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INDEX

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INDEX

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INDEX

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INDEX

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INDEX

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INDEX

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Carbon Fertilization – Boon to Crop Production

Article ID: 31400

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Summary

Increasing automobile industries in this modern era lead to rapid increase in carbon dioxide level in the atmosphere air. Increase in the CO_2 level gradually increase the photosynthesis process in plant leaf and lead to higher plant growth. Carbon fertilization improve the water use efficiency of plants and it also provide greening effect to the crops. Increase in the carbon content in the plant reduce the other essential mineral nutrient in the plant cell, in turn people who consume that crop will lead to an undernourished population.

Introduction

In recent decades increasing industrialization and anthropogenic activity lead to rapid production of carbon dioxide. The enhanced production of CO_2 is being considered as negative sign of climate change. The worldwide several scientists have been involved to discover to various methodology for lessening the greenhouse gas emission to that of pre industrial era and also efficient novel strategies are utilized in policy making in government sectors. Though higher carbon dioxide in atmosphere causes impairment to environment but shows relative amount of positive response over some plants. Interestingly, increasing carbon dioxide level in atmosphere leads to raise the photosynthesis rate thereby can achieve enhanced crop production. Thus, nourishing process of carbon dioxide in plant as fertilizer, made to call it as carbon fertilization and is used by many environmentalists to reduce the global atmospheric carbon. In short fertilization of carbon dioxide to plant is known as carbon fertilization and is not only the cause of plant growth but also contributes the greening effect.

Effects of High Concentration of Greenhouse Gases

1. Carbon Dioxide fertilisation on plants.
2. Global Warming.
3. Depletion of ozone layer in the stratosphere.

How does Carbon Fertilization Effect on Crop Production?

Soil carbon pool is the third largest pool related to carbon sequestration than atmospheric and biotic pools. The atmospheric carbon enters into the soil by senesce of living organism or plant that captured atmospheric carbon for their metabolic activities and it can persist into soil for decades, centuries or even millennia. Though the soil has higher potential to store carbon but impact of anthropogenic activities determines the role of soil either sink or source of carbon. Because of soil degradation the sequestrated carbon emitted back as CO_2 or CH_4 into atmosphere. In addition, soil erosion dissolve and washout, the surface organic carbon into rivers and oceans that will make the soil become less fertile.

The dynamics of these processes spot out the importance of quantifying global carbon fluxes to ensure maximum benefits of soil organic carbon to food production, and water and climate regulation. The impact varies depending on the temperature, plant species, and water & nutrients availability. The impact of carbon dioxide fertilization on crop production is listed below:

1. The plant do photosynthesis at leaves chloroplast: Where carbon dioxide chemically combines with water and utilize the light energy from sun as well as nutrient sources form soil and air for producing the starch. For plant, the produced starch become food but for life on the globe, it is the major source of food, fibre, fuel and energy.

2. Increase of anthropogenic emission: The anthropogenic activities increase carbon dioxide concentration in atmosphere affect the photosynthetic rate in plant. The increasing atmospheric carbon level increases photosynthetic rate that will further enhance the biomass production thereby can achieve higher crop production.

3. Increases the efficiency of plant water utility: The plant protects themselves by water loss through narrow opening of stomata at elevated CO_2 concentration in atmosphere and that will reduce the plant water requirement.

4. Major proportion of produced carbohydrate: Dispersed to root where some part of exudates would be released as root exudates which increase fixation of nitrogen in root nodules, development of mycorrhiza around root thereby plants can grow even low nutritional soil.

In the above discussion, it depicted that enhanced concentrations of CO_2 increase the photosynthesis which ultimately helps in plant growth. Hence, this proves that carbon fertilisation is not only the cause of plant growth but also contributes the greening effect.

Disadvantage of Carbon Fertilization

Decreases in minerals and impacts on human nutrition: Several empirical reports showed that lower concentration of many mineral nutrient in plant tissues occurred under increasing level of CO_2 in the atmosphere. When CO_2 level is double leads to decline of 8% mineral concentration in plant tissue. Declines in Mg, Ca, K, Fe, Zn and other minerals in crops can reduce the quality of crop and worsen the human nutrition and lead to undernourished/ malnutrition in the human population. Some two billion people live in countries where citizens receive more than 60 percent of their zinc or iron from these types of crops. Deficiencies of these nutrients already cause an estimated loss of 63 million life-years annually.

Conclusion

Carbon fertilization is an effective technique to reduce the atmospheric CO2 level in the atmosphere. Carbon fertilization improve the plant growth due to greening effect. Increase in the plant carbon concentration in the plant lead to lowering the concentration of other mineral nutrient in the plants and animals.

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Genetic Improvement of Entomopathogenic Fungi

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Genetic engineering has been proved to be an efficient tool to improve the efficacy of mycoinsecticides by improving their tolerance to environmental stresses and their virulence. In addition, some methods appear to mitigate safety concerns regarding genetically engineered entomopathogenic fungi. Genetic engineering to improve virulence has focused on reducing both lethal conidial dosage and time to kill. Reducing conidial dosage improves infection rates; allowing control to be achieved with less product. It also increases effective persistence of the biopesticides because as conidia decay there is a greater probability that an insect will come into contact with enough propagules of the genetically engineered fungus to exceed the inoculum threshold.

Based on the sources of genes for genetic engineering four major strategies are currently being exploited to improve virulence of entomopathogenic fungi.

Strategy I: Using the Pathogen's Own Genes to Improve Virulence

The insect cuticle is mostly composed of chitin fibrils embedded in a matrix of proteins. Proteases and chitinases are produced by entomopathogenic fungus to penetrate into the host insect body. But normally, expression of these genes is under tight control. Constitutively overexpressing the gene encoding the subtilisin-like protease Pr1A in the recombinant strain increased the virulence of *Metarhizium anisopliae* to *Manduca sexta*, as compared to the parent wild-type (WT) strain. Importantly, field trial of Pr1A overexpressing strain of *M. anisopliae* was the first EPA approved field trial of a transgenic fungal pathogen. Similarly, constitutive overproduction of *B. bassiana*'s chitinase CHIT1 improved virulence by 23%.

Strategy II: Insect's Proteins for Genetically Engineering Entomopathogenic Fungi

Genome-wide analysis of horizontal gene transfer (HGT) events revealed that, *Metarhizium* species picked up different genes from various organisms like bacteria, archaea, arthropods, plants, and vertebrates. An example is a sterol transporter (Mr-NPC2a) that several strands of evidence suggest was acquired from an insect by HGT and which allows the fungus to compete with the host for growth limiting sterols in the hemolymph. To our knowledge, this is first example of HGT from host to a eukaryotic pathogen, and the host gene ultimately improved the infectivity of the pathogen. Hence, HGT provided entomopathogenic fungi with host genetic material that impaired the host's normal physiological processes. This evolutionary event was reproduced by transferring the sterol carrier gene into *B. bassiana*, which lacks an endogenous Mr-NPC2a homolog, improving its pathogenicity.

Strategy III: Genes from Insect Predators and Other Insect Pathogens for Genetically Engineering Entomopathogenic Fungi

Insect predatory arthropods inject victims with venom, which kills or paralyzes the prey. The venom is a mix of potent compounds (neurotoxins, enzyme inhibitors, etc.), each having different mode of action and effect; more than one million peptide toxins have been isolated from arachnids and scorpions, having very good efficacy in killing arthropods. With their natural ability to penetrate into insects, entomopathogenic fungi can be used as vector to deliver anti-insect compounds from predators like arachids and scorpions into insects, improving the virulence of the fungi. The scorpion sodium channel blocker AaIT1 is well studied and very potent, so it was the first arthropod toxin tested in the broad host-range *M. anisopliae* strain ARSEF 549. The modified fungus achieved the same mortality rates in tobacco hornworm (M. sexta) at 22-fold lower conidial doses as compared to WT fungus, and decreased survival time up to 40%. This modified fungus also produced similar results with mosquitoes and coffee berry borer beetle. Entomopathogenic fungus, Lecanicillium lecanii expressing scorpion toxin BmKit from Buthus martensi achieved the same mortality rates in cotton aphids (Aphis gossypii) at 7.1-fold lower conidial doses and the median survival time (ST50) for a transformant (BmKit-12) was reduced by 26.5% compared with WT.

Strategy IV: Invented Proteins for Genetically Engineering Entomopathogenic Fungi

Scientists can invent multifunctional genes that are hybrids of different activities found in other genes through protein engineering. The cuticle was the first target for protein engineering efforts. Overexpression of either the Pr1A protease or the Bbchit1 chitinase resulted in an increase in fungal virulence. Expression of the fusion protein CDEP1:Bbchit1 that contains the Pr1A-like protease CDEP1and the chitinase Bbchit1 accelerated cuticular penetration by *B. bassiana* compared to the WT strain or transformants overexpressing each gene singly.

Improve Tolerance to Abiotic Stresses

Abiotic stresses such as ultraviolet (UV) radiation, high temperature, and low water activity result in inconsistent performances by mycoinsecticides in the field, limiting their use. Tolerance to these abiotic stresses can be improved by selecting optimal growth substrate and conditions for the production of the conidia. Recent studies have shown that fungal tolerance to the abiotic stresses can also be greatly improved by genetic engineering.

Improve Tolerance to UV Radiation

UV radiation from sunlight is probably the most detrimental environmental factor affecting the viability of entomopathogenic fungi applied to solar-exposed sites (eg, leaves) for pest control. UV radiation primarily causes DNA damage through induction of chemical base modifications. UV radiation causes not only DNA damage but also produces reactive oxidative species (ROS) that elevate oxidative stress in cells (Lesser, 1996). Overexpression of a superoxide dismutase (SOD) increased the ability of *B. bassiana* to detoxify ROS, enhancing UV tolerance. Similarly, expression of thioredoxin (trxA) from the bacterium *Escherichia coli* also increased the tolerance of *B. bassiana* to UV-B irradiation, oxidation, and heat.

Improve Tolerance to Heat Stress

Tolerance to heat stress by entomopathogenic fungi can also be improved by transferring single genes. Overexpressing HSP25 in *M. robertsii* increased fungal growth under heat stress either in nutrient-rich medium or on locust wings and enhanced the tolerance of heat shock-treated conidia to osmotic stress. Tolerance to heat stress by entomopathogenic fungi can also be improved by transferring single genes. Similar to UV radiation, heat stress produces ROS. Expression of ROS scavengers, such as SOD and bacterial thioredoxin, increases the heat tolerance in entomopathogenic fungi.

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Redox Biology: The Good Side of Reactive Oxygen Species in Plant Growth and Development

Article ID: 31402

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Introduction

Environmental stress negatively influence survival, biomass production and crop yield. The stress usually causes protein dysfunction, cellular activity alteration, change in ion homeostasis and reactive oxygen species (ROS) generation. Reactive oxygen species (ROS) is the term used to describe forms of oxygen that are energetically more reactive than molecular oxygen. Typically, ROS (sometimes also referred to as AOS, active oxygen species, or ROI, reactive oxygen intermediates) are molecular species that have undergone electron addition(s) and are thus reduced forms of oxygen. Such ROS include the two free radical species, the superoxide anion ($O_2^{\bullet-}$) and its protonated form the perhydroxyl radical ($HO_2^{\bullet}$), the uncharged, non-radical species hydrogen peroxide (H_2O_2) and the highly reactive hydroxyl radical ($OH^{\bullet}$). ROS also include singlet oxygen ($^1O_2$) generated by photoexcitation of chlorophyll. ROS are all toxic molecules, their particular destructiveness depending on their reactivity. ROS, the by-products of metabolic process that regulate plant growth and development (Foyer and Noctor, 2009; Mittler, 2017; Noctor *et al.,* 2017) which are determined by a tightly controlled balance between production and breakdown that is achieved via sophisticated and highly complex antioxidant systems (Mittler *et al.,* 2011; Noctor *et al.,* 2012, Foyer *et al.,*2018).

These free radical species are highly reactive and unstable, only becoming stables by acquiring electrons from, lipids, proteins, nucleic acids, carbohydrates or any nearby molecule and thus causing a cascade of damage. ROS most likely appeared on Earth together with the first atmospheric oxygen molecules about 2.4–3.8 billion years ago, and have been a constant companion of aerobic life ever since In higher plants, for example, ROS were found to regulate development, differentiation, redox levels, stress signalling, interactions with other organisms, systemic responses, and cell death.

This process of ROS production as a by-product of aerobic metabolism, coupled with ROS removal by cellular antioxidative mechanisms, occurs constantly in cells to prevent some of the potential toxic effects of ROS that could include DNA, RNA, protein, and membrane oxidation and damage (collectively referred to as oxidative stress).When the level of ROS exceeds the defence mechanisms, a cell is said to be in a state of "oxidative stress." Whether ROS will act as damaging or signalling molecule depends on the delicate equilibrium between ROS production and scavenging.

So, oxidative stress is defined as a disturbance in the prooxidant–antioxidant balance in favour of the former, thus leading to a potential damage to the cells and organs. The production of free oxygen radicals or ROS is a double-edged sword (Silva *et al*. 2010) in plant developmental process. Despite their destructive activity, ROS are well-described second messengers in a variety of cellular processes including tolerance to environmental stresses. This article deals with the good sides of the most lethal reactive oxygen species in the plant system.

Beneficial Role of ROS in Plant Growthy and Development

1. ROS and germination: Reactive oxygen species (ROS), released during normal metabolism of oxygen, are known to have significant roles in the process of seed germination. In dry and dormant seeds, plant embryos and the surrounding endosperm display very limited metabolic activities and thus production of ROS is very low. If ROS levels are too low seeds will never leave dormancy, and if they are too high then seeds will suffer excessive oxidative damage during seed imbibition and will be non-viable. In imbibed seeds, increment of ROS production occurred in various metabolically activate such as glyoxysomes (by the catabolism of lipids), peroxisomes (by the catabolism of purines), mitochondria (through respiratory activity), chloroplasts (by election transfer in photosystems), and plasma membranes (by NADPH oxidase) via various pathways.

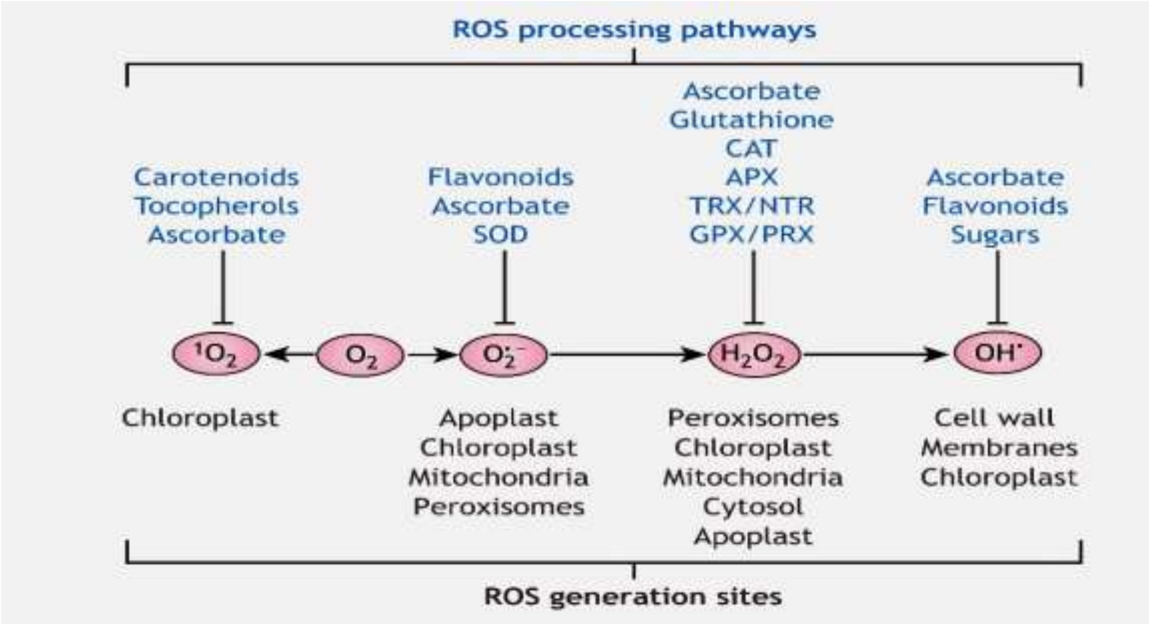

Fig:1. An overview of the major ROS production sites and processing pathways in plants. Major subcellular sites involved in ROS production are listed below the ROS and the key ROS processing pathways are highlighted above.(Source: Mhamdi and Breusegem, 2018).

During germination process GA_3 is released from embryo and stimulates specific genes for mRNA transcription by ∞-amylase. ROS action during seed germination relies heavily on interactions with ABA and GA, the two main phytohormones that antagonistically participate in regulation of the seed germination process. H_2O_2 accumulation in germinating seeds was associated with ABA degradation probably through the activation of ABA-8-hydroxylase, an ABA catalytic enzyme. Rapid generation of H_2O_2 react with $O_2^{\cdot}$ in the presence cell wall peroxidase leading to the formation of hydroxyl radical (·OH) and it react on the cell wall causing polysaccharide cleavage resulting in-cell wall loosening endosperm weakening, and radicle elongation. Thus, ROS homeostasis during germination needs to be tightly controlled and this creates an oxidative window for germination that restricts proficient seedling development within certain that restricts proficient seedling development within certain borders of increased ROS levels (Barba-Espin *et al.,* 2010; Rajjou *et al.,* 2012; Wojtyla *et al.,* 2016; Ishibashi *et al.,* 2017).

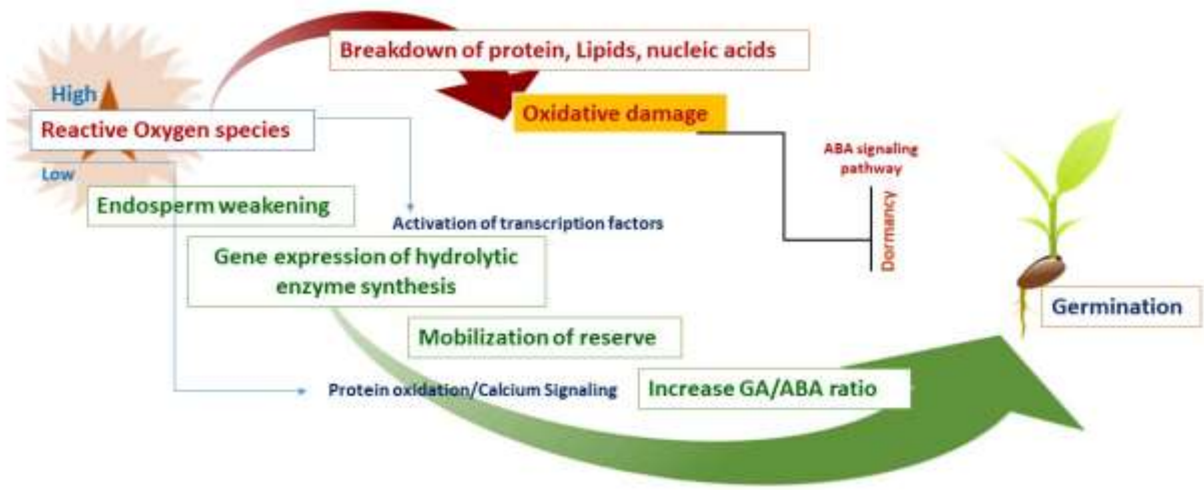

Fig:2 Role of ROS in dormancy release and germination [high ROS levels increase, leading to 1) oxidative damage and subsequent seed germination inhibition, or 2) low ROS mediated oxidative signalling leads to seed germination].

2. ROS and root gravitropism and root hair formation: Directional plant growth responses to various environmental stimuli, such as light (phototropism) or gravity (gravitropism) was determined by phytohormone auxin. Gravity induces asymmetric movement of auxin stimulates ROS generation to mediate gravitropism. Auxin can evoke ROS generation via NAPDH oxidases in the roots which acts like a gravitropic stimulus. Superoxide radical was localized within the tip of root primordia, vascular cylinder cells as well as in the distal and middle parts of newly formed organs during the early stages of rhizogenesis; while H2O2 was pronounced in cortical and vascular bundle cells. Superoxide radical accumulation was then restricted to epidermis cells, while that of H2O2 was limited in vascular tissues. Auxin and ABA ratio plays a significant role crucial for the development of the lateral root. More specifically, lateral root emergence is determined by peroxidases through ROS signalling that promotes the transition from cellular proliferation to cell differentiation. Both phytohormones induce ROS production to promote cell expansion in growing roots. The decreased levels of IAA in the roots elicits significant changes in auxin that inhibit lateral root formation and vice versa (Lupini et al., 2013 and Libik-Konieczny et al., 2015).

3. ROS and Meristem Development: The indeterminate growth characteristics of most plant roots not only entails continuous cell division and cell expansion of the primary root, but also the development of lateral roots and root hairs. Studies have shown that altered ROS homeostasis affects all of these processes, restricting growth of the primary root, triggering lateral roots emergence, and enhancing root hair growth (Foreman et al., 2003; Orman-Ligeza et al., 2016). An overview of ROS function in controlling root growth and development was recently provided by Tsukagoshi (2016) and highlights that interactions between ROS and auxin signalling, which play a crucial role in shaping root architecture (Du and Scheres, 2018), partially govern root growth and development.

4. ROS and Programmed cell death: Programmed cell death, which is critical in plant organogenesis and survival, is an integral cellular program employed by plants by which targeted cells terminate to demise under certain developmental (vegetative and reproductive) and stress conditions. Plant PCD is related with a number of developmental processes including embryo formation, degeneration of the aleurone layer in germinating seeds, formation of root aerenchyma and epidermal trichomes, differentiation of tracheary elements, tapetum degeneration, pollen self-incompatibility, floral organ abscission, leaf shape remodelling, and leaf senescence . ROS such as H2O2 is identified as key modulators of PCD along with other biological processes such as growth and development (Gechev et al., 2006; Durme and Nowack, 2016). Plant senescence is a slow process and is accompanied by extensive reprogramming of gene expression which is regulated by increased availability of ROS, which assist in degradation of cellular contents for recycling purposes but also play a role in initiating the senescence process.

5. ROS and Flower Development: ROS-associated genes involved in the control of flower and gametophyte development. During pollination, when stigma is receptive (ready to receive pollen grains), accumulates high H2O2 levels, and that H2O2 levels decrease when stigma starts to support pollen development. During development of male sex organs, ROS signatures dictate the correct timing of tapetal PCD because in order to release pollen, tapetum cells must die (Jiménez-Quesada et al., 2016; Schippers et al., 2016).
VI. ROS and Desiccation: Another process in which ROS are seen as having a central role is the dehydration of orthodox seeds (desiccation). Oxidative processes and free radical accumulations have frequently been reported during desiccation, accompanied by lipid peroxidation and substantial seed tissue damage. Dried tolerant bean seeds showed high CAT and GR and low SOD and APX activities, while the opposite situation was seen in immature dried seeds, suggesting that the acquisition of drying tolerance is also related to reorientation of the enzymatic ROS-scavenging systems (Bailly et al., 2008).

6. ROS acts as Secondary messenger: Cell signalling transductions are the basic mechanisms of many vital physical processes. ROS at low level under normal conditions, is found to act as signalling molecules in many physiological processes, including redox homeostasis and cellular signal transduction. By activating proteins such as tyrosine kinases, mitogen-activated protein kinases, or Ras proteins, ROS are important mediators of signal transduction pathways. Dependent on cell types, ROS have been found to function as signalling molecules in cell proliferation, cellular senescence, or cell death. The divergent effects of ROS on many cellular processes suggest that ROS are not merely detrimental by products, but also generated purposefully to mediate a variety of signalling pathways. ROS acts as the second messenger which directly or indirectly stimulate synthesis of different hormone in the plant which is essential for appropriate and specific cellular responses with the help of some redox-sensitive proteins, calcium mobilization, protein phosphorylation, and gene expression. The elevated level of H2O2 induce abscisic acid (ABA) transduction pathway in guard cells that leads to stomatal closure (Pel et al., 2000).

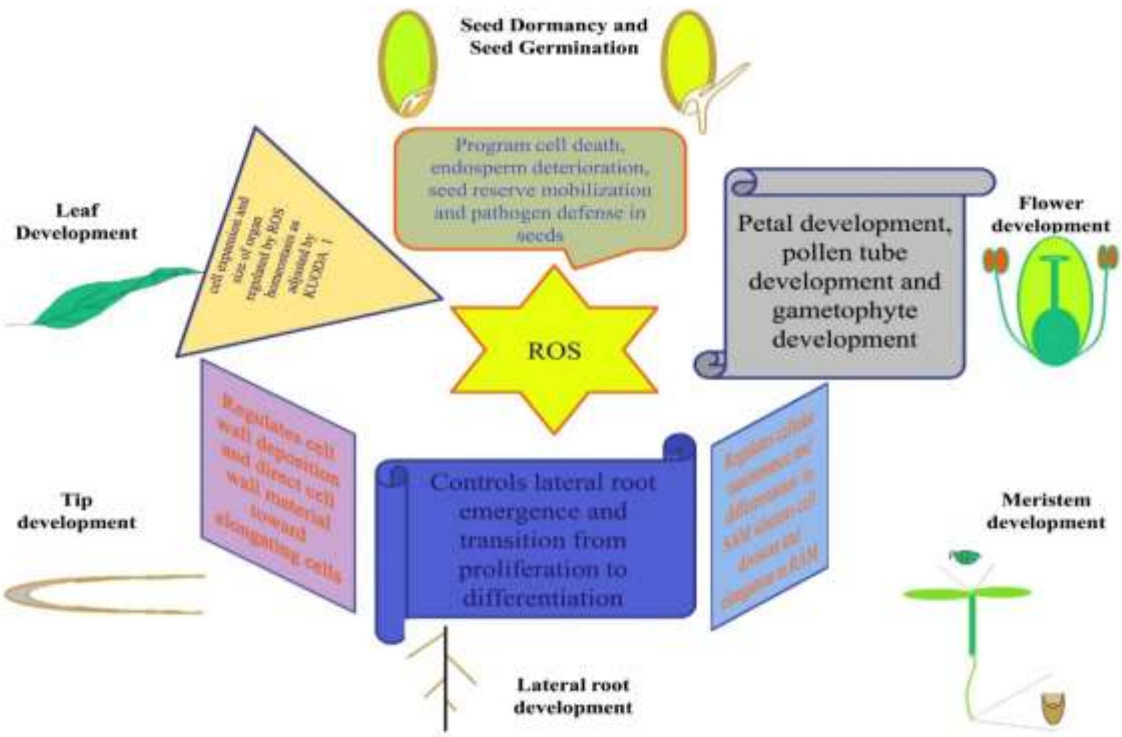

Fig: 3. Schematic overview of the ROS functional aspects at different phases of plant development. (Source: Choudhary et al., 2020).

8. Signalling during hypersensitive response: ROS are shown to act as a second messenger for the induction of defence genes in response to wounding. ROS were generated near cell walls of vascular bundle cells of leaves in response to wounding and resulted H2O2 from wound inducible polygalacturonase acted as a second messenger for the activation of defence genes in mesophyll cells. In Hypersensitive response, SA is thought to potentiate ROS signalling. This production-called oxidative burst could be considered as a specific signal during pathogenesis or plant-pathogen interactions

9. Lignin deposition under stress: Lignin is important for the plant's response to environmental stress. Peroxidases take part in lignin formation in the primary cell wall. ROS mediated reduction in cellulose biosynthesis induces production of the phytohormones jasmonic acid (JA), salicylic acid, and ethylene, enhances pathogen resistance, and leads to changes in cell wall composition/ structure, as well as causing ectopic lignin production (Herna´ndez-Blanco et al., 2007; Hamann et al., 2009).

