters have selected the target for allele mining, which has been dubbed "Promoter mining." Importance of Allele Mining It facilitates studies of allele evolution. The method can also be used to discover new haplotypes and create allele-specific markers for making use of marker-assisted selection (MAS). In addition to providing breeders with direct access to alleles that confer the following benefits:

- Resistance to biotic stresses

- Tolerance to abiotic stresses
- Greater nutrient use efficiency
- Enhanced yield
- Improved quality.

It can also detect nucleotide sequence differences associated with superior alleles and provide molecular bases for novel attributes.

Approaches for Allele Mining

For detecting sequence polymorphisms in naturally occurring populations for a given gene, two major approaches are available. They are:

1. Modified TILLING (Targeting Induced Local Lesions in Genomes) procedure called EcoTilling.
2. Sequencing-based allele mining.

EcoTilling

It involves utilizing heteroduplex analysis to discover polymorphisms (most notably point mutations) in a target gene caused by induced mutations. A version of this approach, EcoTilling, is used to assess how much natural variation there is under certain genes. As with TILLING, this method involves the detection of mutations from naturally occurring alleles in the primary and secondary crop gene pools rather than those produced artificially (Comai et al., 2004). EcoTilling, like TILLING, relies on the enzymatic cleavage of heteroduplexed DNA (formed by a single nucleotide mismatch in the sequence between the reference and test genotype) with a single strand specific nuclease (i.e., Cel 1, mung bean nuclease, S1 nuclease, etc.) under specific conditions, followed by detection with LiCorgenotypers (Li-Cor, USA). Nucleases cleave products with point mutations into two cleaved products of equal size.

Sequencing-Based Allele Mining

A method of allele mining based on sequencing is to amplify the alleles of a gene belonging to different genotypes, followed by DNA sequencing to detect nucleotide variations in the alleles. By doing so, it is possible to identify a variety of alleles within the cultivars. An analysis of haplotype diversity and structure will be used to infer the genetic association of plants. A haplotype is formed by the analysis of sequences for SNPs, insertions, and deletions (InDels), in order to determine the influence of mutations on gene structure. Allele mining is a highly successful strategy for increasing rice blast R gene source and managing destructive blast disease. In addition, this method can also be used to manage a variety of other crop diseases. Whenever allele mining is based on sequencing, there is no need for expensive equipment or time-consuming stages, but sequencing the targeted genes is still the major expense. This will be the principal cost of allele mining programme of this type. Increasingly efficient sequencing techniques and technologies, including massively parallel and supported oligonucleotide ligation detectors (SOLiD) are bringing down sequencing costs (Hutchison, 2007). It has been proposed that both tilling and Eco-tilling are effective haplotyping and SNP finding methods. As part of these procedures, a variety of complex steps are needed, such as generation of DNA pools, nuclease cleavage settings, and genotyping using polyacrylamide gels.

Bioinformatic Tools Required for Allele Mining

There are many bioinformatics tools that are required for allele mining, including PLACE, plantCARE, TRANSFAC, JASPAR, MEME, Plantprom DB, DCPD, SCPD, BioEdit and ClustalW. Sequence alignment tools can be used to compare a new genome sequence to a reference genome (Reddy et al., 2014).

Applications of Allele Mining

Using genotype mining in diverse genetic resources to detect additional alleles from the gene of interest has been successful. To determine nucleotide sequence changes associated with superior alleles, allele mining can provide information about the molecular basis of variation. In addition to allelic similarity/dissimilarity at a candidate gene and a gene's allelic synteny with other genes within the family, this method can also examine allelic synteny between family members. Molecular variation between related species can be distinguished through allele mining. The technique helps to monitor allele development and identify new haplotypes at candidate genes of interest as well as examine the haplotype variety.

Fig: Applications of Allele Mining

Research on association mapping might be organized based on the frequencies and changes of haplotypes within populations. The ability to detect associations between genetic variants and disease with haplotypes of closely related single nucleotide polymorphisms is likely to be enhanced over individual SNPs. Syntenic relationships can be examined for the identified loci/genes based on sequence information from allele mining studies (Ashkani et al., 2015).

Conclusion

An effective use of genetic and genomic resources depends on the efficient mining of alleles. A sequencing-based allele mining approach will certainly emerge as the preferred method for revealing natural variations and providing novel and effective alleles, and will take center stage in all seed improvement activities.

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11. SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Effect of Municipal Solid Waste on Soil Properties

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Abstract

Composting of municipal solid waste has potential as a beneficial recycling tool. Its safe use in agriculture, dependson the production of good quality compost, specifically, compost that is mature and sufficiently low in metals and salt content. The best method of reducing metal content and improving the quality of MSW compost is early source separation, perhaps requiring separation to occur before or at source of collection. Bioavailability should be addressed in the guideline limits, in addition to metal loading. Sewage water has a good nutrient potential in crop husbandry as it contains considerable amount of N, P, K, and S besides other micronutrients. Since the amount of N in sewage effluents is high, the C/N ratio for the organic components is low and a release of mineral N from organic substances is favored. Such sewage water, mainly in its raw (untreated) form in India, is used extensively as source of irrigation water in the nearby area of sewage canal mainly for fodder and vegetable production. However, pathogenic contamination to sewage farmers' as well as to consumers (particularly when vegetables consumed uncooked) is a major concern.

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Introduction

India generates about 50 million tons of municipal solid wastes (MSW) every year from cities. There has been a significant increase in municipal solid waste generation in India in the last few decades. This is largely due to rapid population growth and economic development in the country. Solid waste management (SWM) has become a major environmental issue because of serious environmental implications like global warming (through green house gases emission) and Contamination of surface and ground water bodies with toxic pollutants.Composting municipal solid waste involves managing conditions to accelerate the biological decomposition of its organic components. End product is an organically rich product with potential benefits for agricultural soils. The conditions for efficient biological decomposition of organic waste depend on optimum temperatures (50–65°C), moisture (45–55%), aeration (>15% O_2), pH (6.0–7.5), levels and carbon to nitrogen (25:1–30:1) ratios of the feedstock. If conditions deviate from these optimum conditions, the composting process is slowed and chemically unstable (immature) compost may be produced. When microorganisms degrade the organic materials under optimum oxygen levels, the process is called aerobic composting. In contrast, a different group of microorganisms can degrade the organic material under limited oxygen levels, where the process is called anaerobic composting. Aerobiccomposting is usually preferred over anaerobic composting because it is faster in biological oxidation and does not generate as many foul odors (i.e., ammonia, sulfur compounds, and organic acids).

Effect of Municipal Solid Waste Composts on Soil Resources

Most agricultural cropping systems result in the depletion of organic matter.Agricultural lands are excellent sites for beneficially using municipal solid waste compost as an organic soil amendment. SOM also acts as a large pool for the storage of nitrogen, phosphorus, and sulfur, and has the capacity to supply these and other nutrients for plant growth. Soil organic matter interacts with trace metals, often reducing their toxicity to plants. The physical benefits of organic matter on soil include improved soil structure, increased aeration, reduced bulk density, increased water-holding capacity, enhanced soil aggregation, and reduced soil erosion. The application of municipal solid waste compost to agricultural soil can be a means to return the organic matter to agricultural soil and in some cases reduce the cost of municipal solid waste disposal.

Physical Soil Properties: A primary benefit of MSW compost is the high organic matter content and low bulk density. Municipal solid waste compost has a high water holding capacity because of its organic matter content, which in turn improves the water holding capacity, aggregate stability and structure of the soil.

Biological Soil Properties: Soil ecology is increasingly being used to evaluate soil quality. It is thought that soil microbiological properties are most sensitive to changes in the soil environment. Biomass N, C and S showed increases in the soil immediately after compost addition. In long-term experiments, it was found that multiple additions of MSW compost increased microbial biomass C, and this increase persisted years after application. Another measure of soil microbial health is the activity of soil enzymes involved in the transformation of the principal nutrients. Enzyme activities e.g., dehydrogenase, phosphodiesterase, alkaline phosphomonoesterase, arylsulphatase, deaminase, urease, and protease increase due to MSW compost application. Some enzyme activities were reported to decrease where MSW compost was applied for long. The decrease was attributed to the potential toxic effects exerted by trace elements in this particular compost.