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Phyllosphere Methylotrophic Bacteria on Plant Growth and Stress Mitigation

Article ID: 31403

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Introduction

Methylotrophs are defined as microbes that can utilize C1 compounds as the sole source of carbon and energy. The phyllosphere is a well-known habitat of methanol-utilizing methylotrophs, and leaf surfaces are colonized by a large population of these bacteria, which include the genera *Methylobacterium*, *Methylophilus*, *Methylibium* and *Hyphomicrobium*. Among the limited carbon sources present on plant leaves, methanol is assumed to be abundant, which provides an advantage for colonization of methanol-utilizing methylotrophs on plant phyllosphere (Sy et al., 2005). Also, the microbial community composition on leaves is affected by the plant genotype, plant age, soil type, climate and geography, the major driving forces being the plant genotype and geography (Vorholt, 2012). Application of chemical fertilizer was found to enhance the growth and yield of plants. Nonetheless the chemical residues on plants and soil disturb the natural ecosystem.

To circumvent this, use of methylotrophs – a phyllosphere dwelling microorganism as a bioinoculant, may enhances the plant growth, by altering the plant physiology, secreting growth hormones and mitigating various biotic and abiotic stress. In addition, the use of methylotrophs as a bioinoculant may also meet the requirements of organic crop production. Excessive use of chemical fertilizers has increased agricultural costs, as well as causing a variety of environmental problems and concerns of food safety.

Therefore, utilization of microorganisms as biofertilizers has emerged as an alternative for providing plant nutrients to increase plant yield and quality in sustainable agroecosystems (Ryu et al., 2006). Foliar application of biofertilizer avoids many of the biotic and abiotic factors and constraints of the soil environment, thereby increasing crop growth and yield.

Phyllosphere

The below-ground parts are called the rhizosphere, while the above-ground parts of plants, such as the stem and leaf, are called the phyllosphere, though more typically phyllosphere is used to refer to the surface of the leaf. Foliar application of nutrients is considered as more efficient than soil fertilization. Therefore, foliar application of habitat adopted plant growth promoting bacteria provides an alternative fertilization strategy minimizing the potential risk of chemical residues accumulation compared to chemical fertilization. Morphological feature of leaf surface and its surrounding climate makes leaf ecosystem harsh than another habitat. This leaf surface is often exposed to intensely fluctuating environmental conditions, including harmful ultraviolet rays, high and low temperatures, variations in nutrient and water availability, and winds (Hirano and Upper, 2000; Lindow and Brandl, 2003). However, this habitat serves as home to many beneficial and pathogenic microbes. But a balanced ecosystem is important for plant health, therefore all the phyllosphere inhabitants are significant. They also have the ability to answer a broad range of biological questions about the adaptation of phyllosphere organisms. The adaptation of bacterial species indicates biotechnological potential, which has driven scientists to explore adaptive mechanisms, including identifying new bacterial species which possess unique enzymes that can be exploited in agriculture and industry (Dias et al., 2009).

Methylotrophs

The phyllosphere emits methanol, a waste product of pectin metabolism, and *Methylobacterium* spp. utilize methanol as sole source of carbon and energy. *Methylobacterium* species are non-pathogenic, and in nature, they are ubiquitous, found in variety of habitats (Green, 2006). Their capacity for adapting to changing environmental conditions and growing at high rates on methanol, and a variety of C_1-C_n compounds (facultative) reflects their metabolic potentiality. Aerobic plant-associated methylobacteria are phytosymbionts and their ability to synthesize cytokinins, auxins and vitamins expands their significance and biotechnological potential. The phyllosphere is a well-known habitat of methanol-utilizing methylotrophs, and leaf surfaces of many economically important crops are colonized by a large population of these bacteria. Full genome sequence of the novel methylotroph revealed that the methylotrophs are equipped with several kinds of genes for adaptation on plant surfaces such as defense against UV radiation, oxidative stress, desiccation, or nutrient deficiency, as well as high proportion of genes related to motility and signaling (Kwak et al., 2014). *Methylobacterium* spp. Inoculation improved plant health against biotic and abiotic stress by reducing stress ethylene level and increasing pathogen related protein content (Subramanian et al., 2015).

Methylotrophs Mediated Stress Mitigation

The phyllosphere is a well-known habitat of methanol-utilizing methylotrophs, and leaf surfaces are colonized by a large population of these bacteria. *Methylobacterium* is known as pink-pigmented facultative methylotrophic bacteria (PPFMs) due to their pink pigment production (Figure 1). Plants that are treated with PPFM that synthesize the enzyme 1-aminocyclopropane-1-carboxylate (ACC) deaminase, break down the ACC to ammonia and alpha ketobuterate. Because of PPFM ACC deaminase enzyme down regulates ethylene production in plants are reduced under stress conditions. In addition, ACC deaminase producing PPFM are able to develop resistance against phytopathogens by modifying the ethylene metabolism. Enhancing plant tolerance against *Ralstonia solanacearum* pathogen in tomato was presorted by Yim et al., (2013). PPFM are involved in drought stress mitigation by altering plant ABA metabolism and stomata opening and closing. Plants treated with PPFM showed significantly higher relative water content in tissue compared to the untreated control plants under drought conditions (Sivakumar et al., 2017).

Conclusion

Pigmented facultative methylotrophic bacteria are one of the promising candidates for enhancing plant growth in stress condition. Generally, all the plant species has PPFM as their microbial partner in the phyllosphere region. Hence isolating the habitat adopted efficient PPFM strains and used as a bio-inoculant for crop plants may enhance the plant growth and yield.

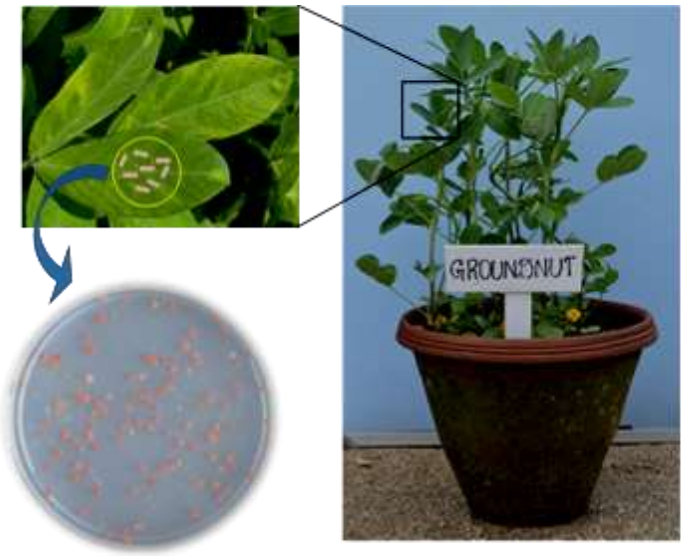

Figure 1. Methylotrophic bacteria habitats on groundnut leaves

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Agriculture Diversification for Food, Nutrition, Livelihood & Environmental Security

Article ID: 31404

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Introduction

Diversification is a basic part of the progression of structural renovation of an economy. It means the addition of different crops or cropping systems to agricultural production on a specific farm land taking under consideration the various returns from value-added crops with complementary marketing opportunities. Its ultimate aims to enhance soil fertility and maintain equilibrium in agro-ecosystem. Crop diversification emphasizes on the economic returns from different value addition of crops (Singh et al., 2010). Our market is globalized, hence agricultural crop diversification aims to enhance the total crop productivity in terms of quality, quantity and net monetary returns under specific and diverse agro-climatic situations world-wide.

Why “Diversification”?

1. Our Indian agriculture is having full of impossibilities and uncertainties because more than two-third of cultivated land is coming under rainfed farming. The farmers are not sure about output from agriculture production due to uncertain weather and market risk.

2. For developing countries, Diversification of crops is an essential tool, because growing of only basic staples food crops for e.g. cereals cannot alone support economic development as well as not fulfilling the need of ever-increasing population.

3. Diversification of crops by taking commercial crops and commodities becomes an important approach which will increase monetary values, reduces the risk of crop failure and increase foreign exchange.

4. Diversification are often designed to assist poverty improvement, employment generation and ecological conservation.

5. Diversification is beneficial for small and marginal farmers because they are unable to adopt capital intensive farming practices.

Benefits of Crop Diversification

1. Increasing returns on small farm holdings.
2. Reduce fluctuation of price.
3. Mitigating uncertain whether hazards.
4. Increasing fodder quality for animal feed.
5. Maintenance of natural resources (soil, water, etc.).
6. Reduce environmental pollution.
7. Increasing dependence on “On-farm” inputs.
8. Reduces the infestation of insect pests, diseases and control weeds.
9. Focuses on conserve food and its security.

Crop Diversification for Sustainable Diets and Nutrition

FAO’s Plant Production and Protection Division (AGP) supports diversification of crops for maintaining sustainability, nutritional health and increasing monetary values of livelihood. (Gangwar et al., 2012). The concept of AGP is the incorporation and coordination of suitable crop production technologies and strategies for enhancing crop productivity for meeting the key Millennium Development Aims of reducing hunger, protecting natural resources and environment conservation for future generation.

Activities of FAO’s Plant Production and Protection Division

1. Take ideal decisions to increase crop production by incorporating nutrition-sensitive crop diversification.
2. Effective monitoring of trans boundary and other important outbreaks of pests.
3. To avoid negative impact of pesticides, generate suitable policies and strategies.
4. Integration of conservation, plant breeding and seed sector development for preservation and appropriate use of plant genetic resources.

“Work Related to Sustainable Diets, Nutritional, Health and Improved Livelihood”

1. Growing Greener Cities.
2. Promotion of fruits and Vegetables.
3. School gardens and micro-gardens.

Growing Greener Cities: Urban and Peri-urban Horticulture (UPH) Initiatives

1. A project for UPH in five cities in the Democratic Republic of Congo is helping to grow 150000 tons of vegetables a year.

2. Provides fresh, nutritious produce to 11.5 million urban citizens, fabricated sustainable employments for 16000 small scale market gardeners.

3. Generate employments and earnings for 60000 people in the horticulture value chain.

4. Countries supported their institutional backgrounds by forming national UPH units at the level of the Ministry of Agriculture at reorganized level in cities.

Advancement of Fruit and Vegetables for Health Advantage

1. In this approach, national or local production abilities, prevailing agricultural and alimentary practices, predominant forms of nutrition, the health position of the residents, and current fruit and vegetable advertising programs are being used.

2. Most of the countries are in the progression of forming platforms like (agriculture, health/nutrition and education) and creating a National Horticulture Development Master Plan with prominence on the role of fruit and vegetables in a viable diet for human health and with due attention to gender discriminations.

School Gardens and Micro-Gardens

1. School gardens are necessary tools for enhancement of child nutrition.

2. They educate children about horticulture, offer fresh fruit and vegetables for healthy school meals, support teachers to improve nutrition courses and, when simulated at home, also increase family nutrition.

3. From last 10 years, FAO/AGP in association with FAO's Nutrition and Consumer Protection Division (AGN) has delivered practices, seeds and techniques to create many of school gardens in more than 30 countries.

4. Micro-gardens are incorporated with school feeding programs to encourage children's diets by providing fresh and nutritious vegetables.

5. These gardens are very prevalent with females, because energy requiring practices like seed bed preparation, weed control are not mandatory.

Furthermore, it decreases the problem of carrying irrigation water and benefited by saving water, which is costly and limited in the towns.

Approaches

1. Horizontal Diversification: It means, we intensify crops by taking new and different high-value crops to prevailing cropping systems in such a way to increase the overall productivity and economy of a farm enterprise.

2. Vertical diversification: Here, farmers focus to enhance the product value through processing, regional branding, packaging, merchandising etc.

Table 1: Substitution of crops suggested to take in the place of rice and wheat in major growing states:

State	Main Crop	Kharif Alternate Crops	Main Crop	Rabi Alternate Crops
Punjab	Rice	Maize, mungbean, uradbean, soybeen, pigeonpea (short duration), fruits, vegetables, agro-forestry	Wheat	Mustard, lentil, chickpea, field peas, barley
Haryana	Rice	Maize, Mungbean/ uradbean, pigeonpea (short duration), fruits, vegetables, agro-forestry	Wheat	Mustard, lentil, chickpea, barley
Uttar Pradesh	Rice	Pigeonpea (short duration), Mungbean/uradbean	Wheat	Mustard, field peas, chickpea
Bihar	Rice	Not suggested as most of the rice area is waterlogged	Wheat	Maize, mustard, lentil, chickpea
Chhattisgarh	Rice	Soybean	Wheat	Chickpea, lentil, field peas
Madhya Pradesh	Rice	Soybean, pigeonpea, mungbean/uradbean, seasame	Wheat	Mustard, linseed

Government Schemes and Approaches for Crop Diversification

1. NAIS (National Agriculture Insurance Scheme).
2. Technology Mission on Cotton.
3. Endowment of Capital Subsidy of 25 percent for Creation / Transformation / Development of Cold Storages structure for Horticultural Produce.
4. Launch of Watershed Development Fund.
5. Consolidation of Agricultural Marketing.
6. Seed Crop Insurance.
7. Seed Bank Scheme.

Conclusion

Diversification of agriculture is important for taking the benefits of balancing and additional relationships to secure the maximum income. And it is also essential to increase resource use efficiency through efficient use of land, judicious use of output of one enterprise as an input for others and rigorous use of family labour. However, alteration of crop and addition of new crops in prevailing cropping system has been the ideal process of diversification in India. The nature of crop diversification has been mainly from low value coarse cereals to high value oilseeds and other food grains.

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Importance of Chemotaxis in Plant Growth Promoting Bacteria (PGPB)

Article ID: 31405

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Introduction

Motility is one of the most demonstrated bacterial characters, and chemotaxis is one of the most studied bacterial behaviors. Motile organisms are attracted by certain chemicals and repelled by others (positive and negative chemotaxis). Quantification of chemotactic motion is necessary to identify chemo effectors and to determine the bacterial colonization in plant root. Chemotaxis is the process by which cells sense chemical gradients in their environment and then move towards more favorable conditions. The success of plant growth promotion by microorganisms depends largely on their timely response to chemical stimuli released by plants, their competition or interaction with other microorganisms, and persistence throughout the growing season. Chemotaxis is suggested to be the first step of bacterial colonization of roots of several plant species. Furthermore, chemotaxis and motility have been found to play a number of important roles in the symbiotic interactions of rhizobacteria with their hosts. These key characteristics of plant-growth-promoting microorganism plays important role in the interaction process, yet the role of motility and chemotaxis in plant-microbe interaction are poorly studied.

Before being able to confer any plant beneficial effects, (bioinoculant) PGPB need to be rhizosphere and/or rhizoplane competent, i.e. they have to be able to colonize the rhizosphere and/or the rhizoplane during an extended period characterized by strong microbial competition. Many factors can be involved in rhizosphere and rhizoplane competence by PGPB, one of the most important is movement of rhizobacteria towards root exudates, this is depending on the composition of root exudates. The microbial dependency to the particular crop will be decided by the composition of the root exudates, some root exudates attract specific group of bacteria but some compound repel microorganism.

Plant Root Exudates

The chemicals secreted into the soil by roots are broadly referred to as root exudates. Root exudates are a plants' only means of communicating with the rhizosphere and the microbes residing there, so the plant must make use of a wide array of compounds and signal molecules to accomplish this communication. Through the exudation of a wide variety of compounds, roots may regulate the soil microbial community in their immediate vicinity, cope with herbivores, encourage beneficial symbioses, change the chemical and physical properties of the soil, and inhibit the growth of competing plant species. The ability of secreting a vast array of compounds into the rhizosphere is one of the most remarkable metabolic features of plant roots, with nearly 5% to 21% of all photo synthetically fixed carbon being transferred to the rhizosphere through root exudates.

Root exudates have traditionally been grouped into low- and high-Mr compounds. However, a systematic study to determine the complexity and chemical composition of root exudates from diverse plant species has not been undertaken. Low-Mr compounds such as amino acids, organic acids, sugars, phenolics, and various other secondary metabolites are believed to comprise the majority of root exudates, whereas high-Mr exudates primarily include mucilage (high-Mr polysaccharides) and proteins.

Root Exudates in Microbial Root Colonization

Rhizosphere and rhizoplane colonization of microorganism has been described to be linked to root exudation. Various carbohydrates, amino acids, organic acids, as well as other compounds, which provide a source of nutrients for root-associated bacteria, are released in the rhizosphere. Microorganisms are known to be chemo attracted and move towards exudates, allowing them to colonize and multiply both in the rhizosphere and the rhizoplane. Host-bacteria associations can involve specific interactions and recognition processes. The composition of exudates depends on the cultivar, the exposure of the plant to stress, the plant growth stage and may also showed differences along the route structure resulting in differences in the composition of the various bacterial communities. Differences in root exudate composition may also influence the colonization process. In addition, some exudates are known to have negative effects on bacterial strains. Differences between attractive or repulsive compounds that affect bacterial colonization are likely to have an effect on bacterial gene expression.

Root Exudates Collection (Modified Method of Pariasca Tanaka Et. Al., 2010)

1. Growth conditions:

a. Plant seeds will be surface sterilized using 0.1 % $HgCl_2$ for 3 min and 70% ethanol for 30 sec (surface sterilization may subject to change with crops), rinsed with distilled water, and incubated at room temperature for germination.

b. The germinated seeds will be then transferred to a floating system containing 0.5 mM $CaCl_2$.

2. Collection of root exudates:

a. After 14 days, plants will be transferred to the trap solution (1 mM NH_4Cl and 0.1 mM $CaCl_2$).

b. The root mass will be carefully immersed in a 1-L dark bottle containing trap solution for 24 h to collect root exudates.

c. The pH will be monitored every 8 h during the 24-h collection period and readjusted to 5.6±0.2 with HCl or NaOH if necessary.

d. After 24 h, the root and shoot tissue will be saved for dry matter determination.

3. Concentration of root exudates:

a. Collected exudates will be concentrated to 10% of the original volume by rotary evaporation at 40OC.

b. Root exudates will be filter sterilized and stored at -20OC for further experiments.

Chemotaxis Measurement of PGPB Towards Root Exudates (Modified Capillary Tube Chemotaxis Assay of Bakker Et. Al., 2007) (Figure 1)

1. Microbial cells will be grown to late logarithmic phase (~1 x 107 cells/ml) and centrifuged at 4°C for 8 min at 4000rpm.
2. Gently resuspend in a motility buffer consisting of potassium phosphate buffer (pH 7.5) and 20 µM EDTA and adjusted to pH 7.4.
3. 200 µl PCR tubes may be used (may be changed based on the requirement), 200 µl of culture which is dissolved in motility buffer will be added to the PCR tubes.
4. Root exudate will be filled in 70 µl capillary tubes, and one side of the capillary tube was closed with gum.
5. The capillary tube will be inserted into PCR tube which contain 200 µl of buffer with microbial cells, incubated at room temperature
6. After every 15 mins (15, 30, 45, 60, 75), the capillary tubes will be removed (replicates must be kept to measure different times), the outsides will be carefully wiped with a paper towel and 70 µl will be transferred to 2. 0 ml Microfuge tubes
7. This 70 µl will be serially diluted using 630 µl of motility buffer
8. 100 µl from each dilution will be plated in agar medium (media may be changed based on the microorganism using) by spread plate technique.
9. Plates will be incubated at 30oC for 3 days and population count will be expressed as number of colonies forming unites at different time interval.

Conclusion

Each plant species has ability to recruit their own rhizosphere microbial partner's through secreting the signaling molecules through root exudates. Hence development of any bio-inoculants for particular plant species must be tested with this chemotaxis assay before recommending to the farmers.

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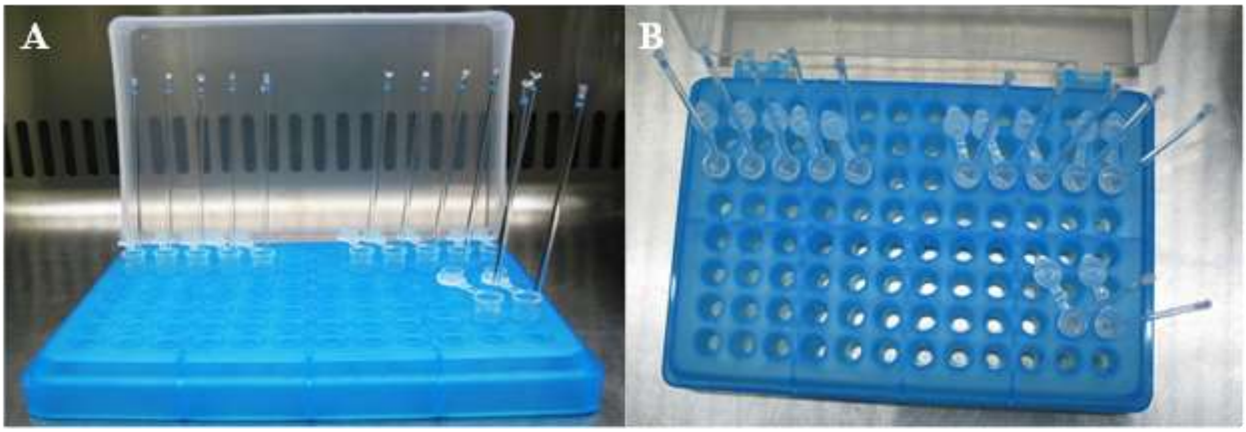
Figure 1 – Modified Capillary Tube Chemotaxis Assay Setup for Illustrating the Effect of Plant Root Exudates on Attracting/Repelling of PGPB



Two hundred micro litter of bacterial culture is taken in PCR tube and capillary tubes are inserted in 200µl culture in PCR tube (A), Top view (B)

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Application of RNA Interference (RNAi) as a Promising Gene Regulatory Approach of Gene Silencing Mechanism for Disease Resistance in Plants

Article ID: 31406

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Plant disease has been a major challenging factor influencing food production, food security, food safety and human societal development since long time which caused huge reduction in crop yield that can have a significant negative economic impact and also, they have threatened to wipe-out the entire plant species. Many plant disease management strategies together with several agronomic practices used in modern agriculture have also generated unintended problems including loss of biodiversity and other natural resources, environmental deterioration/ hazards in terms of plants health, animal health and human health and accelerated evolution of new and diverse strains/races of the pathogens. To overcome all these problematic attributes, a new emerging, powerful, effective, reliable and sophisticated tool to induce disease resistance properties in host plant as a management prospective through gene silencing mechanism (by knocking-out or knocking down the specific gene of interest in pathogens) at molecular level commonly known as RNA Interference (RNAi). This novel approach has opened new avenues for crop improvement by developing disease resistant, abiotic or biotic stress tolerant, and high yielding elite varieties. RNA interference (RNAi) is a promising gene regulatory approach in functional genomics that has significant impact on crop improvement which permits down-regulation in gene expression with greater precise manner without affecting the expression of other genes. RNAi technique was first time applied on *Petunia hybrida* L. plants to enhance anthocyanin pigment through introduction of chalcone synthase gene (chsA) which resulted appearance of new colour of flower in transgenic *Petunia* due to over expression of chsA gene that encodes major enzymes i.e. chalcone synthase in anthocyanin biosynthesis pathway.

It is a homology-dependent nucleotide sequence specific process of limiting the transcription level by either suppressing transcription through a process known as RNA-directed DNA methylation at TGS level (transcriptional gene silencing) or by activating a sequence-specific m-RNA degradation process at PTGS level, post-transcriptional gene silencing (Translation inhibition) or Inhibition of RBS(Ribosome binding site) for translation process. The term RNAi was coined by Fire & Mello in 1998 and the mechanism of RNAi was observed in an animal nematodes *Cenerorahabditis elegans*. In plants, two functionally different RNAs; microRNA (mi-RNA) and small interfering RNA (siRNA), have been characterized. The mi-RNAs are small 21-26nt long dsRNAs that are genome coded and are endogenous to every cell. The miRNAs are processed and generated from stem loop precursors (shRNA and/or hpRNA) upon the activity of dicer. Structurally, miRNA comprised of a stem region which is double stranded and a loop region which is single stranded and are basically involved in the regulation of development. On the other hand, siRNAs are generated from long dsRNA and are involved in defense through RNA interference. The dsRNA might be present in the cell as synthetic RNAs, replicating viruses (replicative intermediate during replication of RNA of DNA of viral genomes) or transcribed from nuclear genes. During RNAi mechanism, silencing initiate with enzyme Dicer (RNaseIII member family) which recognizes the long dsRNAs and cleave them into duplex siRNA (21-25 nt). The mature siRNA duplex comprised of two strands; strand complementary to target mRNA is guide strand and other is passenger strand. Small interfering RNA (siRNA) loaded to multiple complex proteins consisting of argonaute protein, dicer and other accessory proteins to form RNA-induced silencing complex (RISC). RISC is a combination of Dicer (an endonuclease enzyme), some accessory proteins namely argonaute (ago1, 4, 6, 9; catalytic endonucleases) and RNA binding proteins (RBP), and some trans-acting RNA-binding proteins (TRBP). Argonaute protein possess 2 important domains i.e. PAZ & PIWI domains. PAZ domains having siRNA binding domains and PIWI domains having endonucleolytic (slicer) activity. The guide strand (antisense strands) of RISC guided to target mRNA in sequence specific manner causing mRNA degradation results in translation of target mRNA is inhibited. The application of RNAi techniques has been fully exploited against wide range of insect, pests and diseases viz. disease resistance, insects/pest's resistance, crop quality and nutritional status improvement, abiotic stress tolerance i.e. drought stress tolerance, salt stress tolerance, cold and heat stress tolerance and mechanical stress tolerance. Use of RNAi technology in various plant species against different insect/pests and pathogens have been exploited in paddy against Magnaporthe grisea and Xanthomonas oryzae pv.oryzae with objective of functional analysis of a rice homolog SSI2, a target gene (OsSSI2) for disease resistance, crown gall of apple (iaaM, iaaH and ipt gene) apple scab (GFP transgene and THN), cotton american bollworm, BPH of rice, citrus tristeza virus (CTV), Plum Pox Virus (PPV) and papaya ring spot virus (PRSV) etc.

Thus, it can be concluded that RNAi is a sophisticated technique in functional genomics for the functional analysis of target genes and regulation of gene expression for crop protection and genetic improvement at molecular level. Further research should be going on identification of new siRNA, dicer and diverse group of argonaute proteins in plants so as to increase the efficiency of gene silencing mechanism. As future point of view, knockdown technology might improve vastly with better-designed plasmid- or virus-based vectors for delivery of siRNAs to the appropriate tissues at the appropriate time. Development of more efficient & rapid technologies for assessment of impact of RNAi technology in environment and impact on plant, animals and human being as a health point of view and to prevent off-target mutation, non-target mutation in other genes of plant cells. There is a need to adopt clean vector technology which facilitates the deleterious effect of genes present in vector construct during delivery of siRNA.

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Source Sink Communication

Article ID: 31407

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Regulation of Plant Productivity: Source Sink Communication

Plant coordinates its growth and development by capturing energy and nutrients via the dynamic coordination of numerous signal transduction pathways. It develops from an embryo at the onset of their active growing life, and depends on the metabolism of transported nutrients from storage organs, like seeds. Throughout their active vegetative growth and development plants depend on the energy obtained by the CO_2 fixation (arise in source organs) into carbohydrate (via photosynthesis) and translocation of photo assimilates, predominantly sucrose, from source organ to sink organ for their utilization through phloem. Sugars and other nutrients are remobilized from the mature leaves to developing seeds in the course of reproductive stage. Most of the fundamental processes of plant life cycle including embryogenesis, germination, vegetative growth, reproduction, senescence, responses to diseases and environmental stimuli are regulated by sugars. As a whole sugar up regulate genes involved in biosynthesis, transport, stored reserves, and cell growth, whereas down regulate those associated with photosynthesis and reserve mobilization conversely starvation of sugar imposes the opposite effect. In perennating organs of many plants species starch as a major carbohydrate represent up to 90% of total dry weight. Starch pool synthesized in photosynthetic source tissues and non- storage sinks are the measures of overall crop productivity. Carbon reserves are optimally utilized in plants by proper functioning of starch as a ‘sugar-source’ (in need of carbon) and “sugar-sink” (when sugar exceeds). Distribution of carbon into various metabolic pathways is termed as carbon partitioning and carbon distribution from source to sink is termed carbon allocation. Transfer of sucrose from source organ to sink organ is a chief feature of source–sink communication that regulate C assimilation and partitioning during growth and development, which determines the pattern of carbohydrate allocation throughout the plant and has a prime role in determining crop productivity. So, it is clear that starch can be present in a plant in almost every tissue at some phase of its life cycle but when and where it will deposit and metabolized later on to sugar will vary. Plant life cycle is accompanied by source sink transition. The regulation of the starch metabolism pathway will depend on tissue and developmental stages of plant and coordinated/governed/regulated by source sink communication. Carbohydrate assimilation and partitioning and eventually the crop yield is the outcome of source activity and sink strength as explored below.