Chemical Properties: Increased soil pH of acidic soil is regarded as a major advantage when MSW compost is used. These increases were usually proportional to the application rate. The increase in the pHof soil may be due to the mineralization of carbon and the subsequent production of OH^-ions by ligand exchange as well as the introduction of basic cations, such asand K^+, Ca^{2+},Mg^{2+}. Immature

MSW compost tended to have a lower pH prior to thermophilic stage due to the intensive production of organic acids. A survey of selected Indian MSW composts found that the EC of the composts were much higher than that of agricultural soils. Municipal solid waste composts applied at rates ranging from 40 to 120 Mg ha^{-1}were seen to proportionally increase the EC of soils to which they were applied. Most studies concluded that MSW compost increased the EC value in soils. In some cases, soil EC levels were excessive and inhibited plant growth. As with many other properties of MSW compost, the EC content of the MSW compost is likely related to the feedstock used in the compost and compost facility procedures.

Nutrient Potential: The range of nitrogen concentrations that have been reported to be present in MSW compost is0.26 to 1.71%. The availability of nitrogen in MSW compost has been estimated tobe 10% in the first year after application with some reports of N release in the second year after application. While some studies showed that MSW compost increased soil N content, MSW compost is often reported to be less effective in supplying available N in the first year of application to the soil–plant system than inorganic mineral fertilizers. It is thought that N immobilization occurs in soils treated with compost because of increased soil microbial biomass.Researches have also found aeration to play a large role in the inorganic N content of MSW compost. Low oxygen levels slow decomposition and increases the opportunity for adsorption of ammonia onto the solid materials leading to immobilization. The concentration of nitrogen in MSW compost has been seen to increase with composting time as carbon is utilized by microorganisms. Immature compost can cause N immobilization due to a high compost C/N ratio.

The range of phosphorus that has been found in MSW composts is 0.08 to 0.73% (mean 0.16%).A 10–50% of total P in MSW compost was available both inthe first and second year after application. Soil P availability was increased with the addition of MSW compost, however, soil P retention decreased with increasing compost application because of competition between organic ligands and phosphate for sites on metallic oxides as well as the formation of phosphohumic complexes which can increase P mobility.The range of K found in MSW compost produced in India is generally low and ranged between 0.12 to 1.31% (mean 0.44%). Of the total K in MSW compost, 36–48% was found to be plant available. Soil K concentrations are increased even when very low rates of MSW compost are used.

A variety of MSW composts manufactured in India were found to have high content of heavy metals, viz., Zn, Cu, Cd, Pb, Ni and Cr. Different field crops and horticultural crops have been reported to take up heavy metals when soil was amended with MSW compost. Metal and trace metal availability from compost is thought to vary with compost maturity. As compost matures, the humic material in compost tends to increase and is capable of binding many metals thus decreasing their availability. The water-soluble fraction of Zn, Pb, Cu, and Cd were found to decrease and stabilize after the thermophilic stage of composting.

12. AGRICULTURE-SOIL SCIENCE

Phosphorus Recovery from Human Urine with Source Separation Toilet System

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Introduction

Phosphorus is an essential nutrient in crop cultivation. Global food production depends upon availability of phosphate rock, a non-renewable fertilizer ore that is diminishing global supply. Phosphate rock is the only economical source of phosphorus for manufacturing phosphatic fertilizers and other chemicals. It is estimated, that there are affordable and relatively easily extractable phosphate rock reserves left for only another 50–100 years. Also, the quality of the phosphorus mineral is diminishing. Yet there is an ever increasing demand for phosphorus in agriculture (Cordell, D*et al.* 2011). Source separation of human urine offers one option for nutrient reuse from human waste. Urine can be diverted from the solid excreta and it can be used as a liquid fertiliser as such. This diversion enables reuse of waste for agriculture purposes and at the same time protects the natural water bodies from waste pollution and eutrophication (Vinneras and Jonsson, 2002). Source separated human urine is a nutrient-rich liquid where the main nutrients (N, P, K) occur in water-soluble ionic form and are therefore readily available for plant uptake The use of source separated human urine could be one option to complete the demand of phosphorus source and to close the nutrient cycle.

Phosphorus Recovery with Source Separation of Human Urine

Recycling human urine may be the answer to looming shortage of phosphorus. Human Urine is the most concentrated source of phosphorus. It is estimated that a person produces 500 liters of urine per year. Fifty to sixty percent of phosphorus is present in human urine. At the moment we dilute this through sewage system. In the industrialized world we must start moving to resource-recovery approach rather that current waste water treatment approach. Technology that allows urine to be separated in the home is available (Figure 1) and its already used in many countries like Sweden and India.

These look similar to flushing toilets but the urine is directed down a second set of pipes to holding tank, which farmers empty at regular periods, using the urine as phosphorus nutrient/ fertilizer source.

Fig 1. Source Separating Toilet System

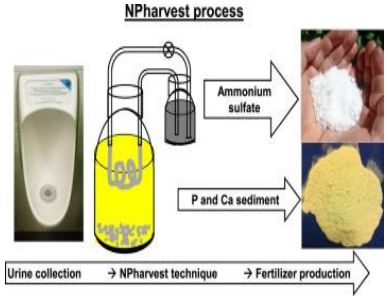

Fig 2 Phosphorus Recovery with Source Separation of Human Urine

Phosphorus from the urine can be recovered by mixing the urine with magnesium, which binds the phosphorus and nitrogen. The generated precipitate is composed of struvite or Magnesium Ammonium phosphate, solid mineral fertilizers (Fig 2).

Advantages

- Recycling system has additional benefits for the environment because the toilet use less water and les energy is needed for treatment stage.

- The nutrients in urine are therefore quite concentrated and are readily available to plants.

Conclusion

Food production of India depends upon the imported phosphate. Historically, we have imported virtually all our phosphate. Our demand for more phosphorus will increase further four- fold increase in demand for high protein rich foods. Therefore, the urine should be accepted as a fertilizer and the use of source separation and fertilizer techniques could be taken into consideration.

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13. SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Hyperspectral Imaging

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Hyperspectral imaging, like other types of spectral imaging, gathers and processes data from all parts of the electromagnetic spectrum. The goal of hyperspectral imaging is to collect the spectrum for each pixel in a scene image in order to locate objects, identify materials and detect processes. Multiband imaging measures dispersed spectral bands, whereas hyperspectral imaging measures continuous spectral bands. Spectral imagers are divided into three categories. Push broom scanners and related whisk broom scanners (spatial scanning) read images over time, band sequential scanners (spectral scanning) acquire images of an area at different wavelengths and snapshot hyperspectral imaging (which uses a staring array to generate an image in an instant) are all examples of spectral scanning. The recorded spectra in hyperspectral imaging have a precise wavelength resolution and encompass a wide range of wavelengths.

Hyperspectral sensors collect data in the form of a series of images. Each image depicts a spectral band, or a specific wavelength range of the electromagnetic spectrum. For processing and analysis, these images are combined to produce a three-dimensional (x, y, λ) hyperspectral data cube, where x and y represent the two spatial dimensions, and represents the spectral dimension (comprising a range of wavelengths). There are four ways for sensors to sample the hyperspectral cube: Spatial scanning, spectral scanning, snapshot imaging,and spatio-spectral scanning. Hyperspectral cubes are generated from airborne sensors like NASA'sAirborne Visible/Infrared Imaging Spectrometer (AVIRIS), or from satellites like NASA'sEO-1with its hyperspectral instrument Hyperion

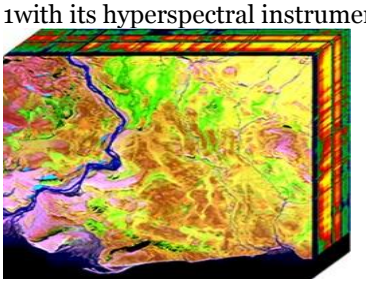

Fig. 1: Two-Dimensional Projection of a Hyperspectral Cube

The acquisition and processing of hyperspectral images is also referred to as imaging spectroscopyor with reference to the hyperspectral cube, as 3D spectroscopy.