Source Activity

Actively photosynthesizing plant organs are exporters of photo assimilates that produce surplus carbohydrate of their own need like mature leaves, storage organs or mature roots. These source organs are prime location for photosynthesis (in mature leaves) and nutrient remobilization (in storage seeds and tubers) this is defined as source activity. Mature leaves export the carbohydrate predominantly as sucrose that transported to sink sites through phloem for its utilization as the sink tissues are unable to produce enough carbohydrate for their growth and storage needs. Storage organs have reserve food (in form of starch, lipids, and proteins) and at beginning of plant life cycle (seed germination) these nutrients are hydrolysed to smaller molecules (i.e. sugars, amino acid, fatty acids, phosphate, minerals) and exported to support seedling growth from developing embryo. Water and other minerals from soil are transported by mature roots to all other tissues of plant through xylem. Higher photosynthesis, higher rates of nutrient remobilization define the higher source activity. At the vegetative state of plant sucrose produced by mature leaves is transported to immature leaves and developing roots and during the reproductive stage it transported to developing seeds. Plant life cycle is accompanied by source sink transition. Factors like increased CO_2 concentration, light quality, light intensity or photoperiod and increased sink demand increase the carbon fixation in source organ as a consequence improve the plant yield.

Sink Strength / Activity

Non –photosynthetic plant organs import the carbon from source tissues as a substrate for biosynthesis of all compounds including starch that is defined as sink activity. Immature leaves and developing seeds, developing roots, fruits, or tubers are all the sink organs. immature leaves, and developing roots import carbohydrates and nutrients for highly active metabolisms; are classified as 'utilization sinks. Developing seeds, fruits, or tubers import and deposit carbohydrates and other nutrients in the form of storage compounds, such as starch, proteins, and lipids are classified as 'storage sinks' (trends in plant science). Availability of carbon in source organ modulate the plant growth. Increased sink demand fosters the photosynthesis in source organ while, lowered sink strength cause to build-up the sugars in source organ. Hence as whole source activity (carbon assimilation and export) and sink activity (sugar import and usage) share a high positive correlation. Nutrients directly contribute in leaf growth so plant preparation that nurtures the leaf and other source organs will directly target the source activity of plant followed by higher sink activity and indirectly improve the plant productivity.

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Management of Collar Rot Disease of Groundnut

Article ID: 31408

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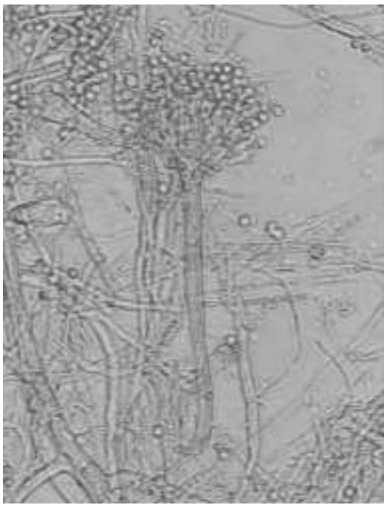
Introduction

Groundnut or peanut (=*Arachis hypogaea* L., Family: Fabaceae, Native: South America), is a legume crop cultivated in tropical and subtropical areas. In India, groundnut occupies 35% of the total cropped area under oilseeds and accounts for 40 % of total oilseed production. Groundnut seed contain 45 per cent oil and 26 per cent of protein. Factors affecting groundnut production are poor soil fertility in addition to the abiotic and biotic stresses. Collar rot caused by *Aspergillus niger* van Teighem, (first reported by Jain and Nehra (1952)) is one of the most important disease of groundnut which is more extensive in the kharif than the rabi/summer seasons (Fig 1). The disease causes more damage in sandy loam and medium black soil. Annual world yield loss caused by collar rot is more than 10 per cent (Pande and Rao, 2000) and is more prevalent in soils with low moisture content and high temperature, approximately 30ºC (Kishore et al., 2007). In India, disease leads to extensive damage in Rajasthan state, which is a major groundnut growing region of the state. A survey of damage caused by the disease was done by Kumari and Singh (2014) in Jaipur and Sikar districts of Rajasthan, they observed that the disease incidence may reach upto 52% and more prevalence of the disease.

Pathogen

Aspergillus niger is an ascomycetous fungus belonging to the family Trichocomaceae of the order Eurotiales. Commonly known as black mould due to the production of black conidia. Microscopically fungus has filamentous mycelium and colony appear white initially which changes to black colour after the production of spores (conidia). The mycelium of the fungus is hyaline to sub-hyaline. Conidiophores arise directly from the substrate and are septate, thick walled, hyaline or olive brown in colour. The vesicles are mostly globose and have two rows of hyaline phialides *viz*., primary and secondary phialides. The conidial head are dark brown to black. The conidia are globose, dark brown in colour and produce in long chains. The fungus has wide habitat range and commonly found in the soil as a saprophyte. As a plant pathogen, it has wide host range affecting 37 genera of crop plants including tomatoes, groundnuts, maize etc. and is a common postharvest pathogen contaminating the produce.



Symptomatology

The disease usually appears in three phases.

1. Pre-emergence rot: Conidia of the pathogen present in the soil and plant debris infect healthy seeds in the soil and result in the rotting of seeds. Seed germination is greatly reduced and infected seeds are covered with the black spore mass of the pathogen.

2. Post-emergence rot: Young emerging seedlings are infected by the conidia of the pathogen and brown spots appear on the cotyledons and collar regions. The affected portion of the seedlings become soft and rot, the affected seedlings collapse.

Crown Rot

The infection when occurs in adult plants show crown rot symptoms. Large lesions develop on the stem below the soil and spread upwards along the branches causing drooping of leaves and wilting of plant. The disease is favoured by high soil temperature (30-35°C) and low soil moisture. Deep sowing of the seeds should be avoided as a prevention measure of the disease.

Disease Cycle

The pathogen survives in plant debris in the soil from the previous host crop. Soil-borne conidia because disease carry over from season to season. The other primary source is the infected seeds. The pathogen is also seedborne in nature. Infected seeds do not germinate and if germination occur the collar region is infected and seedlings are wilted. Secondary spread occurs with the conidia under favourable conditions (Figure 1).

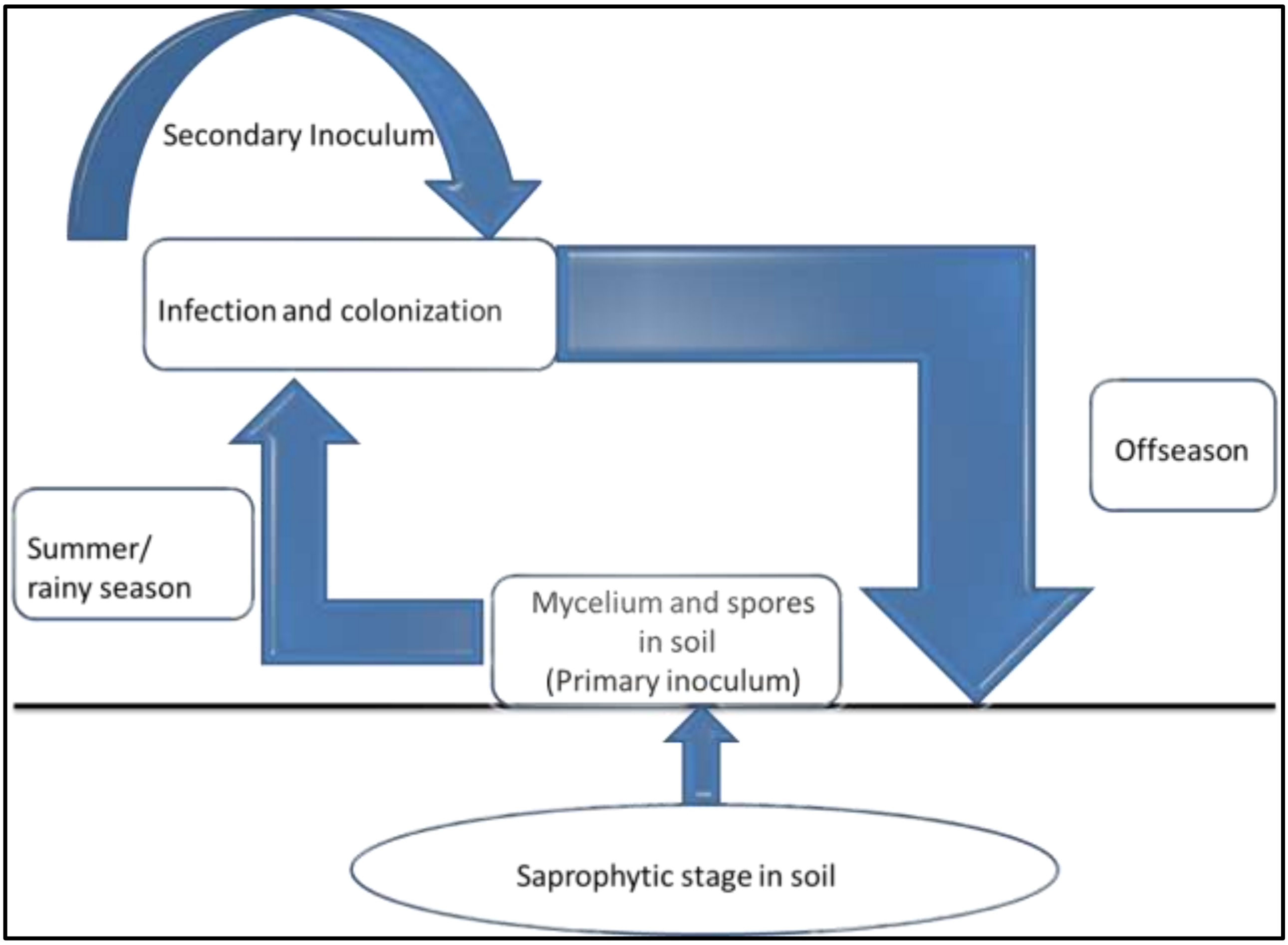


Figure 1: Schematic diagram of disease cycle of collar rot of groundnut

Management

1. Crop rotation.
2. Destruction of plant debris.
3. Remove and destroy previous season's infested crop debris in the field

4. Seed treatment with *Trichoderma viride / T. harzianum* @ 10 g/kg of seeds and soil application of *Trichoderma viride* / *T. harzianum* at 10 g/ha, preferably with organic amendments such as castor cake or neem cake or mustard cake @ 250 kg/ ha or multiplied in 250 kg farmyard manure (15 days prior to application and applied at the time of sowing).
5. Resistant varieties for collar rot in ground nut are HNG-69, HNG 123 and RG 510.

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Factors Responsible for Emergence and Introduction of Plant Pathogens

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Introduction

Losses caused by plant pathogens have been and remain important constraints, worldwide, on efforts to increase crop production and productivity. With what appears to have been a decade of small improvements in the yield of major food and fiber crops, interest has been renewed on better definition and reduction of losses as a means of increasing crop yields. Crop loss assessment and management requires a multidisciplinary approach because pathogens (fungi, bacteria, viruses and nematodes) not only interact with each other, but with other biotic and abiotic factors to affect yield (Teng et al., 2008).

At the same time due to several factors new plant pathogen is emerging and they are been spreading from one state to other state within a country and always between the countries. Spread of these plant pathogens pose serious threat to the major food crops of the world. An emerging disease is an original case or group of cases that are newly recognized or newly appeared in an area and can increase fast in incidence and severity. The introduction- arrival, of potentially hazardous plant pathogens to a new cropping area, generates risks in food production (Chakraborty, 2005).

Factors Responsible for Emergence and Introduction of Plant Pathogens

1. Climate change.
2. Human population growth.
3. Industrial and agricultural chemical pollution.
4. Farming techniques: land use, water storage and irrigation.
5. Biotechnological approaches.
6. Trade and human movements.
7. Habitat destruction.

Climate Change

It has been predicted that as temperatures increase many pathogens will spread into new geographic areas, where they will come into contact with new potential hosts Several aspects of the biology of a pathogen can be directly influenced by environmental factors. Production and germination of propagules and pathogen growth rates are strongly dependent on temperature, relative humidity (RH), and, in the case of foliar pathogens, often leaf wetness (Colhoun 1973; Huber and Gillespie 1992). Decreased levels of rainfall may lead to decreased incidence of downy mildew infections of grape. However, in a warming scenario, the increase in temperature more than compensates for the reduction in duration of leaf wetness, in part because infections that start earlier in the growing season allow more time for epidemics to develop.

Human Population Growth

To satisfy a growing demand for food, global agricultural production must increase by 70 per cent by 2050. India still accounts for a quarter of the world's hungry people and home to over 190 million undernourished people. To meet this growing demand for food due to increase in population as we cannot increase the land, the only option we have is to increase the productivity of the crops. To achieve this many new high yielding varieties are being developed and they are found to be susceptible to the plant pathogens. Introduction of these varieties have also introduced the new pathogens. Development of disease resistant varieties has been tried but it is not possible to retain them for longer period of time, which leads to new disease epidemics.

Industrial and Agricultural Chemical Pollution

Industrial waste that are been released to water bodies may cause of mutation of microorganisms that are present in water bodies and they may attack the plants for their nutrition which cause emergence of new plant pathogens. In the same agricultural chemicals may cause resurgence of the pests. Due to excess use of pesticides (fungicides, insecticides and nematicides), the pathogens may develop resistance against them and cause epidemics.

Farming Techniques

It includes water storage, irrigation, use new farm equipment, cropping patterns, etc., Modern farm equipment and their movement from place to place lead to the spread of pathogens. Equipment when are used without cleaning carry the pathogens to other fields.

Biotechnological Approaches

Genetic engineering is a technique that allows to detect, isolate, multiply and transplant specific genes in another living organism. The introduction of genes in another living organism or other species is a process unstable and insecure with side effects and consequences difficult to predict on the recipient genome and interaction with the surrounding environment. Genetically modified plants or animals, are able to reproduce, spread and propagate in an uncontrolled and irreversible biosphere, with unpredictable effects on the surrounding biodiversity and interactions with the latter. Due to spread of GM crops they are replacing many landraces or wild types which lead to lose to resistant genes and it has environmental impacts like decrease in beneficial insects and increase in weed resistance.

Trade and Human Movements

India, is involved in export and import of many agricultural commodities which sometimes may bring new plant pathogens into the country and may even take some pathogens to other countries both pose a serious threat to the agricultural crops.

Habitat Destruction

Habitat destruction influences the emergence of new diseases both directly and indirectly. Deforestation leads to change in the climate which in turn affects plants by increasing the population of plant pathogens and pests. Due to destruction of habitat the pathogens which are prevalent in that habitat may change their host and shift on to agricultural crops due to non-availability of their habitat.

Conclusion

All the factors listed above are interlinked to one another; change in one factor influences the other. As the damage caused by plant pathogens is increasing day by day it is very important to have knowledge about the factors that are responsible for the emergence and spread of these pathogens. Brief understanding of these factors helps us in framing management practices, helps in taking precautions to prevent their entry and also helps in framing regulatory measures.

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Mycorrhiza – A Root Fungus

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A history of mycorrhiza was fossil records show mycorrhizae have been around for 460 million years old. In 460 million-year-old fossils, the underground parts have mycorrhizal fungi very similar to those found in today's plants. Robert Harting (1840) first illustrated the mycorrhizal fine roots of a pine but did not recognize them as a separate being. A.B. Frank (1885) described the fungus-root structure and showed increased growth in the plant when mycorrhizal. A mycorrhiza from Greek "fungus"or"root"; mycorrhizae, mycorrhiza or mycorrhizas is a symbiotic association between a fungus and a plant root. The term mycorrhiza refers to the role of the fungus in the plant's rhizosphere, its root system. Mycorrhizae play important roles in plant nutrition, soil biology and soil chemistry. As the American pathologist, Stephen Wilhelm said: "*in agricultural field conditions, plants do not, strictly speaking, have roots, they have mycorrhizas*".

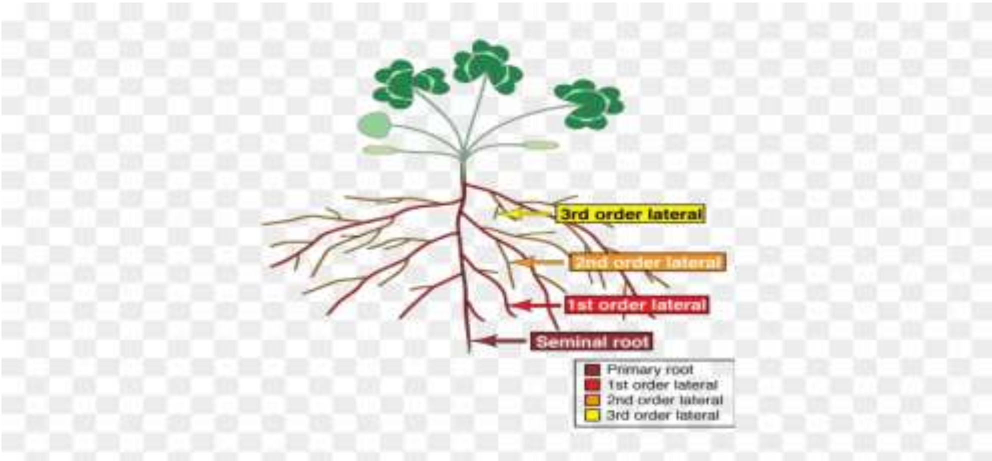

Fig.1- Plant root develop for mycorrhiza

In a mycorrhizal association, the fungus colonizes the host plant's root tissues, either intracellularly as in arbuscular mycorrhizal fungi (AMF or AM), or extracellularly as in ectomycorrhizal fungi. The association is sometimes mutualistic. In particular species or particular circumstances, mycorrhizae may have a parasitic association with host plants.

Mycorrhizas are commonly divided into *ectomycorrhizas* and *endomycorrhizas*. The two types are differentiated by the fact that the hyphae of ectomycorrhizal fungi do not penetrate individual cells within the root, while the hyphae of endomycorrhizal fungi penetrate the cell wall and invaginate the cell membrane. Endomycorrhiza includes *arbuscular*, *ericoid*, and *orchid mycorrhiza*, while *arbutoidmycorrhizas* can be classified as *ectoendomycorrhizas*. *Monotropoid* mycorrhizas form a special category. Arbuscular Mycorrhizal (AM) fungi (*Glomus* spp.) colonize the roots of host plants and enhance the surface area of roots. This directly contributes to the enhanced uptake of nutrients like nitrogen (N), phosphorus (P), etc. and improved growth parameters of plants. AM fungi colonization has also been reported to improve the nutrient uptake and growth of mungbean plants (Manke*et al.*, 2008 and Kumar *et al.*, 2017).

The associations between roots and fungi are called mycorrhizae. These symbiotic arrangements have been found in about 90% of all land plants, and have been around for approximately 400 million years. Plant roots are hospitable sites for the fungi to anchor and produce their threads (hyphae). The roots provide essential nutrients for the growth of the fungi. In return, the large mass of fungal hyphae acts as a virtual root system for the plants, increasing the amount of water and nutrients that the plant may obtain from the surrounding soil. A plant that forms an association benefiting both the fungus and the plant is a "host." Large numbers of native desert plants are hosts to these fungi and would not survive without them. The development of a healthy root system depends not only on the genetic properties of the plant but also on the physical and chemical properties of the substrate used (Wilson *etal*., 2001).

Type of Mycorrhiza

1. Endomycorrhizal: symbiotic relationship with approximately 85% of plant families. Pair with most commercially produced plants, including green, leafy, and fruiting or flowering plants. Penetrate the root cortex and form nutrient exchange structure within the root cells (arbuscules, vesicles, etc.).

2. Ectomycorrhizal: form a symbiotic relationship with about 10% of plant families. Mainly pair with conifers and many American hardwoods. Do not penetrate the root cell walls, but form a sheath around the root, and nutrient exchange structure known as a "harting net."

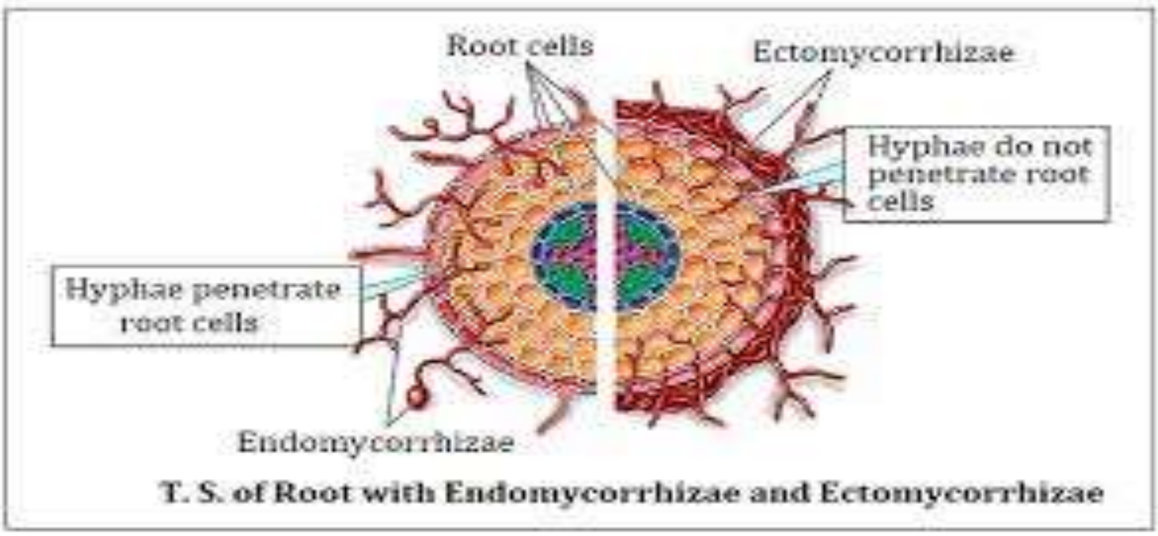

Fig.2-Root with Endomycorrhizae and Ectomycorrhizae

Endomycorrhiza / Arbuscular Mycorrhiza

An Endomycorrhiza/Arbuscular mycorrhiza (plural mycorrhizae or mycorrhizas) is a type of mycorrhiza in which the fungus penetrates the cortical cells of the roots of a vascular plant. Arbuscular mycorrhizae (AMs) are characterized by the formation of unique structures such as arbuscules and vesicles by fungi of the phylum Glomeromycotan (AM fungi). AM fungi help plants to capture nutrients such as phosphorus and micronutrients from the soil. It is believed that the development of the arbuscular mycorrhizal symbiosis played a crucial role in the initial colonization of land by plants and in the evolution of the vascular plants.

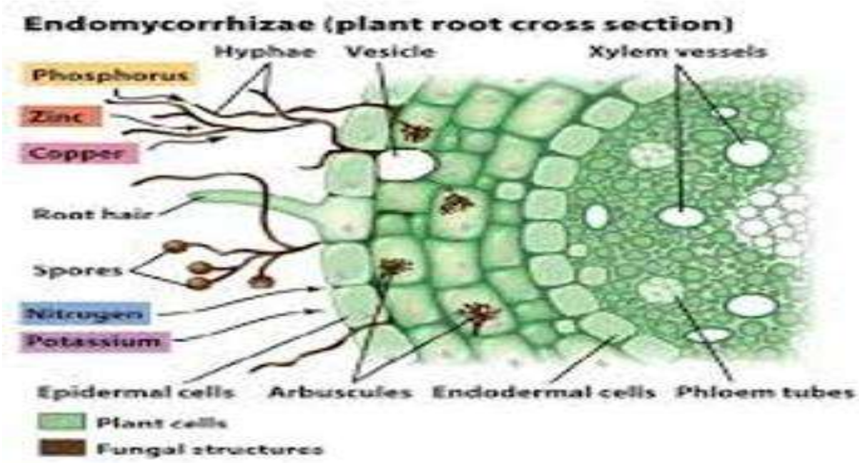

Fig.3- Endomycorrhiza plant root section

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1. Form the symbiotic relationship with approximately 85% of the plant family.
2. Pair with most commercially produced plants, including green, leafy and fruiting of flowering plants.
3. Penetrate the root cortex and form nutrient exchange structure within the root cells (Arbuscular, vesicles, etc.).

Ectomycorrhiza

Ectomycorrhizas (sometimes termed ectotrophic mycorrhizas) is characteristic of many trees in the cooler parts of the world - for example, pines, spruces, firs, oaks, birches in the Northern Hemisphere and eucalypts in Australia. However, some trees (e.g. willows) can have both ectomycorrhizas and arbuscular mycorrhizas, and most tropical trees have only arbuscular mycorrhizas.

The fungi involved are mainly Ascomycota and Basidiomycota, including many that produce the characteristic toadstools of the forest floor (Figures A-C below). Most of these fungi can be grown in laboratory culture but, unlike the wood-rotting fungi, they are poor degraders of cellulose and other plant wall materials.

So, they gain most of their sugars from the living plant roots in natural conditions:
1. Form a symbiotic relationship with about 10% of plant families.
2. Mainly pair with conifers and many American hardwoods.
3. Do not penetrate the root cell walls, a bit form a sheath around the root, and nutrient exchange structure know as a “harting net.”

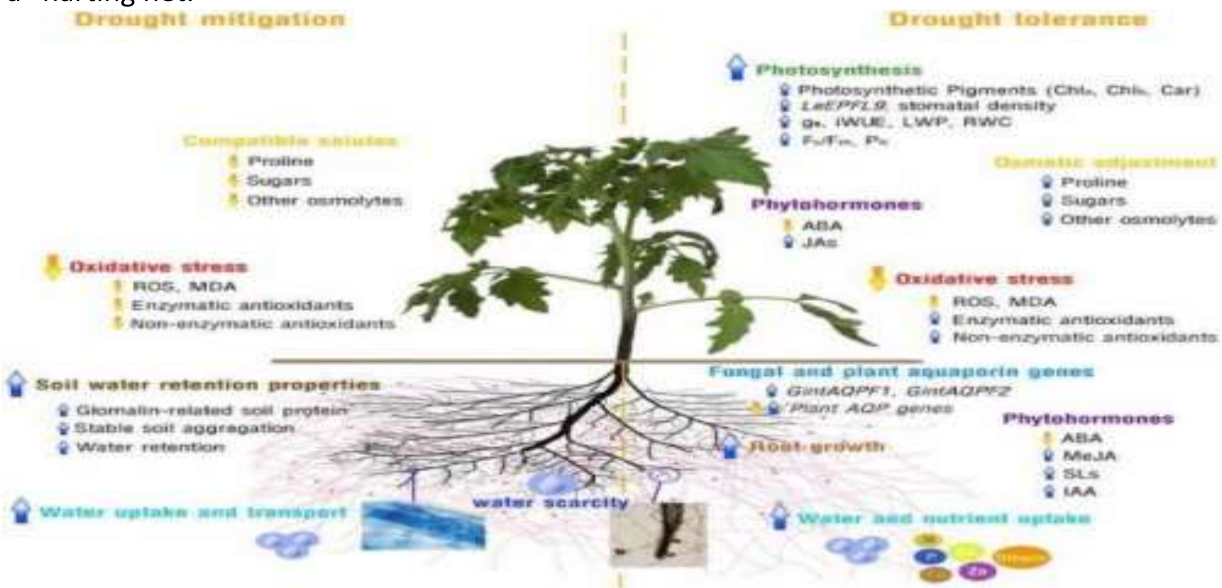

Fig.4- Drought, disease and salinity resistance of Mycorrhiza

Disease, Drought and Salinity Resistance and its Correlation to Mycorrhiza

Mycorrhizal plants are often more resistant to diseases, such as those caused by a microbial soil-borne pathogen. These associations have been found to assist in plant defence both above and below ground. Mycorrhizas have been found to excrete enzymes that are toxic to soil-borne organisms such as nematodes. More recent studies have shown that mycorrhizal associations result in a priming effect of plants that essentially acts as a primary immune response. When this association is formed a defence, response is activated similarly to the response that occurs when the plant is under attack. As a result of this inoculation, defences responses are stronger in plants with mycorrhizal associations. An increasing number of studies highlight a significant role of AMF in the mediation of disease resistances. Besides an improved phosphorus use efficiency, individual reports have shown enhanced levels of defence-related compounds (such as glucanases, chitinases and phenolics) in mycorrhizal plants, and there is the first evidence of certain phytohormone pathways to be involved in mycorrhiza mediated disease resistance (Jung et al., 2012).