There are four basic techniques for acquiring the three-dimensional (x,y,λ) dataset of a hyperspectral cube.

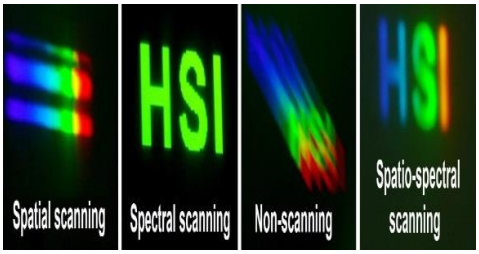

Fig. 2 Photos Illustrating Individual Sensor Outputs for The Four Hyperspectral Imaging Techniques

Spatial Scanning: Each two-dimensional (2-D) sensor output in spatial scanning represents a whole slit spectrum (x,y). Slit spectra are obtained by projecting a strip of the scene onto a slit and dispersing the slit image with a prism or grating in hyperspectral imaging (HSI) devices for spatial scanning.

Spectral Scanning:Each 2-D sensor output in spectral scanning represents a monochromatic, spatial (x, y) representation of the scene. Optical band-pass filters are commonly used in HSI devices for spectral scanning. While the platform remains stationary, the scene is spectrally scanned by replacing one filter after another. If there is movement within the scene, spectral smearing can occur, undermining spectral correlation/detection in such staring, wavelength scanning devices. Nonetheless, the ability to pick and choose spectral bands, as well as having a direct depiction of the scene's two spatial dimensions, are advantages.

Non-Scanning:A single 2-D sensor output contains all spatial (x, y) and spectral data in non-scanning mode. Non-scanning HSI devices produce the entire data cube at once, eliminating the need for scanning. A single snapshot can be thought of as a perspective projection of the data cube, from which the three-dimensional structure can be reconstructed. The snapshot advantage and quicker acquisition time are two of the most notable advantages of these snapshot hyperspectral imaging systems.

Spatio-Spectral Scanning:Each 2-D sensor output in Spatiospectral scanning represents a wavelength-coded ('rainbow-colored', = (y), spatial (x, y) representation of the scene. A camera at a non-zero distance behind a basic slit spectroscope (slit + dispersive element) is used in a prototype for this technology, which was introduced in 2014. By adding a dispersive element in front of a spatial scanning system, advanced spatiospectral scanning systems can be obtained. Scanning can be accomplished by moving the entire system, the camera alone or the slit alone in relation to the scene. Spatiospectral scanning combines some of the benefits of spatial and spectral scanning while also addressing some of their drawbacks.

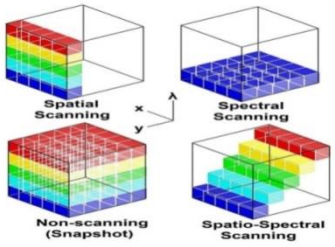

Fig. 3 Acquisition Techniques for Hyperspectralimaging, visualized as sections of the hyperspectral datacube with its two spatial dimensions (x,y) and one spectral dimension (lambda).

Advantages of HyperspectralData

- The primary advantage to hyperspectral imaging is that, because an entire spectrum is acquired at each point, the operator needs no prior knowledge of the sample and post processing allows all available information from the dataset to be mined.
- Hyperspectral imaging can also take advantage of the spatial relationships among the different spectra in a neighbourhood, allowing more elaborate spectral-spatial models for a more accurate segmentationand classification of the image.

Limitation of HyperspectralData

- The primary disadvantages are cost and complexity
- Fast computers, sensitive detectors and large data storage capacities are needed for analysinghyperspectral data.
- Difficult to interpret the spectral signatures of an impure pixel
- Because of high spectral resolution of hyperspectral imaging, fine atmospheric absorption features will

be detected, which may be confused with the ground material being imaged
- Data volume storage and transmission of hyperspectral data are one of the issues
- Redundancy: Overlap of information content over several bands
- The full potential of hyperspectral imaging has not yet been realized.