AMF was also significantly correlated with soil biological fertility variables such as soil microbial communities and associated disease suppressive. Thus, ecosystem services provided by AMF may depend on the soil microbiome. Furthermore, AMF was significantly correlated with soil physical variable, but only with water level and not with aggregate stability. and are also more resistant to the effects of drought. The significance of arbuscular mycorrhizal fungi includes alleviation of salt stress and its beneficial effects on plant growth and productivity. Although salinity can negatively affect arbuscular mycorrhizal fungi, many reports show improved growth and performance of mycorrhizal plants under salt stress conditions.

Industrial banana producers control the leaf-spot disease using essentially repeated applications of systemic and protectant fungicides. The use of resistant cultivars is another cultural practice for controlling the leaf-spot disease and this may be the most suitable option for small farmers, who usually are unable to afford chemicals due to limited finance (Almekinders et al., 2019).

What are the Main Benefits of Mycorrhizae?

There are numerous documented benefits that mycorrhizal fungi provide to plants. The key benefits that mycorrhizae provide to professional growers are:

1. Root System Enhancement.
2. Improved Nutrient Efficiency.
3. Increased Water Absorption & Utilization.

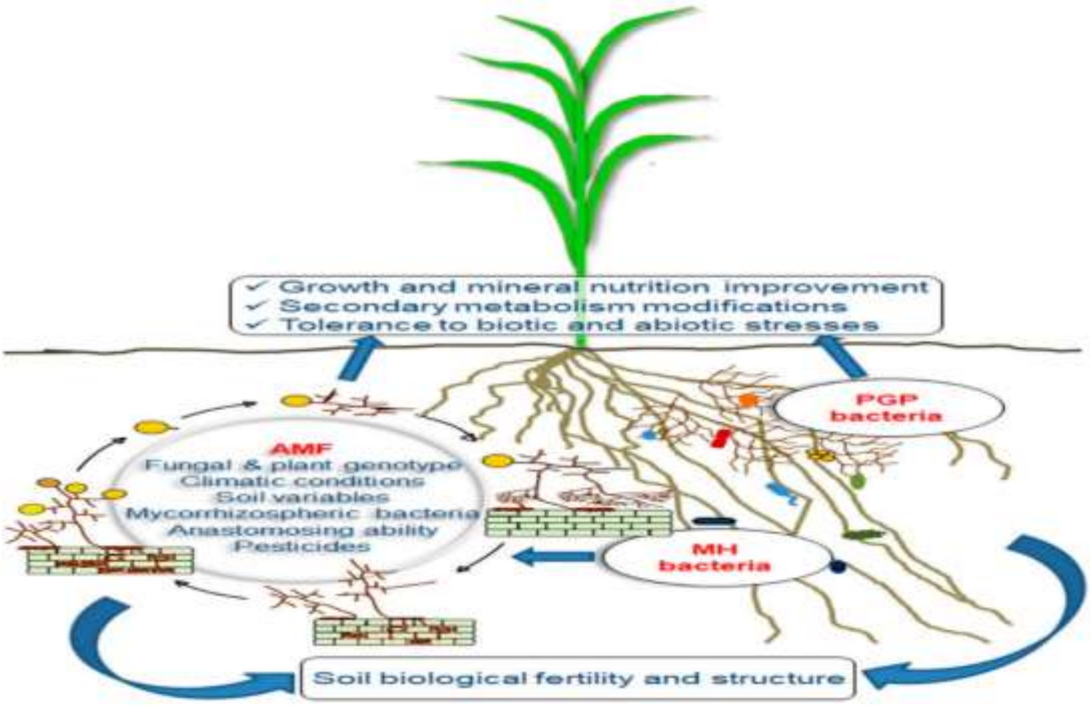

Fig.5- Nutrient cycle and plant growth

Key Benefits of Mycorrhizal Fungi

1. Root system growth:

a. Mycorrhizal fungi support faster plant establishment

b. Mycorrhizal hyphae access to water and nutrients beyond the root zone and deliver them to the plant's vascular network.

c. Increase absorption area by as much as 50 times.

2. Nutrient efficiency:

a. Mycorrhizal hyphae absorb and actively deliver nutrients directly to the roots.

b. Improve utilization of soil nutrients including.

i. Nitrogen.

ii. Phosphorus.

iii. Potassium.

iv. Micronutrients.

3. Water absorption:

a. Mycorrhizal hyphae absorb and transport soil moisture from beyond the root zone to the plant's roots.
b. The mycorrhizal symbiosis increases the plant's effective water utilization capability.
c. Improve tolerance to stress.
d. Greater resistance to drought.

Some Other Benefits of Mycorrhizae?

The symbiotic relationship with mycorrhizal fungi provides many additional benefits to plants and their environments, along with the top-three listed above. These additional benefits include improved soil structure, greater transplant success, increased stress tolerance, reduced nutrient runoff, and many more. Thus, the selection of a proper growing medium is very important for getting good germination and quality seedlings in the nursery. A good growth medium provides sufficient anchorage to the plant, serves as a reservoir for nutrients and water, allows oxygen diffusion to the roots and permits gaseous exchange between roots and the atmosphere outside the root substrate (Unal, 2013).

Conclusion

So, it is clear from the above discussion that there is immense prospect of mycorrhizae as a nutrient management tool for several field crops. It is also an evident that mycorrhizae improve soil physical, chemical and biological properties. Mycorrhizae play an important role in nutrient management aspects of field crop by enhancing growth, yield and quality parameters without endangering the ecosystem.

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Aloe Vera: A Miracle Plant

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Introduction

Aloe Vera is a plant species of the genus Aloe. It grows wild in tropical climates around the world and is cultivated for agricultural and medicinal uses. Aloe is also used for decorative purposes and grows successfully in doors as a potted plant. *Aloe vera*, a cactus-like plant has been used for traditional medical purposes for thousands of years. This plant is one of the oldest known and its first documented use by humans' dates back to an Egyptian papyrus from 3500 BC. *Aloe vera* is a perennial, drought-resisting, succulent plant belonging to the *Asphodelaceae* family. The name, aloe, is derived from the Arabic "alloeh" or Hebrew "halal" meaning bitter shiny substance. The Greek philosopher Aristotle wrote about the beneficial medicinal effect of Aloe vera, while references are also found throughout the Bible. The ancient Greeks, Romans, Chinese and Indians used it. Aloe leaves can be separated into two basic products: the latex, a bitter yellow liquid beneath the epidermis of the leaf and the gel, a colorless and tasteless substance in the inner part of the leaf. Both of them have many biologically active components, mainly anthraquinones and polysaccharides (the most active is acemannan).

The plant aloe vera is as old as human civilization. It is almost sessile plant with multiple tuberous roots and various supported roots. Now a days it is largely grown in various parts of India. It has been medicinally used for an array of ailments such as mild fever, wounds and burns, gastrointestinal disorders, diabetes, sexual vitality and fertility problems to cancer, immune modulation, AIDS and various skin diseases. Aloe has been used for various diseases specially related with digestive system. The cultivation of *Aloe vera* has acquired great commercial importance for medicinal products and cosmetics processing. *Aloe vera* cultivation demands skill and it is also very labour intensive. Better management can result in much higher income and net profit.

Aloes' thick, tapered, green, spiny leaves grow from a short stalk near ground level. Aloe is closely related to other members of the Lily family such as onions, leeks, garlic, tulips, turnips and asparagus the two sides of the leaves have thorny structure with a thorny tip. The two sides of the leaves have thorny structure with a thorny tip. The inner substance of the leaves is jelly like, with bad odour and bitter in taste. The plant will have fully mature leaves in 3 years. Each plant usually has 12-16 leaves, when mature may weigh up to 3 pounds. Normally its flowers during October to January and the long inflorescence has a large number of small pink flowers all around. Fruits are developed during February to April. It is normally not propagated through seeds. Vegetative propagation is easy and convenient.

Aloe vera is found to grow in hot humid and high rainfall conditions. It is grown in all kind of soils but well drained soil with high organic matter, is most suitable. It grows well in bright sun light. Shady conditions results in disease infestation It is highly sensitive to water stagnation. Therefore, well drained high land should be selected for its cultivation.

Harvesting of leaves starts after 7-8 months of planting. Sharp knife is used for harvesting. Care should be taken to reduce the loss of juice from the cut portion. If harvesting is done once in a year, October - November are the best period for harvesting. Second year gives maximum yield and for about 4-5 years good yield could be harvested

Uses of Aloe Vera

1. Aloe vera latex and gel have physiologically active substances with biological effects, acting alone or indicating a synergistic effect. The identification of these substances is important for the effective use of the plant. The

chemical composition of Aloe vera varies and depends on climate, region, growing conditions, the age of the plant or the processing method.

2. Aloe vera has found an extensive application in the cosmetic and toiletry industries, such as moisturizers, cleansers, sun lotions, toothpastes, mouthwashes, shaving creams, deodorants and shampoos.

3. Aloe vera is mostly used for the medicinal purpose, it cures various disease mostly related with the digestive system, fertility problems to cancer, immune modulation, AIDS and various skin diseases.


4. It has been used as a resource of functional food such as yogurt or for the preparation of health drinks, including tea. Aloe vera gel can be used as an edible coating to prolong the quality and safety of fresh products. Table grapes coated with Aloe gel significantly delayed the loss of functional compounds such as total phenolic and ascorbic acid.

5. Due to polysaccharides and the growth hormone gibberellins, increased collagen and elastin formation may reduce wrinkling. Aloe vera effects are in the treatment of scar tissue and the prevention of scar formation following injury to the skin, probably are attributed to the activity of the amino acids necessary to new cell formation.


Conclusion

Successful cultivation of this plant is economically attractive. The cultivation of Aloe vera has acquired great commercial importance for medicinal products and cosmetics processing. The Aloe Vera gel is also high in water content which is essential for the body to heal. Most commonly used for its medicinal properties.

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Agrochemicals

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Agrochemicals (pesticides and fertilizers) are the vehicle for improved crop production technology though it is a costly input. Agrochemicals were manufactured to protect agricultural crops from pests and for augmenting crop yields. Balance use, optimum doses, correct method and right time of application of agrochemicals ensures increased crop production. The requirement of fertilizers and pesticides for crops differ according to soil and meteorology.

Classifications of Agrochemicals

In most of the cases, agrochemicals refer to pesticides which include insecticides, herbicides, fungicides, rodenticides, molluscicides, and nematicides. Agrochemical also includes fertilizers and soil conditioners.

1. Pesticides: Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest (insect, rodent, nematode, fungus, weed, other forms of terrestrial or aquatic plant or animal life or viruses, bacteria or other microorganisms on or in living man or other animals, which the administrator declares to be pest, and any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

These can be classified as: Acaricides, Algaecide, Antifeedants, Avicides, Bactericides, Bird repellents, Chemosterillant, Fungicides, Herbicide softeners, Herbicides, Insect attractants, Insect repellents, Insecticides, Mammal repellents, Mating disrupters, Molluscicides, Nematicides, Plant activators, Plant growth regulators, Rodenticides, Synergists, Viruses etc.

2. Insecticides: Insecticides protect crops before and after harvest from potentially devastating pests that threaten yield and quality. Some insects are chewing pests (e.g. Caterpillars& beetles) which feed on plant material itself (leaves, fruits, roots, etc.). This leads to a reduction of the photosynthetic area and yield. The damage caused can seriously weaken the plant. They can also cause serious loss during material storage. Others are sucking pests which feed on sap (e.g. Aphids). This method of feeding can lead to serious viral transmission that can destroy a crop. It is used to destroy insects. Insecticides can be ovicides that kill eggs, larvicides to kill larvae. Pesticides examples: Organochlorines, organophosphates, carbamates, and pyrethroids.

3. Herbicides: 'Weed 'is a term which describes any undesired vegetation and it consequently covers a very large spectrum of plants. Weeds are generally categorised as grasses or broad leaf weeds. The presence of weeds in a field plot can drastically reduce yield. Herbicides control weeds that compete with crops for light and nutrients. They can also prevent soil erosion and water loss by replacing or reducing the need for cultivation. Herbicides can be:

a. Selective: They will only affect a certain type of plant and not all. This allows the spraying of a crop, leaving it unaffected, while controlling weed growth.

b. Non-selective: All vegetation is controlled within the sprayed area. Herbicides also have non-corpuses, for example non-selective herbicides are used to keep train tracks clear and selective herbicides are used in gardens. Herbicides examples: Gramoxone and glyphosate.

4. Fungicides: Fungicides play a key role in keeping a crop healthy from fungal disease which can have severe adverse effects on crop yield and quality. Fungicides are described as broad spectrum (e.g. effective on a wide range on fungi across the taxonomical groups) or specific (e.g. mildew-specific or mycete-specific fungicides). Afungicide can be:

a. Preventative: Prevents the establishment of infection.

b. Curative: Inhibits the development of an established infection which is not showing visible symptoms of disease.

c. Aneradicant: Inhibits the development of an established infection which is showing visible symptoms.

d. Anantisporulant: Prevents or reduces population without necessarily stopping vegetative growth. Fungicides examples: Mankocide.

5. Algaecides: Algaecides are chemical compounds whose active ingredients kill algae and/or prevent it from growing in your pool. Among the available algaecides, there are ones that have copper ions as the active ingredient, containing copper sulfate or a chelated copper ion, and algaecides that contain quaternary ammonium compounds (referred to as “quats”) or polymeric quaternary ammonium compounds (referred to as “poly-quats”).

6. Rodenticides: Rodenticides are pesticides that kill rodents. Rodents include not only rats and mice, but also squirrels, woodchucks, chipmunks, porcupines, nutria, and beavers. Rodents sometimes require control. They can damage crops, transmit disease, and in some cases cause ecological damage. Examples: Klerat.

7. Molluscicides: Molluscicides are pesticides which kill molluscs, an animal phylum of tens of thousands of invertebrate creatures. Molluscs include octopi and squid, as well as snails and slugs, which are usually targeted by molluscicides. Slugs and snails are well-known by farmers and gardeners as some of the most annoying and destructive pests. They can destroy the leaves and fruit of a large variety of plants, old and young.Examples: Slugit.

8. Nematicides: Nematodes attack the root system of plants and remove photo-assimilates and reduce the absorption capacity of water and nutrients of plant. Nematicides are applied to avoid economic losses of the crops. Examples: Furadan.

9. Fertilizers: Fertilizers are chemical substances supplied to the crops to increase their productivity. These are used by the farmers to increase the crops yield. The fertilizers contain the essential nutrients required by the plants including nitrogen, potassium, and phosphorus. They enhance the water retention capacity of the soil and also increase its fertility. Fertilisers can be categorized into two categories: organic and inorganic fertilisers. Organic fertilisers are naturally existing substances prepared through natural processes. Inorganic fertilisers, also referred to as synthetic fertilizers are manufactured artificially using chemical processes by utilizing natural deposits, which are altered chemically.

10. Soil conditioners: Some soils are poor like the soils having compaction and hard pan, with excessive clay, extremely sandy soil, dead and nutrient depleted soil, soil with high salt or chalk, rocky soil, and soil with extremely high or low pH.

Poor soil can restrict the water and nutrient uptake of plants, as well as restrict the root development causing plants to wilt, dry up, stunted and even die.

Soil conditioners are soil amendments that improve the soil structure by increasing aeration, water holding capacity, and nutrients. They loosen up compacted, hard pan and clay soils and release locked up nutrients. Soil conditioners can also raise or lower the pH levels depending on their constituent. Soil conditioners can be organic or inorganic, or a combination of synthetic and natural matter.

11. Liming and acidifying agents: Agricultural soils are commonly too acidic or too alkaline for the optimal growth of many crop species. When this is the case, liming and acidifying products are added to the soil to adjust its pH to a more appropriate range. When the soil is too acidic, calcite on the form of powdered limestone is added primarily, whereas for more alkaline soil sulphur compounds are added to neutralize.

Agrochemicals and their Effects

Although agrochemicals are initially used to improve crop’s health, overuse of these chemicals has now started affecting the environment in many ways. Excessive utilization of these chemicals generates residues that cause nutrients imbalance and reduction of the yielding capacity of crops.

1. Effects on soil: The massive use of inorganic fertilizers world-wide is associated with the accumulation of contaminants, e.g. arsenic (As), cadmium (Cd), fluorine (F), lead (Pb) and mercury (Hg) in agricultural soils.

a. May kill beneficial bacteria.
b. Increase nitrate level in soils.
c. Alter the pH of the soil.
d. Residual effect.
e. Kill soil organisms.
f. Toxicity and reduction in soil quality.
g. Structural deterioration.
h. Reduced water availability.
i. Toxic effects of salts.
j. Soil pollution.

2. Effects on water:

a. Water becomes unfit for consumption.
b. Agrochemicals diffusing in larger water bodies promote the growth of algae.
c. Leads to eutrophication due to excessive chemicals.
d. Affect aquatic animals due to water pollution.
e. Alter the chemical properties of water.

3. Effects on air:

a. Residues and particles of these chemicals diffuse in air and can lead to air pollution.
b. Pesticides drift happens when air carries agrochemicals particles from one place to other spreading their ill effects.
c. Depending on weather conditions, more amount of spray may evaporate due to low relative humidity and higher temperatures.
d. When the polluted air is inhaled by the surrounding organisms' their health is adversely affected.

4. Effects on human health:

a. It causes variety of health effects like skin and eyes irritation.
b. It also affects the nervous system, causes cancer and also reproductive problems.
c. Can cause nerve damage, infertility, hormones disorders and neurotoxicity.

Environmental exposure of humans to agrochemicals is common and results in both acute and chronic health effects, including acute and chronic neurotoxicity (insecticides, fungicides, fumigants), lung damage (parquat), chemical burns (anhydrous ammonia), and infant methemoglobinemia (nitrate in groundwater). A variety of cancers also have been linked to exposure to various pesticides, particularly hematopoietic cancers. Immunologic abnormalities and adverse reproductive and developmental effects due to pesticides also have been reported.

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Impact of Covid-19 on India's Agrifood Sector

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After announcing a lockdown, the Indian government was quick to declare agriculture as an essential sector. Implementation and enforcement in a country of 1.3 billion people comes with its challenges, such as maintaining smooth logistics and countering misinformation. However, the situation has also provided opportunities for innovative approaches, and may lead to lasting changes. When the corona crisis started, India's agriculture sector was on the way to recovery after three years of subdued prices. In the Indian economy, agriculture contributes 11 percent of the GDP but provides a livelihood for 52 percent of the working population.

Lockdown Period Coincided with Harvesting Season

As the lockdown announced, closure of public transport led to an exodus of labourers from big cities to their home villages. This coincided with the harvesting season of the winter crops in north and central India, which faced a record harvest after a good monsoon. However, wholesale markets were closed and there was a shortage of farm labourers. Additional economic activities were allowed in low-risk areas. Also, work activities under the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA; wage employment for households who volunteer to do unskilled manual work) were permitted.

Coronavirus Depresses Demand and Disrupts Supply

The lockdown immediately led to a drop in domestic demand and affected trade. Some farmers growing high value fruits and vegetables for up market restaurants and hotels but due to lockdown, they feed those products to their cattle or use them as manure. Vegetables prices decreased by 50 percent and may crash further, due to higher production and lack of labour and transportation. In many regions the government intervened.

1. Dairy showed a mixed picture: Following the lockdown, consumers initially crowded milk parlours to stock up. Amul, India's largest milk co-operative, announced an increase in production of dairy products. However, within a week milk prices started collapsing as office canteens, restaurants and sweet shops remained closed. Some milk was converted to skimmed milk powder and butter, of which there are now in large volumes in storage.

2. Poultry: The spread of misinformation about poultry being a source of COVID19 on social media heavily impacted consumption. The government countered the misinformation, but the losses between January and mid-February amount to USD 236 million. Sales of poultry meat went down with a staggering 80 percent, and prices for poultry meat were halved. Over a million small poultry farmers and over half a million persons working in the sector have become unemployed. This also impacted feed producers as poultry farmers cancelled orders, some farmers even burying their chickens alive. The poultry sector is predicted to roll back by the end of this year, although capital for new investments may remain limited for some time. The Poultry Federation of India has asked the government for support such as rescheduling of loans, promotion of frozen/cold chicken meat, cold storage, feed subsidies, and introduction of eggs in mid-day meal schemes. April already witnessed some recovery, with 60-70 percent movement of produce and raw material. In the near future, the sector is expected to focus more on online retail, hygienic, high quality food, traceability and labelling.

3. Chilled Products: Worried by the misinformation in the poultry sector, companies selling aerated beverages, ice-creams and juices recently urged the Food Safety and Standards Authority of India to clarify that chilled products are safe for consumption.

4. Processed food: Processed food companies ramped up production after the lockdown, as people are stocked up on (packaged) groceries. Modern retail, representing only 2.4 percent of grocery retail in India, benefited from this in the short term. However, regulations limiting store operations as well as disruptions in logistics and labour movement led to low inventory and sales. Private label branded products were introduced or their distribution ramped up. India's import of palm oil dropped by 58 percent in the month of March when compared to March 2019, due to lower horeca demand, logistics challenges and higher import duties. In general, there was a drop of 40 percent in edible oil processing, packaging and distribution due to labour shortage. Animal markets were closed and affected export of meat (products).

5. Fishing in troubled waters: According to the Central Institute of Fisheries Technology (CIFT), India's fishery sector made losses of around 28 million euros a day. As a result, about 700,000 tonnes of fish had to be thrown away. Currently, sailors are reluctant to leave their families during the lockdown. India's single biggest export commodity is shrimp. More than 90 percent of it is exported to major destinations like US and China with 42 percent and 25 percent respectively and then to EU, South East Asia and Japan. With 80 percent of brooders (mother prawns) imported from the US, the lockdown has hit production in hatcheries of Andhra Pradesh; prompting the Andhra Pradesh government to set up an Aquaculture Authority to monitor the hatcheries from seed to marketing, and to offer a Minimum Selling Price.

6. Floriculture impacted as weddings are postponed: In India, flowers are primarily used for weddings and religious ceremonies. The wedding season runs from February until May and in November and December. The wedding industry turnover is around USD 40–50 billion and among the biggest sources of income for the floriculture sector. As COVID19 led to weddings being postponed, flower growers along with companies that produce planting materials suffered financial losses. With no social and religious gatherings taking place, domestic demand for flowers stopped almost completely. Export of roses to the Gulf States was also hit by an import ban.

7. Inputs: Record fertilizer sales were witnessed during the lockdown period in the month of April. The forecast of a normal monsoon this year would normally increase the crop area and the consumption of fertilizers. However, if the lockdown persists, there may be a reduction in cropping area due to the unavailability of labour and agribusiness inputs as well as logistical challenges and limited capital for inputs (also due to lower remittances as workers return from cities). This shows the importance of having access to and relations in various parts of the country. Bayer recently joined hands with Pune-based e-commerce firm for farm inputs 'AgroStar' for home delivery of seeds and crop protection products in Central, Northern and Western India.

Support Schemes and Food Security

With a history of famines still fresh in the minds of many Indian policy makers; food supply remains a major concern for the government. Over the last 40 days, there were sufficient food reserves and food prices did not shoot up drastically. Most people who did not have any earning were able to get food. The government via the National Food Security Act and Public Distribution System has assured additional food grains for 3 months to around 800 million beneficiaries, although reaching all beneficiaries is a challenge. Farmers also receive some financial support. This is also important as farmers and rural labourers have a high marginal propensity to consume. However, most Indian states witnessed a decline in revenue of between 30 to 60 percent for March, and many states are borrowing from bonds market.

No Force on Earth can Stop an Idea

Following COVID19, India has accelerated (digital) innovations such as the eNAM (electronic National Agriculture Market); a pan-India electronic trading platform for farmers. The government plans to connect all markets to the platform in financial year 2021-22. The Indian government has also recommended that states suspend some provisions of the Agricultural Produce Marketing Committees Acts to encourage direct selling by farmers of crops rather than going to rural wholesale markets ('mandis'). The government launched an app which helps farmers and traders find transport vehicles ('uberization' of farm produce transport). The lockdown was expected to lead to a change in cropping practices. For example, the Punjab government encouraged its farmers to shift to maize and cotton instead of the labour-intensive paddy rice, as migratory labourers have returned to their home states. The Punjab government will also provide a subsidy of up to 50 percent on purchase of paddy/maize sowing machinery to save groundwater and help farmers deal with labour scarcity.

Conclusion

Time will tell how the Indian economy will be impacted by COVID19 and the measures taken. It is expected that India will remain among the world's fastest growing economies. According to Nielsen India, urban Indian consumers are likely to cut spending on discretionary items (restaurants, luxury brands, etc.) in the coming months but spending will increase on organic food and fitness. Consumers are expected to increasingly demand safety-branded food, and buy animal proteins from the organized sector rather than wet markets. Ready to eat /easy to cook products will also become popular, as out of home consumption will be restricted. Packaging is likely to adapt to smaller households and convenience products. This is the time to present solutions that connect farmers to consumers and to labourers or machines. In times to come, we will understand more about the global impact of COVID19.

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Biosensors: The Future of Agro-Defence?

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Introduction

Most countries have some sort of agriculture department working hard to protect the quality and safety of its food supplies. Biosensor technology can improve the productivity, safety, cost and efficiency of both livestock production and crop cultivation, lessen the environmental impact of food production, and improve the safety and welfare of animals and consumers. Fortunately, science and engineering are providing new tools to fight diseases, both old and new. One of the more promising and exciting technologies under development are biosensors-a part of a new field of study called bio nanotechnology. Biosensors, coupled with new diagnostic and detection methods, will allow the agricultural industry stay a step ahead of new and dangerous diseases.

The quality of food is fundamentally based on the biochemical configuration of food. Hence forth recent advances in the fabrication of different types of Biosensors that have been designed for the assessment of various components in the highly perishable agricultural procedures are required of today's era. However, in the area of analytical chemistry, it plays a crucial role in food quality aspects because of almost each and individual sector associated with quality control. A food quality biosensor is a nano-scale or micro-scale device, which can stimulus to some specific property or properties of food and transforms threesomes into a detectable signal, often an electric signal. This signal may provide direct details about the quality parameter to be measured or may have a known relation to that. An immobilized biological material which uses by a sensor could be an enzyme, antibody, nucleic acid, hormone, in a self-contained device. To satisfy the consumer and regulatory requirements and to revive the production feasibility, standard sorting, automation and demotion of production cost and time, eventually could be the vital intention of this technology.

What are Biosensors?

A biosensor is a unit that uses both biological and chemical components to detect the presence of a targeted substance, such as bacteria or toxins. The easiest way to explain this is that it's simply a modern version of the canary in a cage, used by miners in past times to detect poisonous gases in caverns.

Another example might be using a rabbit to determine if a woman is pregnant or not. These are very simplistic examples, but they work the same way. A biological component that is known to react with a given substance is introduced to the sample material, and the reaction is measured using an electronic, visual or chemical device that can be read by humans.

Biosensors are Made Up of Three Components

1. A bio receptor, which is something that will react to a target substance in a known way-sort of like a piece of litmus paper changing colour to indicate the pH or acidity of a given substance.
2. A bio transducer, which converts the biological reaction into something easily and quickly detectable by humans, such as an electronic signal, fluorescence, thermal, etc.
3. An electronic device that can read the signal, such as a computer, monitor, oscilloscope, etc.

Bio Receptors Can be of Several Types, Depending on the Types of Reactions they Cause, and the Material Used as the Bio Receptor

1. Antibody / Antigen: Antibodies bind with the molecules they are designed to interact with, like a lock and key, making them very specific. In classic medicine, diseases are detected by the presence of the antibodies designed to bind with them. Unfortunately, by this time it may be too late to prevent the disease. Using them as biosensors greatly reduces the time it takes for early detection.

2. Enzymatic: Enzymes cause specific reactions with specific substances, and they do it very quickly. A good example is the way catalase breaks down hydrogen peroxide into water and oxygen. These reactions are measurable and can be quickly obtained.

3. Nucleic acids / DNA: This one is difficult to explain without getting too technical. Basically, if you know which DNA sequence you are looking for, you can synthesize a similar hybrid, give it a radioactive marker, and then use it to find similar sequences in the target material, which will generate an optical signal.

4. Cellular: No, I'm not talking about using a smart phone as a bio receptor, (but that would be cool). Cells, organelles, and tissues are very sensitive to surrounding environments, and their reactions can be quickly measured.

5. Other materials are currently in development.

Bio transducers convert the reactions from the bio receptors into different signals such as electrical current; visual signals such as light, or fluorescence; or a thermal signal such as a rise or drop in temperature. Just as a hypothetical example, let's say we've introduced an enzyme that reacts with components of the anthrax bacillus shell coating into a dairy cow. We can't see the effect with the naked eye, but a bio transducer converts the reaction into a small electrical charge through ionization that is proportional to the degree of infection. We can now measure that electrical current and not only see that there is an infection present, but how far it has progressed. And this is all immediate, without having to wait for lab results to come back from somewhere miles and miles away. We can know within minutes what we are dealing with, and can protect the rest of the herd. Of course, this is just a theoretical example, but similar bio transducers are being used right now. The final component is the method used to read the signals. A signal is useless if it cannot be read. So, a computer, voltmeter, oscilloscope, or other appropriate device is used by the technician to both read and measure the results. These can be recorded so that progress can be tracked, and also used for future reference.

The Advantages of Biosensors

The classic method of detecting harmful biological or chemical substances is to take a sample, and either put it in a petri dish with some auger and see what grows, or use various chemical reactions, one at a time, and observe what happens. Taking samples from a herd of 1000 cows, labelling them, and waiting for each sample to grow something can take weeks, or even months, and be very expensive. In addition, the testing cannot be done on site, or in the field. The samples have to be sent off for testing to a lab somewhere. Biosensors can speed up the process exponentially, be more accurate, cheaper, and some can even be used on site. Biosensors can measure substances that are not able to be estimated by other more conventional methods. The ultimate goal is to combine and miniaturize the units so that, eventually, they will have one unit that samples, analyses, and measures, all on one small electronic chip that can be taken anywhere. Imagine how fast and efficient it would be if you could take a sample from a cow or chicken in mere minutes, get the results while you are standing there, and immediately share those results with other livestock producers, food inspectors, processing plants, or anyone else with a need to know.

Biosensors and Agricultural Safety

According to the World Health Organization (WHO), over 600 million people suffer from food-borne illnesses every year, resulting in over 200,000 deaths annually, many of them children. (WHO Fact sheet N°399 December 2015).

Food-borne illnesses cost over 152 billion dollars annually, just in the United States, in the form of healthcare, workplace, and other economic losses. Food-borne illnesses place a huge burden on already stressed healthcare systems, and cost farmers and food producers dearly. Another area of concern is the increased incidences of food allergies, such as to peanuts and gluten. Biosensors can detect the presence of allergens just as easily as they can other food contaminants. Bio nanotechnology is a major step towards addressing all of these problems.

The ability to sample, test, and evaluate possible sources, in the field, before they become a problem, would greatly reduce risks to consumers and producers alike. Being able to get results instantly would also provide enhanced national security, since food-borne disease-causing microbes can also be used as bio-weapons.

Biosensors can be used along with technologies such as smart phones, iPads, and other mobile devices, in conjunction with the internet, to provide instantaneous transmission of information and results, as well as things like remote and continuous testing. Biosensor technology can provide information that can be shared immediately with farmers, livestock producers, distributors, agricultural inspectors, law enforcement and national security agencies, etc.

There are three main areas of concern; dairy, poultry, and pork. Development is underway on biosensor systems for things like early detection and management of melamine contamination in dairy products, food allergens in processing facilities, metabolic diseases in dairy cows, avian flu in poultry, infections in animal wounds, 3D Imaging for biological systems, biosensor systems for continuous monitoring of food quality that can be deployed in food storage facilities, and grain bins etc., screening for genetic disorders, and much more. It won't be long before we are able to continuously monitor the status of our food supplies in real time.

The Future of Biosensor Tech

The world population is growing, and every year it creates more demand on the world's food supplies. This puts added strain on the environment, and it is becoming increasingly important to develop better, more sustainable methods of providing food along the entire supply chain, from the crop and livestock cultivators, to processing, transportation, storage, and ultimately, the consumer. Biosensor technology can provide complete control over every step of the supply chain. Bio nanotechnology can analyse the food quality and safety while allowing for less CO_2 emissions, less greenhouse gasses, reduced pesticide, antibiotic and steroid use, and also monitor the quality of the soil and general environment the food is produced in. Bio nanotechnology is on the cutting edge, and the market for it has grown from 98.2 billion dollars (US) in 2006, to over 180 billion (US) in 2016. A very large part of this market is for creating safe, sustainable food supplies for the world. Biosensors are being developed, or in some cases, already deployed, to monitor crops, soil analysis, pesticides and other contaminants, and even the very composition of the food itself, such as vitamin content, and quality of sugars, etc. Other uses are monitoring the use of water for better management, managing excesses and waste, creating smart packaging that continuously monitors food quality, robotic analytical tools, etc. Coupled with new advances in micro technology and microfluidics, it will be possible to develop new low-cost, ready-to-use systems, sort of like a complete lab on a single computer chip. Wearable biosensors are in development for continuously monitoring the health and status of livestock. Wearable sensors can allow a livestock producer to be alerted as soon as an animal becomes infected, allowing it to be culled from the herd before it can infect other animals. Electronic leg bands are also being tested which monitor cattle feeding and milking behaviours and patterns. These are just some of the new and exciting things that are currently under development.

The future looks bright for the establishment of technologies using biosensors to be able to have a significant effect on the safety, efficiency, and productivity of agricultural and veterinary concerns, as well as going a long way towards helping to protect the environment, reducing the evolution of resistant strains of harmful microbes, and allowing for much more rapid response to the emergence of new and deadly diseases.

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Nutritive Value Aspects of Amaranthus Leaves: Taxonomic Tree

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Introduction

The family Amaranthaceae is generally considered as the "amaranth family." The word Amaranthus is basically derived from the Greek word "anthos" (flower) which means everlasting or unwilling. Amaranthus is a dicotyledonous pseudocereal and one of the New World's oldest crops, having originated in Mesoamerica. Amaranth (Amaranthus spp.) has been Inca, Maya, and Aztec civilizations. Since it is high in iron content and dietary fibre, it is good for anaemic patients, and reduces cholesterol and risks of cardiovascular diseases. According to Ayurveda, the juice extracted from amaranth leaves help in treating diarrhoea and body attack conditions. It is packed with carbohydrates, proteins, minerals and vitamins, and regular consumption helps in easing digestion, excessive menstruation and weight management. These leaves are also deemed to be an effective measure against hair loss and premature greying. They act as a natural astringent and work wonders for skin problems like eczema and acne. Amaranth leaves are also known as (chaulai). Loaded with vitamins and essential minerals, it is the best way of fuelling up on the season's best offerings. While palak (spinach), methi (fenugreek), hari piyaj (spring onions) et al top the popularity chart, there are a few that stay far away from the spotlight but are as nutritious and flavourful.

Nutritional Facts of Amaranthus Leaves

Amaranth leaves are loaded with vitamins and minerals. This is given below table-

Nutritional value per 100 gm.

Vitamins:	
Thiamine	0.116mg (10% of Recommended Dietary Allowance)
Niacin	0.923mg (6% of RDA)
Riboflavin	0.2mg (17% of RDA)
Vitamin B6	0.591mg (45% of RDA)
Folate	82µg (21% of RDA)
Vitamin C	4.2mg (5% of RDA)
Vitamin E	1.19 mg (8% of RDA)

Minerals:	
Calcium	159mg (16% of RDA)
Iron	7.61mg (59% of RDA)
Magnesium	248mg (70% of RDA)
Manganese	3.333mg (159% of RDA)
Phosphorus	557mg (80% of RDA)
Potassium	508 mg (11% of RDA)
Zinc	2.87mg (30% of RDA)
Energy	1,554 KJ (371 Kcal)
Carbohydrates	65.25g
Fat	7.02 g
Protein	13.56g

Health Benefits of Amaranth Leaves

1. Strengthen Body Bones: Calcium is the most important mineral for preventing demineralization of the bones.

2. Improves Digestion: Amaranth leaves are loaded with high fibre content and they are a source of amino acids which help to improve digestive health and reduce constipation.

3. Helps Manage Weight: Vitamins, minerals, proteins and other nutrients are present in the Amaranth leaves which help to reduce insulin levels in the blood and also releases a hormone.

4. Cardiovascular Disease: Fibre present in the Amaranth leaves helps to reduce bad cholesterol and the risk of heart diseases.

5. Promotes Electrolyte Balance: Iron, copper, calcium, potassium, phosphorus and magnesium present in the Amaranth leaves help to maintain necessary balance of electrolytes in human body.

6. Prevents Macular Degeneration (Eye Care): Amaranth leaves have vitamin a help to prevent macular degeneration and stop the development of cataracts and keep vision healthy.

Conclusion

Amaranth is considered as a millennium super-food with high nutraceutical values as it is used for several clinical/medical applications because it is a reasonably well-balanced food with functional properties that have been shown to provide clinical/medicinal benefits. Kidney stones or gallstones, amaranth could worse these conditions because amaranth leaves contain moderate levels of oxalates. existing evidence suggests that nutrition, especially staple-based foods such as amaranth, when part of a balanced pattern, contributes with important protein, polyunsaturated fatty acids, minerals (calcium, zinc, iron, magnesium, and manganese, among other minerals), appropriate dietary fibre, vitamins, and antioxidants that can help mitigate or reduce the risk of several diseases.

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Mulching : Definition, Types and it's Advantage in Crop Production

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Introduction

Mulching is a water-saving technique in dryland area for conserving soil moisture, regulating temperature and reducing soil evaporation (Yang et al., 2015; Kader et al., 2017). The word mulch has been probably derived from the German word "molsch" means soft to decay, which apparently referred to the use of straw and leaves by gardeners as a spread over the ground as mulch (Jacks et al., 1955).

Mulches are used in agriculture for water conservation and erosion control are the most important objectives particularly in arid and semi-arid regions. Mulching is an important agronomic practice in agriculture which acts as a barrier to evaporation, soil temperature could be raised or reduced depending on growing season and crop requirement, higher yield and quality, less infestation of insect and disease, prolonged growing season, higher nutritive value of the produce, improved storage ability etc. transfer of vapor or heat from the soil. Mulching is done with crop residues, polythene paper, ordinary paper, gravel, concrete etc.

Definition

Mulch technical term means 'covering of soil'. Mulch is defined as a coating material spread over the soil surface (Kasirajan and Ngouajio, 2012). It can be either organic or inorganic/synthetic.

Mulching may Broadly be Categorized Into

1. Live mulch: It is a living cover of crop. Usually a legume crops the best choice for live mulch. It is practised in food crops and fruit and plantation crops. Intercrop having good weed smothering ability can also be introduced in inter-rows of an economic crop.

2. Dead mulch: It may again be sub-divided into:

- a. Organic mulches such as:
  - i. Residue mulch (dry residues of plants crops, e.g. straw stover, groundnut shells, sawdust, grass clippings, banana pseudo-stems, sugarcane trash, bark from trees, etc.).
  - ii. Organic matter mulch, e.g. compost, FYM, sludge.
- b. Synthetic mulch, e.g. polyethene film, polyester sheet, latex and starch resin spray mulches.
- c. Soil/dust mulch (no material put to the surface, but few centimetres of surface is disturbed to prevent capillary evaporation in dry semi-arid areas; less useful for weed control).

Organic Mulch

Organic mulch refers to a mulch material that readily decomposes over time, such as leaves, straw, hay, shredded bark, etc. Organic mulches are important for the plant and the soil itself. The mulches act as manure on decomposition, which provide the plant with nutrients. These nutrients are necessary for the soil itself and for the plants.

Inorganic Mulch

Inorganic mulch is different from organic mulch because it is made up of inert materials that cannot decompose over time. Examples include gravels, plastic sheeting, rocks, etc. (Qin et al., 2015).

Advantages of Mulching

1. Improve soil condition: Mulching helps to improves the physical conditions, chemical environment and biological activities of the soil.

2. To help maintenance sustainability and suitability of soil: Mulching is important when maintaining the sustainability and suitability of soil. Mulching is of great importance, as the equilibrium level of the soil's organic matter depends on the balance between input through plant residues and other bio-solids and output through decomposition, erosion, and leaching (Mulumba and Lal, 2008).

3. Soil moisture content: Mulch has a great role in soil moisture conservation through modification of microclimatic soil conditions. Mulch increase soil moisture through increasing infiltration, reducing evaporation, and modifying water retention capacity of the soil.

4. To help control soil erosion: Mulching reduces the deterioration of soil by way of preventing the runoff and Soil loss. Mulching practices to reduce soil erosion include any system that increase surface residues.

5. Mulching enhances the growth and yield of crops: Mulching improves soil aeration around the plant, aggregates the soil particles and adds nutrients to the soil covers soil and performs physical pressure to the weeds.

6. Mulching minimizes the weed infestation: The major aim of mulching is to cut off the light to the weeds and to suppress their growth. Since every type of the mulch

7. Maintain optimal soil temperature: It helps to control of soil temperature fluctuations. Mulch insulates soil helping to provide a buffer from heat and cold temperatures.

8. Reduce runoff losses: Mulches spread over soil, slow down rainwater run-off and increase the amount of water that soaks into the soil. And more water in the soil means more water for the crops.

9. Increase nutrient availability: Mulches adds nutrients to the soil and ultimately enhances the soil fertility and productivity. The decomposition of organic residues under plastic mulch adds organic acids to the soil resulting in low soil pH, which may increase the bioavailability of micronutrients.

Conclusion

Mulching not only helps in protecting the plant roots from frosting, intense heat, and nutrient loss, but also in stabilizing the ecology by defending the plants from stress, strain, and shock from various internal and external factors. The mulch material protects soil surface from sunlight which reduces evaporation by preserving soil water and altering soil temperature. Therefore, it is concluded that the various mulching material uses can save the water resources in agriculture which lead to improve crop yield in rain-fed cultivation.

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Loop Mediated Isothermal Amplification (LAMP) – An Alternative to Polymerase Chain Reaction (PCR)

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Introduction

1. A Loop-mediated isothermal amplification (LAMP) is a simple, rapid, specific and cost-effective nucleic acid amplification method when compared to PCR (Polymerase Chain Reaction), nucleic acid sequence-based amplification, self-sustained sequence replication and strand displacement amplification. (Fakruddin, 2011).

2. This technique uses DNA polymerase and a set of four primer that are specially designed that recognize total six different targets sequences on DNA template.

3. In LAMP, a large amount of DNA is synthesized, yielding a large pyrophosphate ion by-product.

4. It is an established nucleic acid amplification method offering rapid, accurate, and cost-effective diagnosis of infectious diseases.

History

1. Till today several amplification methods have been developed already i.e.,
   a. Nucleic Acid Sequence Based Amplification (NASBA) (Compton, 1991).
   b. Polymerase Chain Reaction (PCR) (Saiki et al., 1985).
   c. Rolling Circle Amplification (RCA) (Lizardi et al., 1998).
   d. Self-Sustained Sequence Replication (3SR) (Guatelli et al., 1990).
   e. Strand Displacement Amplification (SDA) (Walker et al., 1992).

2. All of above listed techniques are able to amplify targets gene or sequence by manifold of order using its own particular mechanism to re-initiate new rounds of DNA synthesis or DNA replication.

3. But still have many shortcomings, including the requirement of precision instruments and elaborate methods for product detection.

3. LAMP is a novel nucleic acid amplification method developed by Notomi et al. (2000) which amplifies DNA with high specificity, sensitivity and rapidity under isothermal condition using a set of four specially designed primers and a Best DNA polymerase.

What it is?

1. For over 30 years, the gold standard for detecting DNA and other nucleic acids has been PCR (the Polymerase Chain Reaction).

2. In PCR, an enzyme called DNA polymerase makes exponential copies of a target DNA molecule. Much of modern biology and medicine depends on DNA amplification by PCR, for example to identify species, diagnose infections, or to detect contamination of a food or water source.

3. The catch is, DNA amplification by PCR requires cycles of heating and cooling, usually 30 thermal cycles, to generate enough DNA for detection.

4. Like PCR, LAMP (loop-mediated isothermal amplification) produces many copies of a specific region of the genome from a tiny amount of starting material.

5. However, LAMP does not require thermal cycling; amplification occurs at a constant temperature (usually between 60 and 65 degrees Celsius). LAMP can be used for creating quick and portable genetic tests that can be carried out using simple equipment, such as a heater or water bath.

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How it Works? / Mechanism of LAMP

1. LAMP works at a single temperature (isothermal) using DNA polymerases that can read through double-stranded DNA without the need for heat to open up the double helix ("strand displacement" activity).

2. To start the copy reaction, LAMP uses specially designed primers (short pieces of DNA complementary to the target) that form stem-like "loop" structures.

3. These loops allow the polymerase to initiate DNA copy reactions at multiple locations, creating large amounts of DNA in a short period of time.

4. As opposed to PCR which typically uses just one pair of primers, LAMP makes use of 2 or 3 sets of primers.

5. LAMP relies on auto-cycling strand displacement DNA synthesis which is carried out the temperature of 60 to 65 °C for 45-60 min in the presence of Bst DNA polymerase, dNTPs, specific primers and the target DNA template.

6. The mechanism of the LAMP amplification reaction as illustrated in Figure 1 and 2 includes three steps: production of starting material, cycling amplification and elongation, and recycling (Notomi et al. 2000).

7. To produce the starting material, inner primer FIB hybridizes to F2c in the target DNA and initiates complementary strand synthesis.

8. Outer primer F3 hybridizes to F3c in the target and initiates strand displacement DNA synthesis, releasing a FIP-linked complementary strand, which forms a looped-out structure at one end.

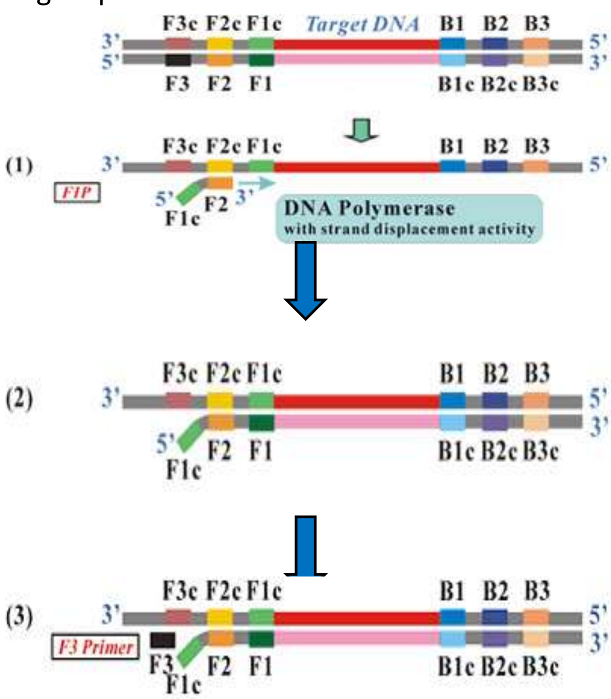
9. This single stranded DNA serves as template for BIP-initiated DNA synthesis and subsequent B3-primed strand displacement DNA synthesis leading to the production of a dumb-bell form DNA which is quickly converted to a stem –loop DNA.

10. This then serves as the starting material for LAMP cycling, the second stage of the LAMP reactions.

11. During cycling amplification, FIP hybridizes to the loop in the stem-loop DNA and primes strand displacement DNA synthesis, generating as an intermediate one gapped stem loop DNA with an additional inverted copy of the target sequence in the stem, and a loop formed at the opposite end via the BIP sequence.

12. Subsequent self-primed strand displacement DNA synthesis yields one complementary structure of the original stem-loop DNA and one gap repaired stem-loop DNA with a stem elongated to twice as long and a loop at the opposite end.

13. Both of these products then serve as templates for BIP-primed strand displacement in the subsequent cycles, the elongation and recycling step.



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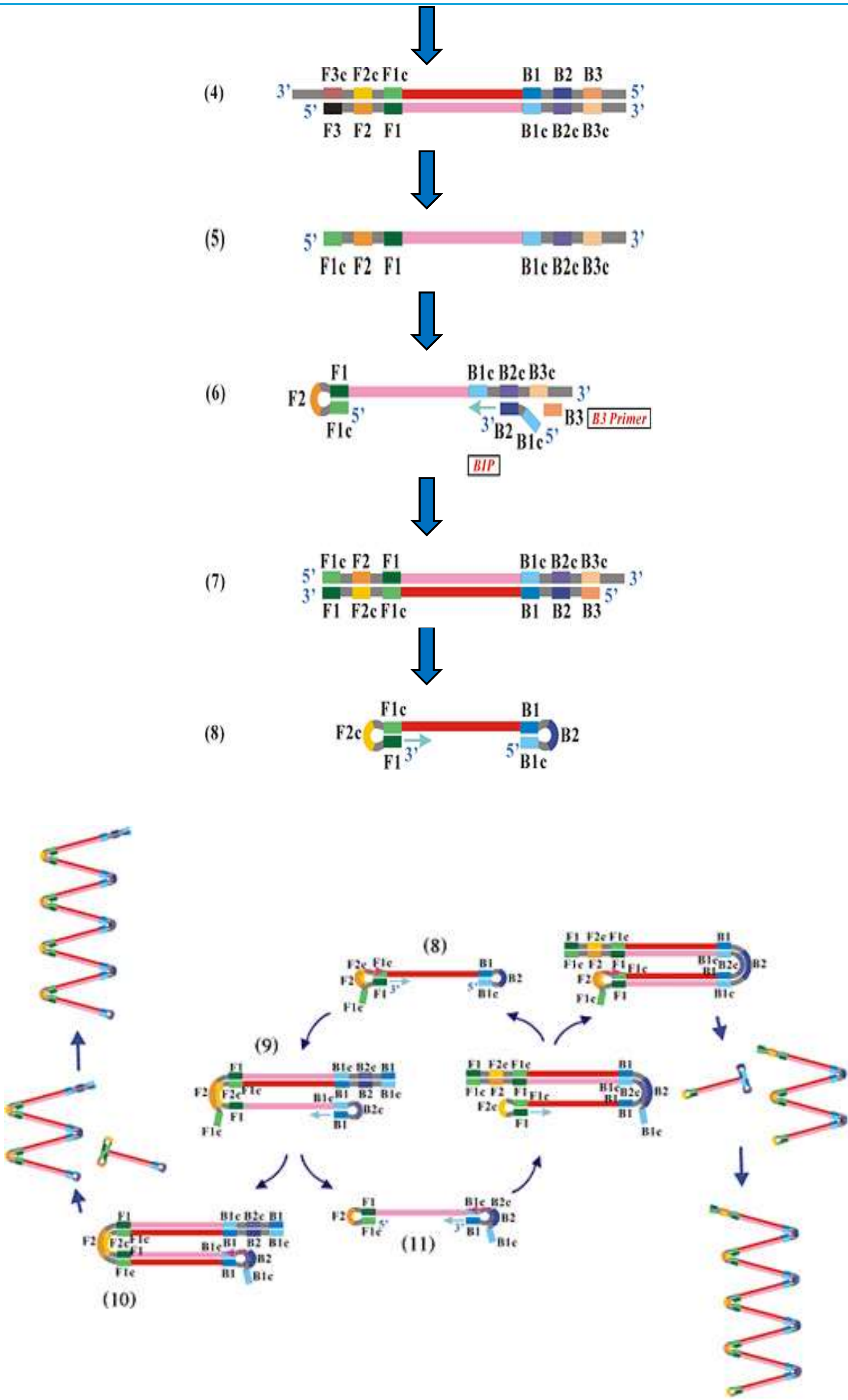

Fig 2

14. The final product is a mixture of stemloop DNA with various stem length and cauliflower-like structures with multiple loops formed by annealing between alternately inverted repeats of the target sequence in the same strand (Notomi et al. 2000) see fig 2.

15. Unlike PCR which makes billions of identical copies of DNA, the final products of LAMP are stem-loop DNAs of various lengths and cauliflower-like structures with multiple loops, adding up to a remarkable amount of DNA!

The Future

1. LAMP is already being used for easy detection of DNA targets in new places, from farms to doctors' offices.
2. It has the potential to bring fast and simple genetic tests to detect disease in field settings.
3. Teams of researchers are using LAMP to diagnose infectious diseases in humans (e.g. malaria) and plants (e.g. fungal infections) directly in the field with minimal instrumentation.
4. Very recently, thanks to Genes in Space, LAMP was successfully used aboard the International Space Station (ISS).
5. Up on the ISS, a colorimetric LAMP experiment designed by high school student Julian Rubinfien enabled astronauts to directly detect DNA targets simply by reading the colour of the tubes, using a mini PCR machine to incubate the samples!

Test platform Using LAMP Could Fulfil WHO's Recommended ASSURED Characteristics

1. Affordable.
2. Sensitive.
3. Specific.
4. User friendly.
5. Robust and rapid.
6. Equipment free.
7. Deliverable to end user.

Table: Comparison Between PCR and LAMP

Sr. No.	Specification	PCR	LAMP
1.	Temperature	Require different temperature to carry out cycling	Require iso-thermal (single) temperature to carry out cycling
2.	Primer	Requires two primers	Requires six primers
3.	Speed	Slow (Typically > 1hr)	Rapid (Typically < 30 min)
4.	Yield	Typical yield ~ 0.2 µg	Typical yield ~ 10–20 µg
5.	Visual detection	Not amenable to visual detection	Amenable to visual detection based on turbidity etc.
6.	Multiplexity	Possible	Difficult
7.	Other	Sensitive to sample matrix inhibitors	Tolerant to sample matrix inhibitors

Advantages

1. Sensitivity, specificity, high efficiency, rapidity and simplicity.
2. Good molecular technique for identifying some infectious diseases.
3. Amplification is performed under isothermal conditions.
4. Possible to obtain high amplification efficiency.
5. Reduced time loss of thermal change.
6. No need for expensive and complicated equipment such as a thermal cycler.
7. The process may be performed simply in a heating block or water bath.
8. High specificity is obtained because of the use of 4-6 primers spanning 6-8 distinct sequences and all target genes must be present in order to initiate amplification.