Conclusion

Active area of research and development, with hundreds of spectral channels are available now, the sampled pixel spectra contain enough detail to allow spectroscopic principles to be applied for image understanding. Requires an understanding of the nature and limitations of the data and of various strategies for processing and interpreting it.

"If a picture is worth 1000 words, a hyperspectral image is worth almost 1000 pictures"

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14. AGRICULTURE

Role of ICT in Agriculture

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Introduction

ICT stands for Information communication technology. Information communication technology is used to handle communication processes such as Telecommunications, broadcast media, intelligent building management system, audiovisual processing, transmission systems, and network based control and monitoring functions. ICT encompasses all mediums, to record information technology for broadcasting information-radio.television, and technology for communicating through voice and sound or images-mircophone, camera, loudsperaker. Which are used by the people every day in daily life?

ICT in Agriculture

Agriculture is primary occupation of Indians although it is still in subsistence nature,farmers are toil entire year in day and night but their socioeconomic condition getting worse over the years. ICT I agriculture is also known an as 'e-agriculture'. Information communication technology (ICT) supports farmers by facilitating accesses to market through real time data on market prices, weather forecasting, and information on pest, seed varieties and planting techniques. The main phases of the agriculture industry are: cultivation practices, water management,Fertilizer application fertigation, harvesting,packaging, food storage etc. ICT can play a important role in passing agricultural information as it consists of three main technology.
They are

1. ComputerTechnology,
2. CommunicationTechnology
3. InformatinonManagementTechnology

These technologies are applied for processing, exchanging, and management data, information and knowledge.

Major Initiative in ICT:-

Central government initiative-

AGRISNET, IKSL, Agmarknet, eArik,MahindaraKisanMitra, Digital green,Akashganganaga, Digital Mandi, e-Sagu,Warana, iKisan, Kissan call centers (KCCs).

1. **Agrisnet-** It is a comprehensive web portal to broadcast relevant information to farmers, which was initiated and funded by the Ministry of Agriculture, Government of India. The AGRISNET serves farming community by disseminating information

and providing services through use of Information & Communication Technology (ICT).

2. **IKSL** IFFCO KISAN SANCHAR LTD (IFFCO Kisan) was started in 2012. It delivers relevant information and custom-made solutions to the concerned farmers through voice messages on mobile phones. The farmers can also communicate directly to the agricultural experts on explicit themes via 'phone-in' programmes.
3. **Agmarknet**Agricultural Marketing Information Network (AGMARKNET) was commenced in March, 2000 by Ministry of Agriculture, Government of India with the aim of empowering decision-making ability of the farmers regarding selling of their produce. This portal was developed to pace up the agricultural marketing system through broadcasting information about influx of agricultural commodities in the market and their prices to producers, consumers, traders, and policy makers transparently and quickly.
4. **eArik**TheeArik project was initiated in 2007 and it aims to disseminate climate smart agricultural practices and to achieve food security. I
5. **MahindaraKisanMitra** This portal provides information to the farmers on price of commodities, weather forecast, crop advisories, loans, insurance, cold storage and warehouses along with success stories of progressive farmers.
6. **Digital green-** Digital green is an international organization, which works with the participatory approach by engaging rural community to improve their livelihood using digital platform.
7. **e- Sagu-** The e-Sagu system was developed in 2004.eSagu provide customized solution to the farmers problems and advice them from sowing to harvestingThe farm situation or problem is communicated to the agricultural experts and they transmit accurate information to the farmers.
8. **Warana-** The warana **"Wired Village**" was developed in 1998 by the Prime Minister Office InfomationTechnology Task Force with the objective of provding information and services to farmers for increasing productivity The information is transmitted to the thefarmers in local language about pricesof agriculture output,employment schemes from govt. of Maharasthtra and educational opportunity.
9. **iKisan-** iKsan is a web portal for transmitting information to the farmers about wide ranging issues related to agriculture such as crop cultivation,weatherforecastiong ,soil quality and market updates.etc
10. **Digital Mandi -** Digital Mandi is an electronic trading platform for faciliting farmers and traders to sell and procureagricultural produce beyond the geographical and temporal limitations effortlessly.
11. **Kissan call centers (KCCs) –** KCCs were commenced on January 21,2004 by the Department of Agricultural andCo-operation with the main inend of endowing extension services to the farmring community in the local languages. The agricultural scientists also visit the field in person to get an idea about complex agricultural problems to resolve them.
12. **Akashganganaga**- This ICT project makes possible the milk collection, fat testing and payment timely and user friendly manner. It augments the income generation of dairy farmers through incorporation of advanced technology.