9. Method is rapid and simple
10. Amplification and detection may be carried out in one single tube.
11. Gene amplification products can be detected not only by agarose gel electrophoresis and real-time monitoring in an inexpensive turbidimeter
12. Gene amplification products can visualize by naked eye, either as turbidity or in the form of a colour change.

Disadvantages

1. The primer designing for LAMP is quite complicated, because it is essential to design 4-6 specific primers.
2. LAMP is inadequate for the detection of unknown or unsequenced targets.
3. For the LAMP, multiplexity is difficult as compared to PCR.

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Want to Boost the Immune System to Fight Corona? Use 'These' Ayurvedic Medicine!

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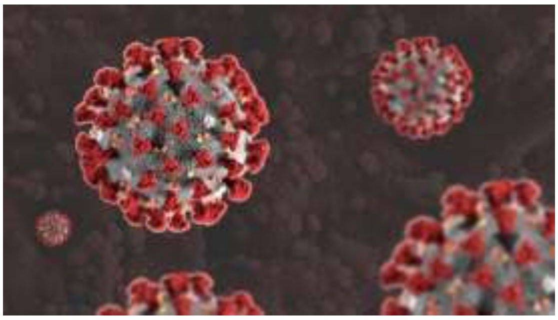


We use a lot of foods in our diet to boost our immune system. In this article we are going to tell you the easy way to boost the immune system by using medicines!

You find vital nutrients the best way to improve the immune system! And the more the food is healthy and right, the better the immune system is willing to do so. Particularly, foods high in vitamin C should be consumed. Such compounds serve as antioxidants to strengthen the immune response of the body. Ayurveda also prescribes a variety of foods and methods for the body's immune response to improve.

Individuals above the age of 35 are the most often diagnosed with the corona virus, according to the World Health Organization. The immune response of the body starts to weaken after 35 years. The corona virus also affects individuals more easily in this age group. Yet small children's tolerance is stronger. Young children experience issues with colds and coughs quickly. The corona virus is also not known to influence young children.

The incidence of corona virus is lower in young children. However, physicians prescribe that children's health be taken into consideration. Babies should wash their hands after dining out thoroughly. It is always recommended to take medications only on the recommendation of a doctor if the environment is cold or cough. More treatment is required in particular for those with poor immunity, pregnant women and cancer patients.

Who is Most at Risk for Corona Virus?

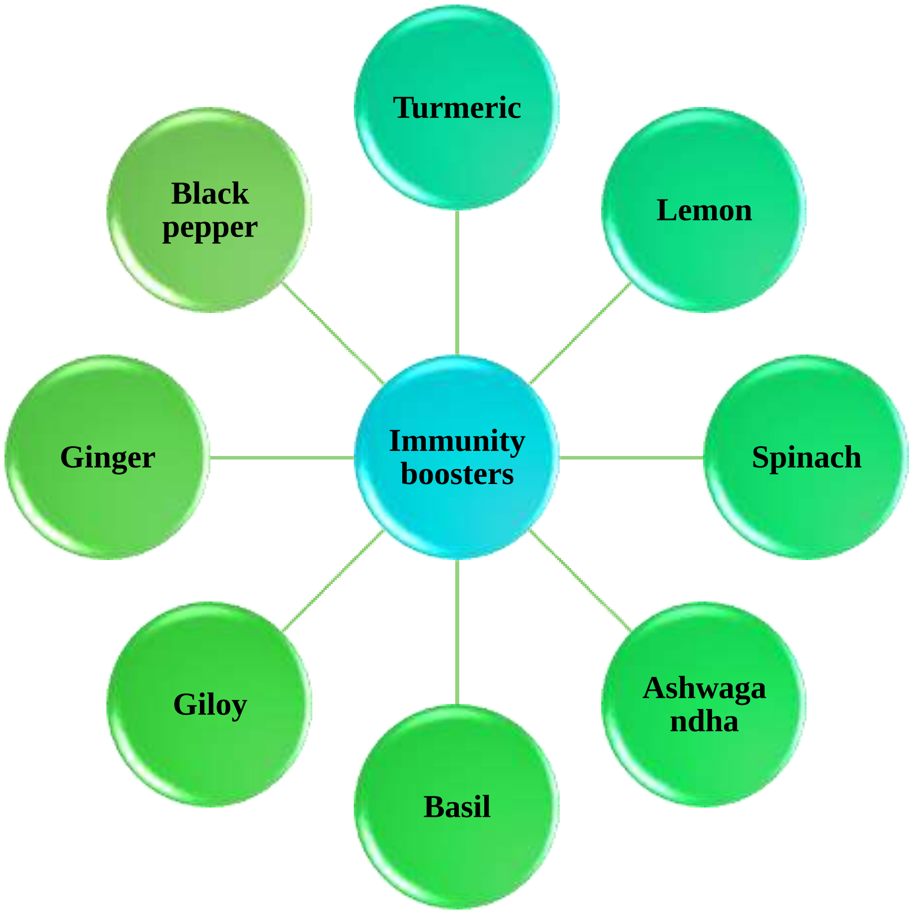
People with low immunity are most at risk. In addition, pregnant women, cancer patients, HIV patients, and patients undergoing chemotherapy need special care. If such persons start experiencing slight discomfort, they should seek immediate treatment. Millions of people in many countries have been infected with the corona virus since the outbreak of the corona virus.

The growing prevalence of corona has become a matter of concern. No vaccine has yet been obtained to control corona. Scientists around the world are working to find a vaccine. No concrete information has yet emerged as to who may or may not have corona. But scientists around the world are studying it and making different discoveries. People who are bald have a higher risk of corona virus and may have a higher risk of death; scientists say. Because androgen hormones are responsible for hair loss. This hormone has been linked to many serious cases of the corona virus.

According to the Daily Mail, Carlos Wambier, a professor and head of research at Brown University in the United States, told the British Telegraph that baldness could pose a serious threat to the corona. Earlier statistics had revealed that men who fell ill due to corona were more likely to die than women.

"We think androgens act as a gateway for the virus to enter the body," said Professor Wambier. In Spain, they studied it in 2 patients. In both cases, it was revealed that the incidence of baldness is higher among hospitalized corona sufferers. A study of 122 patients admitted to three hospitals in Madrid found that 79 percent of those who tested positive for corona had baldness.

The study is published in the Journal of the American Academy of Dermatology. A second study of 41 patients



in Spain found that 71 percent of corona patients had baldness. Therefore, bald people need to be more careful to avoid the risk of corona virus. Ayurveda mentions certain medicines which, if taken regularly, make the immune system work better. We can use the spices mentioned in Ayurveda to boost the immune system. These spices are also a major part of your diet, making them easy to consume. Today we will learn about similar home remedies mentioned in Ayurveda.

Immunity Boosters

1. Turmeric: Turmeric should be included in the diet to boost the immune system. You can also use turmeric to clean fruits and vegetables. Turmeric has anti-bacterial properties. This ingredient helps in destroying micro-organisms on fruits as well as vegetables. After buying fruits and vegetables, first heat the water as required and mix a teaspoon of turmeric in it. Soak fruits and vegetables in hot water for an hour and take out. Vegetables are very important in the meal. Because leafy vegetables keep you healthy. Many leafy vegetables boost your immune system. Some of these vegetables are also healthy. Vitamin C acts as an antioxidant and boosts your immune system.

2. Lemon: Lemon is considered to be the largest and best ingredient of Vitamin C. This is why most people squeeze lemon water after a meal. To get Vitamin C, you can include lemon in your daily diet in many ways.

3. Spinach: Spinach helps in boosting the immune system. Spinach is considered to be a beneficial leafy vegetable in terms of increasing haemoglobin. But very few people should know that in addition to this, there are many other medicinal properties found in spinach. The botanical name of spinach is *Spinacea oleracea*. The qualities found in spinach are not found in ordinary vegetables. This is the reason why spinach is extremely useful, affordable and affordable in terms of health. Spinach is a very healthy vegetable for pregnant women as it contains carotene, folic acid and vitamin C. Spinach milk can also be a substitute. Those who do not like milk should eat a variety of foods made from spinach.

4. Ashwagandha: Ashwagandha is a medicine that is mostly used by the elderly. Consumption of Ashwagandha has also increased as it is considered useful in the ongoing corona crisis. You can consume ashwagandha with milk to boost your immune system. Many studies have shown that consuming ashwagandha helps in strengthening the immune system. Apart from this, this medicine is also useful for relieving stress and insomnia and increasing the sexual capacity of men.

5. Basil: Basil is present in every home. Basil is also considered to be very useful for your health. Basil leaves have some special properties that help boost the body's immune system. Many researches have also concluded that if basil leaves are consumed with honey, the immune system is greatly enhanced.

6. Giloy: You can easily get it in the form of capsules or green leaves. Various parts of the plant are also used in many medicines to boost the immune system. Giloy plant is a completely medicinal plant and every part of it is a panacea for various problems and ailments. Giloy is one of the medicinal plants released by the Ministry of AYUSH to prevent the spread of Corona virus. You can also drink the juice of its leaves.

7. Ginger: Ginger has been used since ancient times to treat common ailments such as colds, coughs and fevers. It is also recommended in Ayurveda as it has many health benefits. Ginger contains anti-bacterial, anti-inflammatory and antioxidant activities that not only help strengthen the immune system but also protect immune cells from weakening. If possible, you can make ginger tea and consume it. Some people even eat ginger with jaggery. So here are some simple ways to boost your immune system, so consume these foods and stay healthy.

8. Black pepper: Right now, the crisis of the Corona has fallen on us. We've all heard that if you want to protect yourself from corona, you need to have a strong immune system. Currently, black pepper is also used in the extracts given in hospitals to boost the immunity of corona sufferers. Black pepper has been given an important place in strengthening the immune system to fight against the corona virus. Immunity is also important to fight many other diseases, so use black pepper regularly. You can also boil it in hot water.

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Canopy Management in Mango

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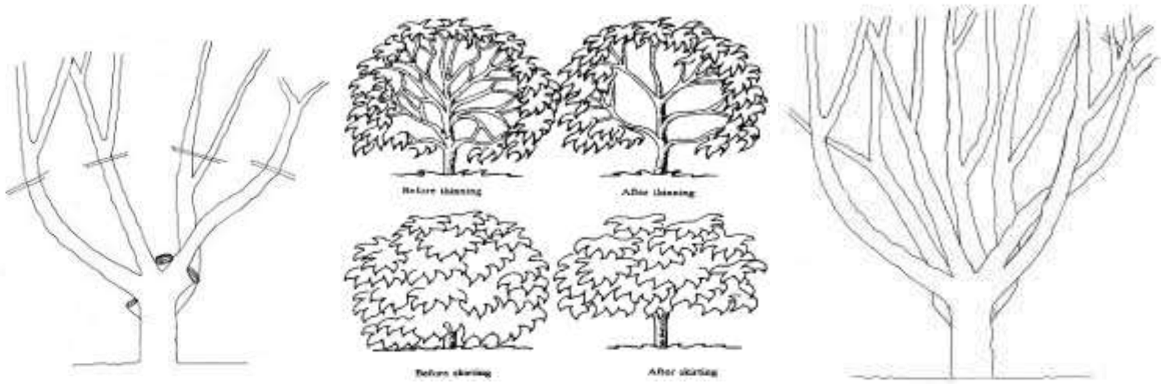
What is Canopy Management?

It is the manipulation of tree canopies to optimize the production of quality fruits.



The canopy management (components like training and pruning), affects the quantity of sunlight intercepted by trees. An ideal training strategy centres around the arrangement of plant parts, especially, to develop a better plant architecture that optimizes the utilization of sunlight and promotes productivity. The main controlling factors are the extent of incoming radiation and percentage radiation intercepted by tree canopies. It can be increased by proper canopy management practices. For commercial fruit cultivation, the natural form and shape of fruit trees are need to be modified through the practice of pruning in order to achieve the targeted yield by scientific approach. Appropriate pruning practices keep the plant in such shape and condition as to yield fruits of desired quality.

Canopy management depends on the:
1. Nature and growth pattern and bearing habit of plant.
2. Number of plants per hectare.
3. Pruning techniques.

Principles of Canopy Management

1. Light is critical for plant growth and development.
2. Better light penetration into the tree canopy improves tree growth, productivity, yield and fruit quality.
3. The green leaves harvest the sunlight to produce carbohydrates and sugars which are transported to the sites where they are needed for – buds, flowers and fruits.
4. The density and orientation of planting also impact light penetration in an orchard.
5. Avoidance of built–up microclimate congenial for diseases and pest infestation.
6. In close planting, quicker shading becomes a problem.
7. An East - Westrow orientation results in more shading as compared to the North-South orientation of trees.

Aim of the Canopy Management

1. To Maximum utilization of light.
2. To have a better crotch angle between the branches
3. To avoid built-up microclimate, congenial for diseases and pest infestation.
4. Convenience in carrying out the cultural practices.

5. Maximizing productivity with quality fruit production.
6. Economy in obtaining required canopy architecture.

Canopy Management in Young Trees

Heading back of plants are done at the age of one year. It is most important for the initial shaping of the young tree.

A well-structured tree will be able:
1. To carry a heavy crop.
2. Facilitate spraying operations.
3. Ensure the fruit exposed to plenty of light leading to a good blush on the fruit at maturity.

Heading back should be done with sharp secateurs to give a sharp and smooth cut during Oct-Dec. To develop a strong trunk, the trees should be allowed to grow over 1 m height initially. They are then cut back to a height of 0.6 to 0.7 m. Heading back results in emergence of new shoots during Mar-Apr (spring season). Mangoes grow in flushes; each flush is delineated by a concentrated whorl of leaves on the stem. This is referred to as a “ring of buds”, as a bud capable of forming into a branch which is situated at the base of each leaf. If the cut is made above this “ring of buds” the resulting re-growth will be a feather duster effect of seven or more shoots developing. These would need to be thinned out to three or four if a good tree structure is to be attained.

After the initial cut, allow 3 or 4 shoots to grow into branches of over 1 m long. These are then cut back to about 60-70 cm length, which will give a good strong branch for supporting the growing tree. After this, the trees should start branching by themselves. Young trees can be pruned at any time of the year. The aim should be to develop a spreading tree rather than a tall tree. Downward and inward growing branches or branches that cross over each other should also be removed.

Stepwise Operations

1. Allow the grafts to grow to a height of one metre from ground (single stem).
2. Head back the graft at 60-70 cm from the ground during October-November to induce primary branches (make a smooth cut with sharp secateur).
3. Heading back results in the formation of new primary branches (3-7) during March-April. Prune the excess branches and allow 3 to 4 in all the directions.
4. Prune primary branches at 60-70 cm height to induce new secondary shoots (7-10 month after the first cut preferably during October-November)
5. Thin the excessive secondary shoots retaining 2-3 shoots per primary branch
6. Tertiary branches (2 to 3) can be obtained by pruning the secondary branches at 60-70 cm height
7. Second cutting is required when these shoots attain maturity.
8. Shoot maturity in mango is determined by colour change of shoots from green to brown.
9. This stage comes after 7-8 months of shoot growth.
10. Second cutting of primary branches is done in Oct-Nov.
11. This cutting also induces new growth during ensuing spring season.
12. Thinning of excessive shoots should be done to ensure 2-3 shoots per primary branch.
13. These shoots develop as secondary branches.
14. Initial training results in open and spreading canopy of trees.

Canopy Management in Ultra High-Density Planting (UHDP) Orchards

Pruning must be completed as soon as possible after harvest preferably before second week of June. Tertiary branches are to be headed back in such a way that the plant height can be maintained at 1.5 to 2 M and having 10 to 15 tertiary shoots per tree.
Excess tertiary shoots are to be thinned out to avoid overcrowding. One month after pruning, thinning of newly emerged shoots is essential to avoid excess shoots and over-crowding. On each tertiary shoot, 3-4 new shoots are to be allowed so that 40-60 panicles can be obtained in each tree. Dried panicle and dried shoots/ branches

must be removed at the time of pruning. To induce flowering, application of paculobutrazol @ 1 ml/plant from the third year onwards, that is for a tree having 2 m canopy diameter in the month of Sept is recommended.

Rejuvenating Old Trees

Old trees often produce fruits and difficult to harvest due to their size. It harbours pest and diseases and it is difficult to reach the whole tree while spraying to control them. It is possible to cut these trees back to a more manageable size, but depending on the severity of the pruning one may lose 2 to 3 crops. Rejuvenation improves production, fruit size and quality once trees recover. But, rejuvenation of mango trees under rainfed condition is not recommended since the tree may not recover after pruning.

The tall central trunks are cut back to about 3-4 m height from the ground. The actual site to cut back to should be at a point where there are side branches by chain saw. One half of the tree is cut back and the remaining trunks and leaves will help protect the stump from sunburn .The freshly exposed trunks and branches to the sun should be painted with white water-based paint diluted three or four times. This is to prevent sunburn, which could attract borer on to the damaged bark. Numerous shoots will develop; but select the most vigorous of these, spaced evenly around the stump and if possible, at differing heights.

Remove all the unwanted shoots. Cultural practices like nutrition, irrigation, hoeing, weeding etc., were done properly. Profuse shoots emerged from prune branches from April onwards. Only 8-10 outward growing well-spaced healthy shoots were retained per branch and the rest were removed.

Plant-protection measures were seriously adopted especially against stem-borer, leaf cutting weevil and anthracnose. Because pruned trees came into flowering and fruiting after 2 years of pruning, growers ended up with loss by missing crops for 2 year, hence, it is advised to take the pruning work in alternate rows in the orchards. With alternate row pruning, availability of light to un-pruned trees in two adjacent rows was greatly improved and their fruiting increased by 2-3 times. Thus, enhanced production from un-pruned trees compensated the loss to some extent. In old and dense mango orchards, light interception and photosynthetic potentials of trees is reduced resulting poor yield. The branches existing on main trunk are considered as first order branches. The branches existing on first order branch are called second order branches. The branches existing on second order branch are called third order branches, similarly fourth and fifth order.

At IIHR, Bangalore, pruning third order branches 30 cm from point of origin recorded the maximum yield in Alphonso (86.3 kg/tree). Trial conducted at CISH revealed that pruning second order branches recorded maximum pooled fruit yield of twelve years after pruning (57.99 kg/tree) of Dashehari.

Conclusion

1. As the varieties differs in growth pattern different types of canopy management should be practised in different varieties.
2. Adoption of better management of the plant canopy we produce a better plant architecture in order to bear a heavy crop load in the future and fruits of better quality.

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Brochosomes- An Inscrutable of Leafhoppers

Article ID: 31420

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Brochosomes

Brochosomes are intricately structured microscopic granules secreted by leafhoppers (the family Cicadellidae of the insect order Hemiptera) and typically found on their body surface and, more rarely, eggs. Brochosomes were first described in 1952 with the aid of an electron microscope. These particles have also been found in samples of air and can easily contaminate foreign objects, which explains erroneous reports of brochosomes on other insects.

Secretion

Brochosomes are produced within cells of specialized glandular segments of the Malpighian tubules – the primary excretory organs of insects, which often serve additional functions. Each cell simultaneously manufactures a large number of brochosomes within its Golgi complexes and eventually releases them into the lumen of the tubule.

Structure and Composition

Brochosomes refers to the characteristic reticulated surface of the granules. Most species of leafhoppers produce hollow spherical brochosomes, 0.2–0.7 micrometres in diameter, with a honeycombed outer wall. They often consist of 20 hexagonal and 12 pentagonal cells, making the outline of each brochosome approximating a truncated icosahedron – the geometry of a soccer ball and a C60 buckminsterfullerene molecule.

The chemical composition of brochosomes includes several kinds of proteins and, according to some studies, lipids. The main protein family, called brochosomins, and other kinds of proteins identified in the composition of brochosomes and their corresponding genes show no relationship to proteins and genes of any organisms outside of Membracoidea and thus are considered to be examples of orphan genes.

Role of Brochosomes

Leafhoppers actively apply brochosomes to their integuments after each moult and sometimes to egg nest. This behaviour is known as anointing.

1. The functions of brochosomes are obscure as they are not investigated experimentally. Brochosomes are functionally analogous to the waxy particulate coatings of epidermal origin on the integument and eggs of various insects.

2. The small size and intricate surface structure of brochosomes apparently render layers of these particles unwettable with water and sticky honeydew.

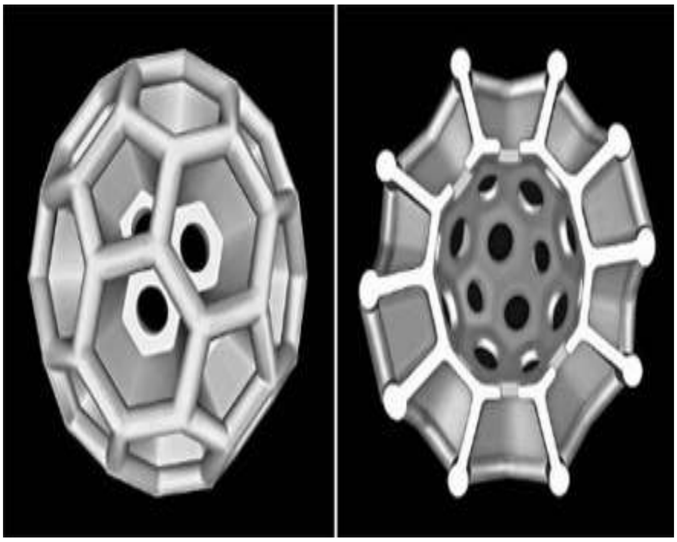
3. Protection from desiccation, UV light, temperature fluctuations, and from predators and parasites, is the major function of this secretion.

4. Anti-reflective property of brochosome make surfaces coated by it appear similar to a leaf in the eyes of insects thus it can be used as camouflage for the eggs.

5. Prior to laying eggs, the female places masses of brochosomes onto its forewings, and later scrapes them off onto the freshly laid eggs with its hind legs. The resulting powdery coat may serve various protective functions, including protection against egg-parasitoids from the order Hymenoptera (Chalcidoidea).

6. The shape and sculpture of such "egg" brochosomes can vary significantly among species, providing additional characteristics for species identification.

7. Another possible function of such coatings is direct or indirect protection against the attachment and germination of fungal spores.



Structure of Brochosomes

Brochosomes on Leafhopper

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Trichoderma as Biocontrol Agents Against Plant Pathogens

Article ID: 31421

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Abstract

Trichoderma spp. have been the most common fungi applied as biological control agents (BCA) as an effort to combat a wide range of plant diseases. Its uses have recorded good success rate in controlling major plant diseases. Fungi in the genus Trichoderma have been known since at least the 1920s for their ability to act as biocontrol agents against plant pathogens. Until recently, the principal mechanisms for control have been assumed to be those primarily acting upon the pathogens and included mycoparasitism, antibiosis, and competition for resources and space.

Introduction

Trichoderma species are free living; cosmopolitan, beneficial fungus is a low-cost, environmentally friendly alternative that reduces the need for chemical fungicides while combatting a range of fungal diseases. *Trichoderma* is a virulent plant symbiont that occurs naturally in all agricultural and forest soils and root ecosystems. It is also highly competitive, displaying antagonism against other pathogenic fungi. It has been successfully cultivated for use as a biofungicide, with *Trichoderma harzianum*, *T. viride, and T. hamatum* as the most common species used for biological control. *Trichoderma* are characterised by high reproductive capacity, rapid growth and utilized in biological plant protection as biofungicides as well as in bioremediation. *Trichoderma* strains have long been recognized as biological agents, for the control of plant disease and for their ability to increase root growth and development, crop productivity, resistance to abiotic stresses, and uptake and use of nutrients.

The genus *Trichoderma* belong to: the phylum Ascomycetes, class Sordariomycetes, order Hypocreales, family Hypocreaceae*.* The systematics and taxonomy of these fungi have evolved since 1794 when Persoon (1794) introduced the name *Trichoderma*. The four species were proposed by Persoon i.e. *T. viride, T. nigroscens, T. aureum* and *T. roseum*. However, the *Trichoderma* is presently considered as *Trichoderma* Pers. Ex. Fr. In India, trichoderma was first time isolated by Thakur and Norris during the year 1928 from Madras.

Advantages

1. *Trichoderma* is a potent biocontrol agent and it has been used successfully against various pathogenic fungi belonging to various genera, viz. *Fusarium, Phytopthara*, *Sceleroti*. It is also known to suppress plant parasitic nematodes.

2. *Trichoderma* strains play a significant role in the bioremediation of soil which are contaminated with pesticides and herbicides. They have the ability to degrade a wide range of insecticides: organochlorines, organophosphates and carbonates.

3. *Trichoderma* does not lead to development of resistance in plant pathogens, no phytotoxic effects, do not creat any pollution problems as it is eco-friendly, promote plant growth, induces resistance in host, solubilize phosphorus and micronutrients and hence increase soil fertility.

4. Transgenic plants such as tobacco and potato with endochitinase gene of *Trichoderma* have increased their resistance to fungal growth. Which are highly tolerant to foliar pathogens such as *Alternaria alternata, A. solani,* and *Botrytis cirerea* as well as to the soil-borne pathogen, *Rhizectonia spp.*

5. *Trichoderma* are used commercially in the food and textile industries for production of cellulases and other enzymes. For example, cellulases from these fungi are used in "biostoning" of denim fabrics to give rise to the

soft, whitened fabric--stone-washed denim and enzymes are also used in poultry feed to increase the digestibility of hemicelluloses from barley or other crops.

Mechanisms of *Tichoderma*

1. Mycoparasitism: Examples of such interactions are *T. harzianum* acting against *Fusarium oxyporum, F. roseum, F. solani, Phytophthara colocaciae* and *Sclerotium rolfsii.*
2. Antibiosis: Examples of such chemicals are trichothecin and a sesquiterpine, trichodermin that has antimicrobial effect on bacteria and fungi.
3. Competition for nutrients or space: For example, *Trichoderma harzianum* reduces collar rot in elephant foot yam by 80-85%.
4. Tolerance to stress through enhanced root and plant development.
5. Solubilization and sequestration of inorganic nutrients.
6. Induced resistance.
7. Inactivation of the pathogen's enzymes.

Application Methods of *Trichoderma*

1. Seed treatment: Before sowing seed should be treated with Trichoderma to minimize the attacks of disease. Mix 6-10 g of Trichoderma formulation per litre of cow dung slurry for treatment of 1kg of seed, particularly for cereals, pulses and oilseeds.

2. Plant Treatment: Drench the soil near stem region with 8-10g Trichoderma powder mixed in a litre of water.

3. Soil treatment: Soil should be treated with Trichoderma to minimize the infestation of soil borne diseases. Mix 1.5 to 2 kg of Trichoderma formulation in 100 kg of farmyard manure and cover it for 7 days with polythene. Turn the mixture in every 3-4 days interval and then broadcast in the field.

4. Seedling root dip: Mix 8-10g of Trichoderma formulation per litre of water and dip the cuttings and seedlings for 10 minutes before planting.

5. Nursery treatment: Apply 10 - 25 g of Trichoderma powder per 100 m2 of nursery bed.

Disease Control

Trichoderma spp. is very widely used to control various crop diseases effectively and some of them are given below.

Name of the Disease	Disease causing micro-organism	Name of the Crop
Damping off	*Pythium sp. Phytophthora sp.*	Chilli, Tomato, Brinjal
Rhizome rot	*Pythium, Phytopthara, Fusarium*	Ginger, Turmeric,
Collar rot	*Sclerotium rolfsii*	Elephant foot yam
Wilt	*Fusarium oxysporum*	Banana, Cotton, Tomato, Brinjal

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What can We Do to Doubling the Farmers' Income?

Article ID: 31422

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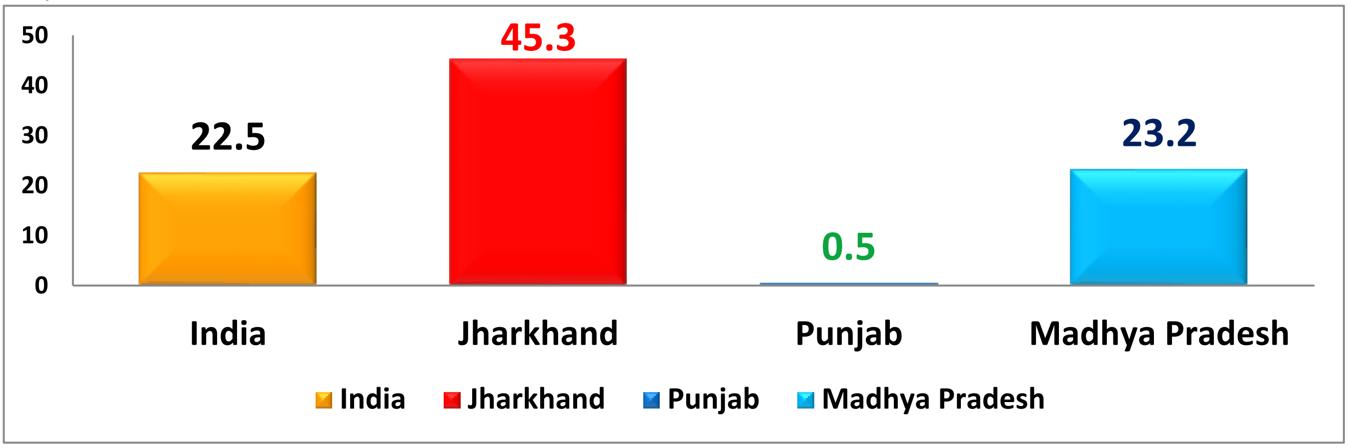
Abstract

To achieve doubling farmer's income might require novel strategies and some change in the policy stance. One could be identification and targeting of the poor or low-income farmers. Unless it is known who within agricultural sector have low income and/or are disadvantaged in terms of access to technology, markets, credit, information and infrastructure, it would be difficult to accomplish the target of doubling farmers income in such a short period. The conclusion is that 70% of the farmers in India have annual per caput income less than 15,000. Only 10% of them earn more than 30,000. Land size and income are identified important correlate. Since more than three-fourths of the low-income farmers (<15,000) are marginal farmers who cultivate land holdings less than or equal to one farmer fall in the high-income class (>30,000) might be due to a more diversified income portfolio in terms of the number of income sources accessed and the intensity of engagement. (Kumar et al. 2016).

Why Double Farmers' Income?

Past strategies for development of the Agricultural sector in India:

1. Focused primarily on raising agricultural output.
2. Focused on improving food and nutrition security.
3. Increased use of quality seed, fertiliser, irrigation and agro chemicals.
4. Did not explicitly recognise the need to raise farmers' income.
5. Did not mention any direct measure to promote farmers' welfare.
6. 45 per cent increase in per person food production: Last 50 years-food production and population multiplied by 3.7 and 2.55 times.
    a. Made India food self-sufficient at aggregate level.
    b. Also a net food exporting country.
7. The NSSO data 2011-12 reported that more than one fifth of rural households having income less than the poverty line.



Source: Estimated from unit level Consumption Expenditure survey data 2011-12, NSSO

Impact of Low Level of Farmers' Income

Agrarian distress and sharp increase in number of farmers suicides (1995-2004) due to losses from farming, shocks in farm income and low farm income. According to SAS 2002-03 of NSSO, 40 per cent farmers showed preference to quit farming if there was choice. Similarly, micro level studies provide strong evidence of youth not interested to work in agriculture (Himanshu et al. 2016). Realizing the need to pay special attention to the plight of farmers the Central government changed the name of Ministry of Agriculture to Ministry of Agriculture and Farmers Welfare in 2015.

The concept of Double Farmers' Income

Current annual growth rate is 2.00% and annual growth rate of 10.40% is required.

1. What is to be doubled:
    a. Income of farmers, GDP of agriculture sector.
    b. Whether the targeted agricultural activities or include income of farmers from other sources.
2. Whether nominal income is to be doubled or real income is to be doubled.

Past Trend in Farmers' Income

The study observed that the income earned from agriculture was not adequate to keep as many as 53 per cent farm households out of poverty, who operated on less than 0.63 hectare of land holdings.

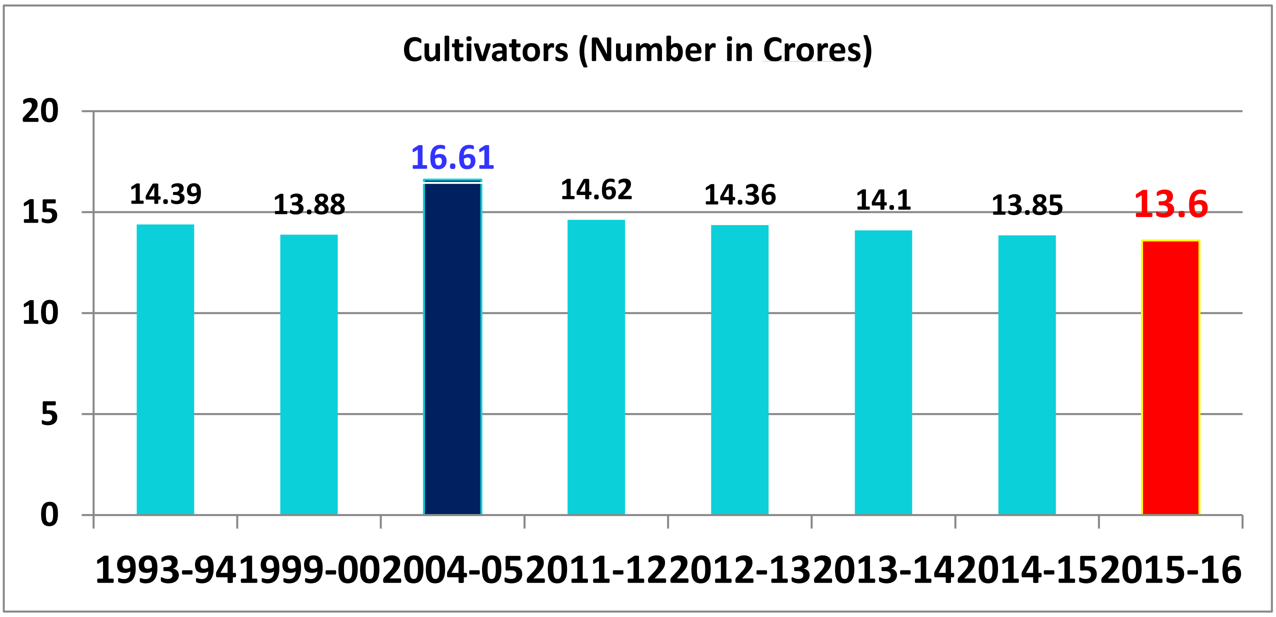
Income of Farmers and Growth During Last Decade

Size class of land possessed (hectares)	Total annual income (Rs.) per agricultural household		CAGR (%)	Real CAGR (%)	Doubling time @ nominal growth	Doubling @ time real growth
	2000-03	2012-13				
1.Landless (< 0.01)	16,560	54,730	12.70	6.10	5.80	11.54
2.Lower Marginal (0.01 - 040)	19,596	49,824	9.78	3.27	7.43	21.54
3.Upper Marginal (0.41 - 1.00)	21,708	62,964	11.24	4.73	6.51	15.01
4.Small (1.01 - 2.00)	29,916	88,176	11.42	4.91	6.41	14.47
5.Semi-Medium (2.01 - 4.00)	43,068	128,760	11.57	5.06	6.33	14.03
6.Medium (4.01 - 10.00)	68,172	235,644	13.20	6.69	5.59	10.70
7.Large (>10.00)	116,034	496,656	15.65	9.14	4.77	7.92
All sires	25,380	77,112	11.75	5.24	6.24	13.56

Source: NSSO 2005&2015

Past Trend in Farmers' Income

The farm income per cultivators shows a slightly higher increase due to the decline in the number of cultivators after 2004-05.



Source: NITI policy paper 2016

Sources of Growth in Farmers' Income

Major sources of growth are:

1. Improvement in productivity.
2. Resource use efficiency or total factor productivity, saving in cost of production.
3. Increase in cropping intensity.
4. Diversification towards high value crops.
5. Shifting cultivators from farm to non-farm occupations.
6. Improvement in terms of trade for farmers or real prices received by farmers.

Major Sources of Growth

1. Increase in Agricultural Productivity:

a. Two sources to increase in agricultural output viz. area and productivity.
b. Productivity of most of the crops in the country is much lower than agriculturally advance countries.
c. Enhancing access to irrigation and technological advancement are the most potent instruments to raise agricultural productivity and production in the country.

2. Diversification towards high value crops: Diversification towards high value crops (HVCs) offers a great scope to improve farmers income.

3. Shifting cultivators to non-farm and subsidiary activities: The decline in workforce in agriculture, employment diversification is slow due to following reasons:

a. Requirement of skill and certain education level.
b. The concentration of industrial units at a distance from rural habitation.
c. The limited capacity of the non-farm sector to ensure productive employment to incoming workers (Chand and Srivastava, 2014).

Strategies for Improving Indian Farmers' Income

1. Production Centric.
2. Post-harvest Management Centric.
3. Marketing Related.
4. Non-farm and other Concerns.
5. Success Mantras.

Production Centric

1. Need to raise output through concerted efforts on increasing productivity, TFP, input management, resource conservation:
    a. Pradhan Mantri Krishi Sinchai Yojana;
    b. Soil health card, Neem Coated Urea
    c. Prampragat Krishi Vikas Yojana etc.
2. Focus on zonal planning in bigger states like UP:
    a. Regional crop plans essential as per the resource and demand situation.
    b. Promoting "Niche Agriculture" and regionally important and suitable commodities like horticulture.
3. Integrated farming systems important, like paddy-cum-fish culture in eastern India:
    a. Investment and subsidies in few technologies like poly-houses may help multiply the returns
    b. Need for Risk Mitigation: insurance against crop and income loss by Pradhan Mantri Fasal Bima Yojana and Climate Smart Agriculture.
    c. Role of ICAR and SAUs crucial in certain states like Arunachal Pradesh.

Post-Harvest Management Centric

1. Need for suitable strategies for reducing post-harvest management to reduce crop losses.
2. Cold storage.
3. Required value addition and processing.
4. States like MP established processing units in the major producing clusters.

Marketing Related

1. Essential to ensure whether the increased production is converted to money?
    a. Need for integrated and value chain approach.
2. e-NAM would prove to be game changer.
    a. Market linkages and reforms essential.
3. Price uncertainty needs to be given due priority
    a. "Consumer should not become the king over farmers' welfare"
    b. Effective procurement strategies like UP.
4. Estimation of regional, national and international demand to avoid the glut situations preventing the situation of price crash.
5. Need for stable commodity trade policies.
    a. Should be farmer friendly.

Non-Farm and Other Concerns

1. Need for attracting Creating suitable infrastructure:
    a. In case of irrigation, requirement of capital is huge.
    b. All schemes under AIBP not sanctioned, only 99 schemes are eligible.
2. Agro-tourism can be a lucrative off-farm activity:
    a. Can bring substantial income in north east.
    b. To go for diversification of fruits and vegetables mainly because of the price risk and uneconomic lot for marketing.
3. Need for separate plans for small farmers in terms of bargaining power in various transactions in the input and output market.
4. FPOs have shown very impressive benefits to small farmers, women, tribal farmers, even in remote and disadvantaged areas.

Success Mantras

1. Certain states have the potential to more than double provided effective plans and strategies are made e.g. Arunachal Pradesh.
2. States like Chhattisgarh and Madhya Pradesh very proactive in finalizing the strategic framework of their states.
3. Prioritization of strategic framework clearly bringing out the expected contribution of each strategy.
4. Breaking-up the required interventions into short term, medium term and long term.
5. Preparing the Investment plan and feasibility of financial resources.

Prime Minister's Seven Point Strategy for Doubling Farmers' Income by 2022

1. Focus on irrigation with per drop-more crop.
2. Quality seed and soil health.
3. Investments in warehousing and cold chains.
4. Value addition through food processing.
5. Creation of a national farm market.
6. New revolutionary crop insurance scheme to mitigate risks at affordable cost.
7. Promotion of ancillary activities like poultry, beekeeping, and fisheries.

Suggestions

1. Israel based water management.
2. Climate smart agriculture.
3. Precision farming (Everything site specific and need based).
4. Marketing policies should be farmer friendly.
5. Subsidies should be provided to bank account directly.
6. Lab to land programme implementation.
7. ICAR and SAUs play a major role for guidance.
8. Monsoon based farming , accurate forecasting.
9. Easy and quick bank loan process etc.

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Sustainable Crop Production through Zero Budget Natural Farming

Article ID: 31423

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Abstract

Zero Budget Natural Farming is practices in which the cost of growing and harvesting plants is zero. This means that farmers are not require purchase of fertilizers and pesticides in order to enhance the healthy growth of cropsa and ecological balance. Crops uptake only 2-4 per cent as nutrients remaining 96 per cent will obtained from air, water and solar energy (Khadse and Rosset, 2019).

Alternative low input farming practices have emerged in India, which reduce input costs like as fertilizers, herbicides and pesticides and higher yields of crop for farmers, chemical-free food for consumers and enhance the soil fertility. Zero Budget Natural Farming is a low-input, climate-resilient farming that inspires farmers to use low-cost and locally-sourced and available inputs, eliminating the use of artificial/chemical fertilisers and industrial pesticides (Daniel Munster, 2016).

Why ZBNF?

1. Rising cost of Inputs.
2. High labour wages volatile market price.
3. Fragile ecosystem - Unpredicted monsoon extremes.
4. Large suicide of farmers.
5. Rising Environmental concerns.
6. Change in Consumers preference towards safety food (Murall, 2016).

Zero Budget Natural Farming in India

Indian agriculturist 'Subash Palekar' is the creator of the 'Zero Budget Natural Farming' model in India. He considered it as 'Krishi ka Rishi'.

Palekar's Vision

This model eliminates the cost of fertilizers, pesticides and seeds. According to Palekear, plants do not need any external inputs if soil fertility is taken care of. He believes in a method of cultivation which makes the already existing nutrients in the soil such as phosphate, potash, zinc and calcium available in absorbable form by the plants (Nandakumar, 2012.).

Which are the States with Big Plans?

According to the Economic Survey, more than 1.6 lakh farmers are practising the ZBNF in almost 1,000 villages using some form of state support, although the method's advocates claim more than 30 lakh practitioners overall. The original pioneer of ZBNF was Karnataka, where was adopted by a State farmers' association.

In June 2018, Andhra Pradesh laid out an ambitious plan to become India's first State to practise 100% natural farming by 2024. It aims to phase out chemical farming over 80 lakh hectares of land, converting the State's 60 lakh farmers to ZBNF methods (Saldanha, 2018).

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Four Pillars of ZBNF

Beejamrutha

It is a mixture of water, cow dung, cow urine, lime and forest soil which is used to treat seeds, seedlings or any planting material which protects from soil and seed borne pathogens.

Jivamrutha

Soil is saturated with all the nutrients, but these are in the non-available form to the roots zone of the plants. Beneficial micro-organisms in Jeevamrut convert the nutrients in unavailable form into available form, when it is inoculated to the soil. Jeevamrut is used by either sprayed/sprinkled on the crop field or added to the irrigation tank in regular interval of 10-15 days until the soil is enriched.

Mulching

Soil mulching, straw mulching, live mulching is done under ZBNF:

1. Reduces need for tillage.
2. Enhances biological activity.
3. Replenishes the nutrient base of the soil.
4. Retains soil moisture.
5. Controls water evaporation.
6. Increases water holding capacity of soil (Bisnoi and Bhati, 2017).

Waaphasa - Soil Moisture

Waaphasa is the condition where there are both air molecules and water molecules present in the soil and it enhance reducing irrigation, irrigating only at noon and in alternate furrows is followed. Waaphasa means the mixture of 50% air and 50% water vapour in the cavities between two soil particles.

Different Asthras for Pest Management

1. Agniastra: This primarily is the mixture of Chilli, Garlic, Neem and cow and used to control the insects (leaf roller, stem borer, fruit borer, pod borer).

2. Bramhastra: Mixture of plants like as Neem, Guava, Custard Apple, Pomogranate etc. with cow urine and it is used to spray over the leaves of the plant surface.

3. Neemastra: Mixture of cow dung, urine, neem etc. and used against leaf sucking insects, aphids and mealy bugs.

ZBNF for Combating Climate Change

ZBNF is positioned as a solution to the debt crisis among Indian farmers. Most recent available figures by the government of India show that about 52% of the agricultural households in the country are in debt. The Government of Andhra Pradesh has decided to transmute farming to Zero Budget Natural Farming (ZBNF) by the year 2024. Andhra Pradesh government has decided to approach 60 lakhs (6 million) farming households to adopt "Climate Resilient Zero Budget Natural Farming (CRBZBNF)" as a farming practice that believes in natural growth of crops without supplying any other external inputs like as fertilizers, herbicides and pesticides (APZBNF, 2018).

Success Stories of Zero Budget Natural Farmers

Mr. Annadurai, paddy farmer from Musuri Trichy who practised ZBNF in 2-acre land obtained 2 tonne of yield per acre and he got confidence to expand it to entire 10 acres (Spritiualfarming.blogspot.in, 2008).

Government Incentives

1. GoI is promoting natural budget natural farming in country through dedicated schemes of Paramparagat Krishi Vikas Yojana (PKVY) and Rashtriya Krishi Vikas Yojana (RKVY).

2. NITI AYOG in a survey found out that the zero-budget technique has resulted in an increase in the yields of crops like cotton by 11 per cent, paddy by 12 per cent, groundnut 23 per cent, and chilli 34 per cent at less than half the cost of cultivation in the year 2016-17.

Conclusion

1. Savings on cost of seeds, fertilizers and plant protection chemicals has been substantial.
2. Because of continuous incorporation of organic residues and replenishment of soil fertility.
3. To enhance the soil fertility.
4. The new system of farming has freed the farmers from the debt trap and it has instilled in them a renewed sense of confidence to make farming an economically viable venture.

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Importance of Vastu Shastra in Interior Design

Article ID: 31424

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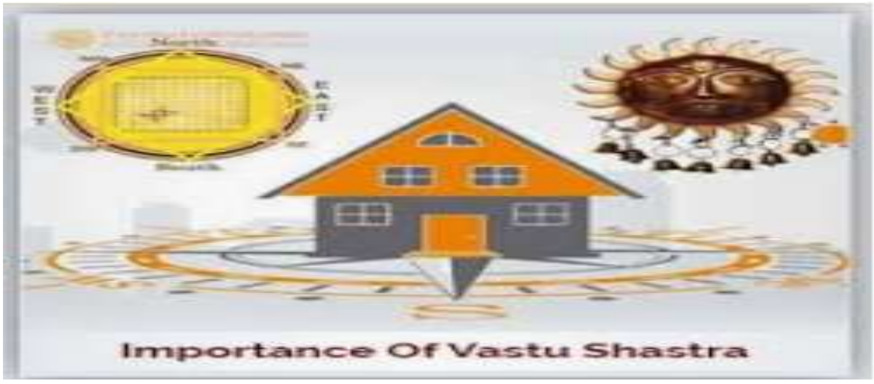
Interior design is trending these days as the designs have an attractive welcome to the building. Vastu Sastra in addition to this can add colours not only to your house or office but also to the well-being of your life. It is a decoration over anything that is found inside a space dividers, windows, passages, finishes, surfaces, light, products and furniture. These segments are used by Best home interior designers to develop utilitarian, safe, and stunningly fulfilling space for a structure's customer.



Vaastu Shastra makes us live in concordance with nature's five central parts of nature i.e. earth, water, fire, air and space and tolerating the endowment of the Gods of the headings.

Vastu Shastra is Important for Home Interior

Vastu Shastra is very important for home interior. We, Top Interior Designers help you decorate the space encased by the outside dividers of the house. The designs are not a homogeneous mass, yet it contrasts from inch to inch so it is a very basic necessity to plan it suitably. Every so often an individual living in Vastu based house can stand up to issues if the internal parts aren't done in proper manner and on different occasions, the issues can be reviewed by changing the inner parts of the house/office.

The purpose of Vaastu is to make us live in congruity with nature, opposing the negativity, the alluring fields, gravitational effects, etc of the earth, the precipitation, the vast framework and the whole of nature and the universe and appropriately conjuring the endowment of the Gods of the headings. So, every heading indicates a particular room and if in any house the Vastu benchmarks are not sought after, that results in problematic episodes and unnecessary issues.

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Vastu Shastra is Important for Office Interior

Work environments are created with the objective of winning in the endeavours taken up. Subsequently for a couple, it is fundamental to not leave any stone unturned in ensuring that they do everything right to gain ground. Vastu is acknowledged to render everything in a positive way keeping the movement of wealth in an excellent condition and help making a business productive. Every now and again various people experience business just in the wake of advising with respect to the plot and course huge for every business. Vastu office keeps up the budgetary improvement, handles staff capably, helps make the earth serene and positive and addresses the barriers coming in the business. Office interior designers in Bangalore are always there to help you out in these aspects.

Some home interior designing tips according to Vastu Shastra:

1. The circumstance of the pooja room impacts prospering and amicability in the house.
2. Keep up a vital good way from avoiding dim lights in the home.
3. Avoid using dull concealing furnishings and tiles in the kitchen.

One should not sleep in the north direction.

4. Keep the north-east corner perfect and clean.
5. The position of mirrors at better places in the house, may influence harmony and fulfilment.
6. Do not have a mirror against walls where you rest or sit. It’s not okay to always look into the mirrors of the house.
7. The area of the kitchen is related to prosperity and wealth of the family. So, it’s always advisable to keep the place clean and tidy.
8. Internal parts of a room impacts the prosperity, calling and individual life, of people who live in it.
9. The arrangement of furniture can influence the evening out of imperativeness, impacting the happiness and mental congruity.
10. The choice of various shades for various fragments in the house is very essential. Get in touch with Top Interior Designers in Bangalore for knowing more about colour combinations.

Some Office Interior Designing Tips According to Vastu Shastra

1. Office place is to be used for the money winning activities and working. Examining and napping on the tables makes negative and slow energies in the business zone.

2. The spot of business going up against the north, northwest or upper east is said to be prosperous. These headings are auspicious. Great karma and extraordinary energies reliably start from these headings.

3. Give up eating food at your workstation. It is understood as the workstation is proposed for working and dealing with the business, other kinds of work should not be performed on the table.

4. Cash should be kept on the south-western part in the working environment. This is the consistent course and the cash kept here gives a relentless effect.

The south-western bit of the working environment is strong. It may help the pioneer of the working environment to control and manage the whole staff and accomplices. This may give the head a consistent business. Best Interior Designing Company in JP Nagar can help you out in analysing and understanding the importance of office interior designing according to Vaastu Sastra.

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Ideal Table Setting in a Dinner

Article ID: 31425

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Table setting (laying a table) or place setting refers to the way to set a table with table ware such as eating utensils and for serving and eating. The arrangement for a single diner is called a place setting. It is also the layout in which the utensils and ornaments are positioned. The three most common types of table settings are formal, casual, and basic. Each place setting includes the utensils and dinnerware pieces that would normally be used with the corresponding style of dining.



Basic Table Setting

If you're getting things ready for an everyday dinner or a weekend breakfast, you might want to know how to set a table properly. For casual events, one needs just a basic table setting: a placemat, cutlery (fork, knife, and spoon), a dinner plate, a water glass, and a napkin.

Basic Table Setting Instructions

1. Lay the placemat on the table.
2. Put the dinner plate in the middle of the placemat.
3. Lay the napkin to the left of the plate.
4. Place the fork on the napkin.
5. Place the water glass slightly above the plate, in between the plate and the utensils, about where 1 p.m. would be on a clock face.

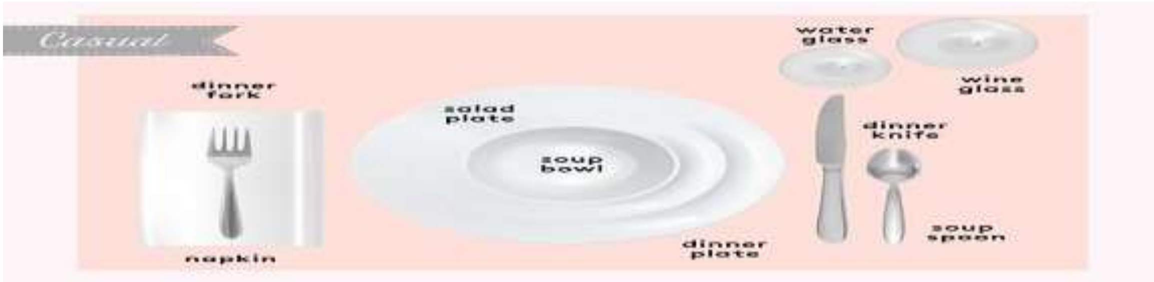
Basic Table Setting Etiquette Tips

If you prefer, it is acceptable to set the napkin on top of the plate in a basic table setting, though some think this can create a more formal feeling. Now that you know the basic table setting rules, brush up on your table etiquette.

Set a Casual Table

Knowing how to set a casual table will come in handy when you're tasked with knowing how to set an informal table for a get-together or a laid-back dinner party. Essentially, the basic table setting, above, and the casual table setting are nearly identical, but in a casual table setting, there is the addition of a soup bowl and a dinner plate. As a general rule, only set out the glassware, tableware, and flatware that you're going to be using. If you're not having a salad course, all you need to set is a dinner fork. If you're only serving white wine, a red wine glass is not needed. And if there's no soup course, skip the soup bowl and spoon.

Chargers are generally reserved for more formal place settings, but Real Simple home editor Stephanie Sisco says you can still use a charger in a casual table setting if you wish—just make sure it's fashioned in a more laid-back style, like raw wood.



Casual Table Setting Instructions

1. Lay the placemat on the table.
2. Put the dinner plate in the middle of the placemat.
3. Place the salad plate on top of the dinner plate.
4. If you're starting with a soup course, place the soup bowl on top of the salad plate.
5. Lay a napkin to the left of the charger.
6. To the left of the plate, place the fork on the napkin.

Casual Table Setting Etiquette Tips

If using individual salt and pepper shakers for each guest, place them at the top of the placemat. Otherwise, place them near the centre of the table, or, if using a long, rectangular table, place them in the middle of each end.

Mastered how to set a casual dinner table, but need a refresher on what else you should keep in mind for your casual dinner party? Here, nine awkward entertaining moments you might encounter.

Formal Dinner Table

If you're hosting an elegant dinner party, you might want to know how to set a table for a three-course meal. Real Simple home editor Stephanie Sisco says the biggest difference between a casual table and a formal table is the use of chargers, also known as presentation plates. Traditionally, formal place settings also tend to forgo placemats, but she says you can opt to use a round placemat underneath a charger for an even more formal look.

A formal table setting includes many pieces: a tablecloth, chargers, dinner plates, soup bowls, salad plates, bread plates, napkins, salad forks, dinner forks, knives, soup spoons, butter knives, dessert spoons, water glasses, red wine glasses, and white wine glasses. Though this may sound overwhelming, if you know how to set a casual table, it's a very easy leap to knowing how to set a table with charger plates.

Formal Dinner Table Setting Instructions

1. Lay an ironed tablecloth on the table.
2. Set a charger at each seat.
3. In the centre of the charger, place a soup bowl.
4. Place the bread plate to the top left of the charger (between 10 and 11 p.m. on a clock face).
5. Lay a napkin to the left of the charger.
6. Directly above the charger, place a dessert spoon (a teaspoon) with the handle pointing to the right.
7. If using a place card, set it above the dessert spoon.