Role of ICT in Agriculture

ICT (Information communication technology) has many role to perform for agricultural development starting from decision support system to the trading of crops.

- **Decision Support System** ICT has a great role as decision support system to the farmers. Through ICT, farmers can be updated with the recent information about agriculture, weather, new varieties of crops and new ways to increase production and quality control. The decision support system through ITC facilitates farmers for planning type of crops, practising good agricultural practices for cultivating, harvesting, post harvesting and marketing their produce

to get better results15. Varied information is required in agriculture based on the different agro climatic regions, size of land holdings, types of crops cultivated, technology followed, market orientation, weather condition, etc.

- **Widen Market Access** One of the major drawbacks in Indian agriculture is complex distribution channels for marketing of agricultural produce. ICT has the great potential to widen marketing horizon of farmers directly to the customers or other appropriate users for maximum benefit. Farmers may connect directly with many users and may get information about current prices for their commodities.
- **Strengthen and Empower Farming Community** ICT technologies can help for strengthening farming communities through wide networking and collaborations with various institutes, NGO's and private sectors. Further, farmers may enhance their own capacities through updated information and wide exposure to scientific, farming and trade community.

Advantages

- **Communication** - Speed / time – money can be saved because it's much quicker to move information around. With the help of ICT it has become quicker and more efficient.
- **Globalization** - Video conferencing saves money on flights and accommodation. ICT has not only brought the countries and people closer together, but it has allowed the world's economy to become a single interdependent system to contact either a business or family member.
- **Cost Effectiveness -** It feels free to send an email (although it isn't); it's without doubt cheaper than phone calls. ICT has also helped to automate business practices, thus restructuring businesses to make them exceptionally cost effective.
- **Greater Availability** - ICT has made it possible for businesses to be automated giving clients access to a website or voicemail 24 hours a day, 7 days a week
- **Bridging the Cultural Gap**– Greater access to technology has helped to bridge the cultural gap by helping people from different cultures to communicate with one another, and allow for the exchange of views and ideas, thus increasing awareness and reducing prejudice.
- **Creation of New Jobs**- Probably, the best advantage of ICT has been the creation of new and interesting jobs.
- **Education** – Computer's along with their programs and the Internet have created educational opportunities not available to previous generations.
- Through ICT, images can easily be used in teaching and improving the retentive memory of student.
- **Complex Structure**- through ICT, teachers can easily explain complex structure, instruction and ensure students comprehension.
- Through ICT, teachers are able to create interactive classrooms and make the lesson more enjoyable.

Disadvantages

- **Education**– Computer's along with their programs and the Internet have created educational opportunities not available to previous generations.
- **Lack of Job Security**– Experts in a wide variety of fields believe that ICT has made job security a big issue, since technology keeps on changing nearly every day. This means that individuals need to be constantly studying or at least keeping up with changes in their profession, if they want to feel secure in their jobs to be secure.
- **Overriding Cultures**- While ICT may have made the world a global village, it has also contributed to one culture consuming another weaker one. For example, it is now argued that teenagers in the US influence how most young

teenagers all over the world now act, dress, and behave.

- **Privacy**- Though information technology may have made communication quicker, easier, and more convenient, it has also brought along privacy issues. From cell phone signal interceptions to e-mail hacking, people are now worried about their once private information becoming public knowledge.
- **Reliance on Technology**– Professor Ian Robertson, a neuropsychology expert based at Trinity College Dublin who carried out the study, said: "People have more to remember these days, and they are relying on technology for their memory but the less you use of your memory, the poorer it becomes. .People don't bother learning to spell because they use spell-checker, or need acalculator do perform minor addition or subtraction.
- **Reliability of Information**– Anyone with access to a computer and an internet connection internet can start a blog or post something up on a website, so just because something's on the webdoesn'tmean it's reliable A prime example of this is the open source encyclopedia, Wikipedia, although considered a good source of information it is not recognized by academic institutions as a trustworthy reference.
- **Computer Viruses**, worms, Trojans, malware, spam, phishing- any or all can cause chaos and disrupt our daily lives
- **Setting**settingup the device can be verytroublesome.
- **Expansive**- too expensive to afford.
- **Lack of experience** hard for teachers to use with a lack of experience using ICT tools.

Reference

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15. GENETICS AND PLANT BREEDING

Putative Orthologous Genes to Enhance Crop Productivity

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Introduction

The yield level of many crop plants including groundnut is stagnated during post 'Green Revolution' era which threatens about the food security in near future. To break this stagnation there is a massive need to achieve rapid success in crop improvement programmes. At this juncture, apart from conventional crop improvement methods what would benefit a breeder during post genome sequencing era is, identification of trait governing genes and there by tagging of functional variants at molecular level.

The progress in tagging/mapping of genes in crops like *Arabidopsis*, rice, maize etc. is far ahead when compared to the major legume crops viz. groundnut, chickpea, redgram, greengram,soyabean etc., even in the post release period of legume genome sequencing databases. This can be attributed mainly to their genome complexity and low level of available genetic diversity in these crops. Further, *de novo* mapping of genes either by forward genetic or by reverse genetic approaches takes lot of time and labor.

Significance

Comparative mapping reveals high degree of sequence co-linearity across the plant kingdom among related species and as well genera, thus helps to exchange molecular recourses between them. Further, the sequenced databases of several crop plants indicate homology existing

between the highly conserved regions during their course of evolution, especially the genic regions that encompass motif/domains of particular gene family. These genes are said to be orthologous/paralogous to each other and known to participate in the same function(s) in plant system. Thus, there is large possibility for transferability of known gene targeted markers from one crop genome to other. For instance, from Triticale, 58% and 39% transferability of molecular markers was achieved for wheat and rye, respectively. Further, it is proved that the seed size or weight governing genes are extremely orthologs among rice, maize, and *Arabidopsis*. Interestingly, the transferability of genic microsatellite (EST-SSR) markers has been proved from grass family member-*Sorghum bicolor* to the legume member-Groundnut (Siddanna*et al*., 2012). Hence, the knowledge of known yield and stress governing genes can be deployed to tag the orthologs in these orphan legume crops wherein it facilitates Marker Assisted Breeding with high veracity for the targeted traits.

Case studies

In the recent past, comparative mapping studies revealed that high degree of sequence co-linearity across the plant kingdom viz. rice to maize and tomato, sorghum to groundnut, *A*rabidopsis to rice and maize etc. thus, helps to exchange molecular resources between them. For instance, a homolog gene was identified in tomato (ovate gene) which has a similar function of putative transmembrane protein as in rice for grain size (*GS3*) (Gupta *et al*., 2006). A homolog in maize for thick tassel dwarf (*td1*) has been identified having a similar function of LRR receptor like protein in *Arabidopsis* (*clv1*) (Gupta *et al*., 2006). Similarly, there were many orthologs between peanut and Arabidopsis which have several functions like influencing flowering and seed germination, regulating arsenic accumulation, acting as typical hexose transporters and also in cell elongation (Wan *et al*., 2020). Likewise, some yield determining genes also have been identified among cereals and model crop Arabidopsis (Orczyk*et al*., 2017)

Conclusion

Hence, the orthologous genes of model crops viz. *Arabidopsis*, rice; appears to be rich and flexible source, which allow further identification of their homologous genes in under researched crops like wheat, maize, greengram, blackgram, groundnut etc., there by usage of these gene's functional variants to food security in near future of climate resilient era through precise crop improvementbreeding.

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