Formal Table Setting Etiquette Tips

After the soup course is complete and the bowls are cleared, a salad plate will take the soup bowl's position. Traditionally, a charger holds the spot for the dinner plate, and is removed after the salad course so the place is never bare. If you do not want to clear the table after the soup course and bring out dinner plates, you can place a dinner plate on top of the charger.

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Unified Market Platform (UMP) - Way Forward in Agricultural Marketing: A Case Study of Raichur Market

Article ID: 31426

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Abstract

The Unified Market Platform is an online agricultural market initiative was launched in Karnataka on 22nd February, 2014. A total of 105 markets spread across 27 districts have been brought under the Unified Market Platform (UMP) as of March 2016. In pricing mechanism under UMP in case of paddy shows if 1 bid increases for lot there was 13.8 per cent, in red gram 8.3 per cent and groundnut 11.48 percent increase in price. Physical performance of UMP shown that transparent bidding and well organised tendering has followed in e-tendering. But e-payment is working at not up to the mark, immediate payment is good for farmers but at the same time commission agents were opposing the immediate payment. Major reason for this was Lack of knowledge about digital payments.

Performance of Unified Market Platform

1. Trends in number of market functionaries: Unification of markets may lead to better competition and increase in number of traders and other functionaries which may result in equalization of trade among the traders and increase in producers share in consumer rupee. The market functionaries included commission agents, traders, hamauls, exporters, importers and stockists.

However, the results shown clearly hamauls were having large share in total number of market functionaries. Even though commission agents were in less share in the total but they were key players in the market activities. After implementation of UMP there was tremendous increase in the processors (148.2%), active traders (75.3%). The reason behind this was UMP creates a platform to get quality product and transparent price discovery. New regulations in APMC made a gateway to traders who want buy from outside Raichur. Hamauls (60.3%) also increased after the intervention of UMP because of increase the trading activities in APMC, Raichur. In total comparing to pre and post UMP periods 50.6 per cent increase in total number of market functionaries. The reason for this intervention of UMP leads to increase in the trading activities under UMP due to more arrivals.

2. Financial performance: Financial performance of the APMC, Raichur indicated that there was increasing trend in market income, expenditure during post UMP compared to pre-UMP period. The market income of the APMC, Raichur was increased to Rs. 16.17 crore from Rs. 12.29 crore; expenditure for the same year was increased to Rs. 9.34 crore from Rs. 8.17 crore with that savings from the total income was increased to Rs. 6.82 crore from Rs. 4.12 crore. Market income was having Compound Annual Growth Rate (CAGR) of 6.15 per cent; expenditure was having 4.42 per cent and savings 10.79 per cent.

The results revealed that, there was consistent increase in the market income, expenditure and savings over the years. CAGR of savings (10.79%) is more than the market income (6.15%) and expenditure (4.42%). Expenditure (4.42%) is less than the market income (6.15%), it shows that market is at running in a profitable manner. There was a consistent increasing trend in the income and savings of the market. In the recent year 2017-18 there was bad season for agriculture in the study area. It leads to reduction in the market income and savings compare to previous years.

3. Opinion of the farmers and village traders about UMP: As discussed in the above, about 46.6 per cent of the respondents facing problem while e-entry. The reason for this was technical inefficiency and newly involved gate entry machine having problem while generating the entry receipt. 60 per cent and 80 per cent of farmers and village traders stated they were felt mistakes while e-permit and it was a long process respectively. Because due to errors occurred in bidding process will delay the permit generation. 83.3 per cent of the farmers and 70 per cent of the village traders were reported transparency in bidding process. 60 per cent of the farmers and village traders satisfied with immediate payment system, before UMP transaction will happen through middle men from trader so dilution of producer rupee was happened and payment will be delayed because of late processing in the market. By implementation of e-payment transactions became more easily and directly to the farmers. 33.3 per cent farmers and 60 per cent of the village traders reported that they were benefitted with UMP. But around 80 per cent of the both respondents were having problem with present payment system, reason for this they were not aware of e-payments and 70 per cent of the sample were not aware of UPI transactions.

4. Opinion of the market intermediaries (traders, processors and commission agents) about UMP: Hence 70 per cent of the sample was satisfied with e-entry, 60 per cent of the sample felt mistakes in e-permit. Only 20 per cent of respondents were comfortable with immediate payment system of UMP. The reason for this was if immediate payment after sale directly to farmer may lose their commission. Commission agents were facing a problem of giving hand loans to farmers before the trade, so if farmers directly got their money than they had fear about the repayment of loan. Around 70 per cent of the sample knew about UPI transactions and they were happy with UMP trading.

5. Opinion of the market officials about UMP: It was clear from above table about 60 percent of the respondents are strongly agreeing that e-entry was working well and 40 percent of the respondents are agreeing with that opinion. Half of the respondents reported that they are agree with e-tendering was working in efficient way, 30 percent stated that they were strongly agree with this and 20 percent were at neutral to their opinion about e-tendering. About performance of e-permit half of the respondents were strongly agreed with it, remaining half of them was agreed with them. About e-payment component 40 percent of the respondents clearly stated that they were strongly disagree with it, 30 percent of the sample were disagreeing with e-payment performance and less than one third of total respondents were neutral to their opinion about e-payment.

Conclusion

Thus, to make UMP more effective it is suggested to concentrate on market infrastructure and facilities for better marketing and price realization. Hence market performance has improved so scope for expansion of e-trading in other markets in Karnataka as well as India.

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LED Lighting Applications in Ornamental Production

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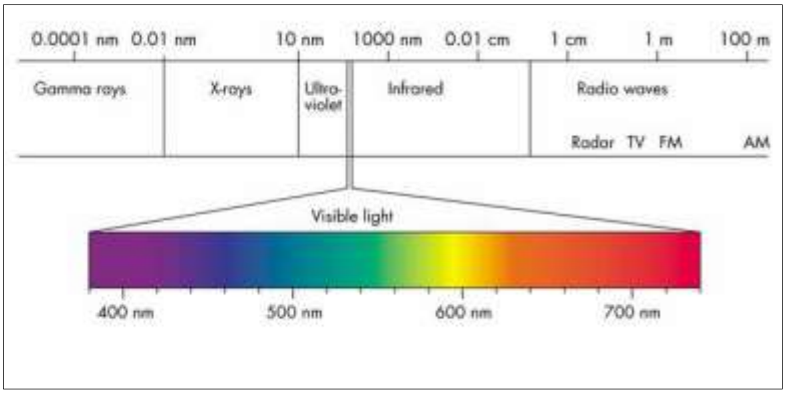
Introduction

Light energy is an important factor for plant growth. In regions where the natural light source (solar radiation) is not sufficient for growth optimization, additional light sources are being used. Traditional light sources such as high-pressure sodium lamps and other metal halide lamps are not very efficient and generate high radiant heat. Recent developments in the field of light source technologies have opened up new perspectives for sustainable and highly efficient light sources in the form of LEDs (Light-Emitting Diodes) for greenhouse lighting.

Ornamental plants are of high economic importance. Cut flowers and foliage have a wide market around the world. LEDs can also play a key role in floriculture by providing a suitable light spectrum (quality and duration). Light controls the circadian rhythm of plants which means the clocking of plants to day (light) and night (dark) cycles, and this circadian rhythm influences photomorphogenesis. This process plays an important role in regulation of flowering. LEDs can play a key role in ornamental crop production by providing a suitable light spectrum.

Light

Light or visible light is electromagnetic radiation within the portion of the electromagnetic spectrum having wavelengths in the range of 400–700 nanometers (nm) – Photosynthetically Active Radiation.



The solar radiation spectrum mainly consists of three parts: ultraviolet (UV), visible light, and infra-red.

1. 200-280 nm (ultraviolet C): This part of the spectrum is harmful to the plant because of its high toxicity.

2. 280–315 nm (ultraviolet B): This part is not very harmful but causes plant colors to fade. 315–380 nm (ultraviolet A): This range does not have any positive or negative effect on plant growth.

3. 380–400 nm (ultraviolet A/visible light): Beginning of visible light spectrum, process of light absorption by plant pigments (chlorophylls and carotenoids) begins.

4. 400–520 nm (visible light): Contains violet, blue and green bands. Peak absorption by chlorophylls occurs in this range and it has a strong influence on vegetative growth and photosynthesis.

5. 520–610 nm (visible light): This range contains green, yellow and orange bands. This range is less absorbed by the plant pigments and has less influence on vegetative growth and photosynthesis.

6. 610–720 nm (visible light): Contains red bands and a large amount of absorption occurs at this range. This band strongly affects the vegetative growth, photosynthesis, flowering and budding.

7. 720–1000 nm (far-red/infrared): Germination and flowering is influenced by this range but little absorption occurs at this band.

8. >1000 nm (infrared): All absorption in this region is converted to heat.

Importance of Light in Photosynthesis

The process of photosynthesis occurs when green plants use the energy of light to convert carbon dioxide (CO2) and water (H2O) into carbohydrates. Light energy is absorbed by chlorophyll, a photosynthetic pigment of the plant, while air containing carbon dioxide and oxygen enters the plant through the leaf stomata.

Glucose, a carbohydrate processed during photosynthesis, is mostly used by plants as an energy source to build leaves, flowers, fruits, and seeds. Molecules of glucose later combine with each other to form more complex carbohydrates such as starch and cellulose. The cellulose is the structural material used in plant cell walls. Photosynthesis provides the basic energy source for virtually all organisms.

Types of Pigments in Plants

1. Mass pigments: Chlorophylls absorb mainly red and blue light and reflect green wavelengths, which is why we see plants green.
2. Accessory pigments: Carotenoids, xanthophylls, flavonoids, anthocyanins capture wavelengths other than only red and blue. The accessory pigments are yellow, red and violet in colour.
3. Sensor pigments: Phytochrome, Cryptochrome , Phototropins.

Photoreceptors (Bantis et al., 2018)

Plants have photoreceptors, which are proteins that are specially designed to perceive light and signal certain biological effects in the plant.
1. Phytochromes (phys): Absorbs Red (600–700 nm) and far-red (700–750 nm) regions of the spectrum.
2. Cryptochromes(crys): Blue light (390–500 nm).
3. Phototropins (phots): Blue light (390–500 nm).

Artificial Lighting

It is process which has been designed to grow plants in spaces where there is little or no natural light available.

How does Light Affect Plant Growth?

Plants require light throughout their whole life-span from germination to flower and seed production. Three parameters of grow light used in greenhouse industries are relevant:
1. Light quantity (intensity): Light quantity or intensity is the main parameter which affects photosynthesis, a photochemical reaction within the chloroplasts of plant cells in which light energy is used to convert atmospheric CO_2 into carbohydrate.

2. Light quality (spectral distribution): Light quality refers to the spectral distribution of the radiation, i.e., which portion of the emission is in the blue, green, red or other visible or invisible wavelength regions. For photosynthesis, plants respond strongest to red and blue light. Light spectral distribution also has an effect on plant shape, development and flowering (photomorphogenesis).

3. Light duration (photoperiod): Photoperiod mainly affects flowering. Flowering time in plants can be controlled by regulating the photoperiod.

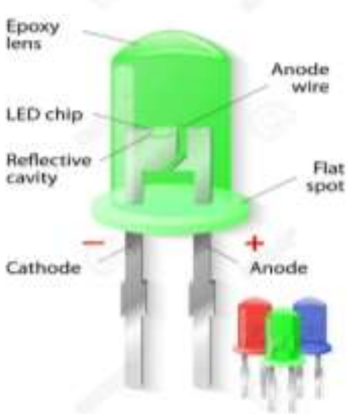
Types of Artificial Lighting

1. Replacement lighting (RL): Complete replacement of solar radiation. Ex. indoor growth rooms and growth chambers
2. Supplemental lighting (SL): To supplement periods of low natural light. Ex. Greenhouse.

3. Photoperiod lighting (PL): Used to stimulate or influence photoperiod dependant plant responses such as flowering or vegetative growth.

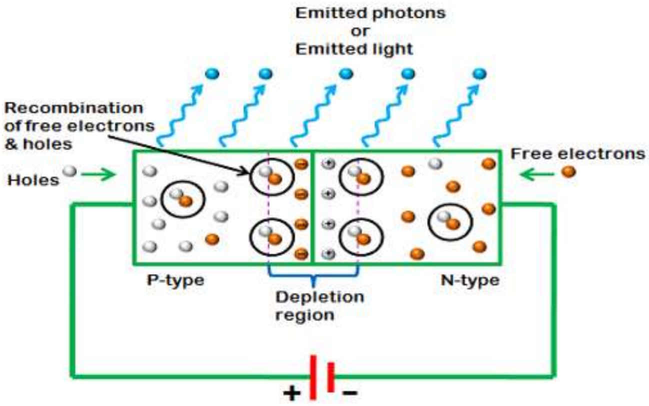
Light-Emitting Diodes (LED)

LED is a type of semiconductor diode which allows the control of spectral composition and the adaptation of light intensity to be matched to the plant photoreceptors in order to furnish better growth and to influence plant morphology as well as different physiological processes such as flowering and photosynthetic efficiency. Using LEDs as a lighting source, it is possible not only to optimize the spectral quality for various plants and different physiological processes, but also to create a digitally controlled and energy efficient lighting system.



The key structure of an LED

1. The semiconductor compounds contain elements - Gallium, Indium, Aluminium, Arsenic, Phosphorus and Nitrogen.
2. LED chip is basically a diode (pn-junction), designed to allow electrons and holes to recombine to generate photons.



Principle

When current flow through diodes, Negative electrons move one way & positive holes move the other way.

The holes exist at a lower energy level than the free electrons, Therefore when a free electrons falls it losses energy – in form of photon, which cause light.

Benefits of LED

1. Reduction in energy consumption up to 70% compared to traditional light sources.
2. Fast switching and steady state operation.
3. Simple electronic dimming function.
4. Reduction of cable gauge (and hence cost and weight).

5. High Relative Quantum Efficiency (RQE): Red light has the highest RQE, meaning it is the most efficient at photosynthesis. Blue light is about 70 to 75% as efficient as red light.
6. Stable temperature inside the growth chamber and greenhouse.
7. Ability to control spectral composition of blue, green, red, and far-red wavelengths.
8. Reduction of heat stress on plants.
9. Reduction in watering and ventilation maintenance.
10. Lifetime, reliability, and compact size as the major technical advantages over traditional light sources.

Applications of LED Lighting Systems in Ornamentals (Park and Jeong, 2019)

1. High Purchasing Cost.
2. Individual diodes cannot be replaced.
3. Light pollution - LED grow lights produce a bright blue light (in addition to other colours) which can cause blindness in humans.

Conclusion

1. Red light - enhance flowering
2. Blue light - production of potted ornamentals.
3. Red light+ blue - enhanced micropropagation rates and secondary metabolite production.
4. MW + R LEDs - higher visual quality for detecting nutritional deficiencies, disease symptoms, and physiological disorders of plants.
5. Savings up to 75% in annual electricity expenses and consumption in in vitro production costs.

Hence, LEDs have the potential to become the dominant light source in ornamental crop production.

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Seed Development in Cultivated Plants

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Seeds can be produced sexually or asexually; the former mode guarantees genetic diversity of a population, whereas the latter (apomictic or vegetative reproduction) results in clones of genetic uniformity. Sexually produced seeds are the results of fertilization, and therefore the embryo develops containing, or is surrounded by, a food store and a protective covering. Seeds of various species have evolved to vary enormously in their structural and anatomical complexity and size. Nevertheless, their development can be divided conveniently into 3 stages:

Stage I. Histo Differentiation

characterized by extensive cell divisions. Formation of the different tissues within the embryo and surrounding structures.

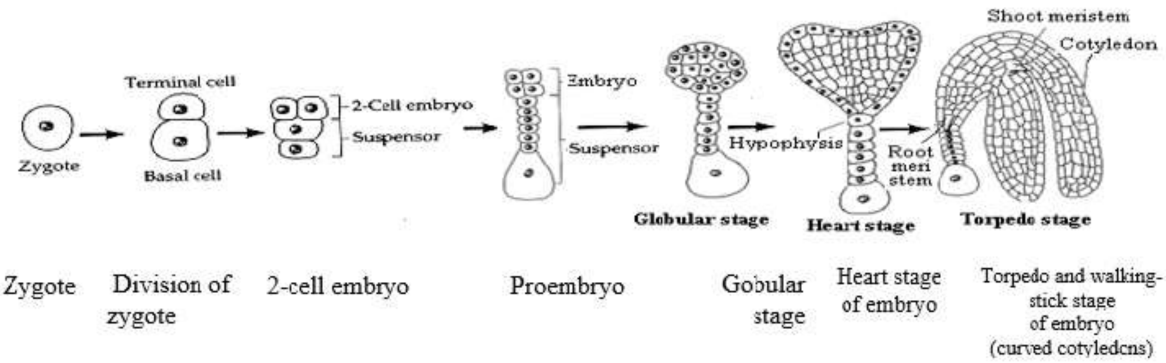
Flower parts	Changed part in seed
Zygote	Embryo
Polar nuclei	Endosperm
Integument	Testa/seed coat
Micropyle	Micropyle
Nucellus	Perisperm
Funiculus	Hilum
Ovule	Seed
Ovary	Fruit

1. Embryo development in a dicot: The stage following egg fertilization where the embryo differentiates = embryogenesis.

Stages of embryogenesis: Dicot = Proembryo - Globular - Cotyledon - Mature embryo.
Monocot = Proembryo - Globular - Scutellar – Coleoptile.

During development, the embryo progresses through the globular, heart and torpedo stages to reach maturity. During the transition from the globular to the heart stage the cotyledon structure and number are established. The mature embryo consists of two cotyledons borne on a hypocotyl, the collet (hypocotyl–radicle transition zone) and the radicle; then seed desiccation occurs.

2. Dicot seed-embryo growth stages:



3. Proembryo stage:

a. Following fusion of the egg and sperm nuclei, a proembryo is formed by a transverse cell division to form an apical and basal cell.

b. The basal cell divides again and will form the suspensor. The suspensor in dicots is typically a column of single or multiple cells. The suspensor functions to push the proembryo into the embryo sac cavity and to soak up and transmit nutrients to the proembryo.

c. The apical cell forms the embryo.

4. Globular stage:

a. Basal cell derivatives in the globular embryo form the hypophysis that goes on to develop into the radicle.

b. Tissue differentiation becomes evident in the 16-celled globular embryo where peripheral cell division begins to form a protoderm.

5. Cotyledon stage: Cell division continues as the embryo enters the cotyledon stage.

a. The formation of two cotyledons in dicots gives the embryo a heart-shaped appearance.

b. Two recognizable stages are the heart and torpedo stages /walking-stick stages (curved cotyledon) based on the degree of elongation seen in the developing cotyledons.

c. In cotyledon stage, the embryo has organized to form an apical meristem, radicle, cotyledons and hypocotyl.

6. Mature embryo stage:

a. In mature embryo stage, the embryo is fully formed and separate cotyledons can be easily seen as well as a distinct shoot and root meristem.

b. At this time, the suspensor and the basal cell begin to disappear.

Histodifferentiation - Monocots

Stages embryo development: Proembryo - Globular - Scutellar – Coleoptile.

1. Proembryo stage: Following fertilization, the first cell division is asymmetrical and leads to an apical and basal cell. The apical cell divides more rapidly than the basal cell and will eventually be the embryo.

2. Globular stage: The proembryo in the globular stage is similar to dicots, except that the suspensor is a multiple row of cells and is less differentiated. In the late globular stage, a group of 15 to 20 cells on one side of the embryo divides more rapidly and become meristematic. These will give rise to the embryo axis. Globular embryo elongates to a club-like shape with radial symmetry and then becomes bilaterally symmetrical through differentiation of the absorptive scutellum and coleoptile, which covers the first foliage leaf. During the coleoptile stage of development, the embryo axis and suspensor are established. Later, during the leaf stage, the shoot and root meristems are defined and leaf primordia differentiate.

3. Scutellar stage: In monocots, there is only a single modified cotyledon termed the scutellum. The scutellum works as a connective tissue between the endosperm and embryo axis.

4. Coleoptile stage: In the coleoptilar stage, the embryo axis differentiates into the plumule (shoot) and radicle. In monocots, the embryo axis also features a specialized tissue surrounding the shoot and root tissue to assist in emergence during germination. These are the coleoptile and coleorhiza.

5. Mature embryo stage: In the mature stage, all of the seedling parts are differentiated. A vascular strand has formed to connect the scutellum with the embryo. The scutellum will act as a conduit for the exchange of storage food reserves between the endosperm and the embryo during germination.

Endosperm Development

1. Endosperm development is essential for proper development of the embryo and a viable seed.
2. Endosperm is that the nutritive tissue formed as a result of triple fusion within the angiosperms.
3. Endosperm formation starts prior to embryo formation.
4. At the time of physiological maturity it reaches the maximum morphological development.

3 basic mode of development patterns of endosperms: Helobial, Cellular Nuclear.

Nuclear Endosperm

Primary endosperm nucleus divides repeatedly to form a large number of free nuclei.
1. No cell plate formation takes place at this stage and a central vacuole appears later.
2. It's followed by cell plate formation which is centripetal.
3. It is the most common type of endosperm e.g., Cotton, Maize, Capsella, Coconut (milk), wheat, etc .

In dicots, in the cotyledon stage, the endosperm becomes cellular filling most of the developing seed. Eventually, the endosperm is consumed by the developing embryo and there is only a single (few) layers of endosperm cells remaining. In these types of seeds, the cotyledons function as the reserve storage material tissue for germination.

In monocots, at maturity, the endosperm in cereal crops like corn (Zea) is completely cellular and non-living except for a single outer layer of living cells called the aleurone.

In cereal grains, the non-living, storage endosperm cells are surrounded by an outer layer of living aleurone cells. During germination, aleurone cells have large prominent red-stained nucleoli within the nucleus that is an indication of active protein (enzyme) biosynthesis.

Cellular Endosperm

Cell wall formation occurs immediately after division.
1. Subsequent divisions also accompanied by cell plate formation.
2. As a result, the endosperm becomes cellular from the beginning. Eg: Balsam, Petunia, barley, grasses, Petunia, Utricularia, Coconut (copra).

Helobial Endosperm

1. Intermediate above two type e.g., members of order helobiales (Monocot).
2. First division is cellular (i.e., wall formation follows the first division)
3. However, inside each of these newly formed cells, free nuclear divisions occur.
4. But finally, the endosperm becomes cellular following the pattern of development of nuclear endosperms.

Endosperm in Endospermic seeds: Seeds where the endosperm persists and is a major storage tissue in the mature seed, it is called an endospermic seed.

Endosperm in Non-endospermic seeds: In non-endospermic seeds, the endosperm is consumed during development and the large cotyledons are the reserve tissue. Gymnosperms differ from angiosperms in having only a single fertilization. The endosperm is formed from haploid (1n) female megagametophyte.

Perisperm

1. The nucellus is that the central portion of the ovule inside the integuments.
2. After fertilization, the nucellus may become the perisperm that feeds the embryo.

Seed Coat

An integument may be a protective cell layer surrounding the ovule.
1. Gymnosperms usually have one integument but angiosperms typically have two integuments.
2. The integuments become the testa when the ovule matures after fertilization.
3. The integuments don't enclose the nucellus completely but leave a gap at its apex mentioned because the micropyle.
4. The opening of micropyle allow the pollen to enter the ovule for fertilization.
5. Located opposite from the micropyle is that the Chalaza where the nucellus is joined to the integuments.
6. Nutrients from the plant travel through the phloem of the vascular system to the funiculus and outer integument and from there through the chalaza to the nucellus inside the ovule.

7. In chalazogamous plants, the pollen tubes enter the ovule through the chalaza rather than the micropyle opening.

Stage II. Seed Expansion (Maturation)

A stage of rapid cell enlargement & expansion: Little cellular division, dry weight increase thanks to reserve deposition, water content decline. Genes for synthesis of reserves are expressed, deposition of reserves occurs.

Important processes during stage II:

1. Accumulation of food reserves:
    a. Carbohydrates (starch).
    b. Storage proteins
    c. Lipids (fats or oils).
2. The cell expansion stage ends when the seeds reach physiological maturity; maximum dry weight.
3. Hardening of seed coat & accumulation of antimicrobial compounds.
4. Mechanisms of seed dispersal – flyers
5. Synthesis of protective compounds that allow the seed to withstand some degree of water loss and adverse environmental conditions. Eg. antioxidants, antimicrobial, resistance to pathogens.

Stage III. Maturation Drying / Desiccation

Water loss happens and embryo becomes metabolically inactive that is known as quiescent stage or dormant state. As maturation drying begins, there is a separation between the seed and mother plant that initiates the drying process. It is a time of rapid water loss.

1. Concurrent with maturation, the embryo and associated tissues typically dehydrate to 7-15% water content and enter a state of dormancy and thus able to withstand adverse environmental conditions.
2. At this stage a seed is quiescent (expressing little metabolic activity); in some cases, it may also be dormant.
    a. Orthodox seeds tolerate maturation drying. They constitute the majority of important agronomic and horticultural crops.
    b. Recalcitrant seeds (about 7% of the world's flora) do not tolerate desiccation drying and are usually shed from the plant at this stage without entering Stage III: maturation drying.

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Critical Role of Potassium in Crop Production

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Abstract

The global potassium (K) demand for agriculture crop production since the 1960s increased. Other side, the world population has doubled and this trend will also persist in the coming decades. Because of this rapid expansion, a massive increase in crop production is required to meet the food and energy demands of future generations, while also preserving the ecological and energy related resources of our planet. Additionally, recent climate models predict that incidences and duration of drought and heat stress periods are increasing in many regions, negatively affecting our major crops yield potential, and thus our food security. Therefore, major challenges for agriculture are to enhance crop yields in more resource-efficient systems and to stabilize plant development and yield formation under biotic and abiotic stress conditions. In this context, among the plant nutrients, K is playing a crucial role in physiological processes vital to growth, yield, quality, and stress resistance of all crops.

Importance

Potassium is among the three major plant nutrient elements denoted as primary nutrients. Its importance in Indian agriculture has increased with intensification of agriculture. Potassium is an essential nutrient element for all living organisms including plants and animals. It is univalent cation found in the largest concentration (100-200 mM) in the plant cell sap and so it is called a 'master cation'. It is an ionic (K^+) in nature, free (not bound to any constituent) and mobile in the plants. Potassium is one of the major nutrients, essential for plant growth and development. Although concentrations of K^+ in soil solution (K^+) are in the range of only 0.1–6 mM [1]; plants accumulate large quantities of this element, which constitutes between 2% and 10% of plant dry weight [6]; [8]. Concentrations of K^+ in the cytosol are maintained in a narrow range, around 100 mM, which is optimal for the function of cytosolic enzymes. Vacuolar content is more variable, depending on K availability and tissue type, and is commonly found to be in the range of 20–200 mM [9].

Potassium Dynamics in Soils

As mineral soils contain 0.04–3% K, the total K of the upper 20 cm of most agricultural soils generally ranges between 10 and 20 g kg^{-1}. However, most of the soil K (90–98%) is incorporated in the crystal lattice structure of minerals and thus not directly available for plant uptake. Most of the K in soil is in the structural form, mainly comprised of K-bearing primary minerals such as muscovite, biotite and feldspars.

K-feldspars may directly release K to the soil solution, whereas interlayer K of micas is held tightly by electrostatic forces. Weathering of K-feldspars and micas inherited from soil parent materials produces secondary soil minerals which represent the potential sources of plant-available K in soils [7]. The K in trioctahedral micas (such as biotite and phlogopite) is reported to be more readily released by weathering, and it has been suggested that application of biotite to K-deficient soils may enhance the plant-available K content of soil. Formation of dioctahedral expansible 2:1 mineral from biotite is a distinct possibility that may enhance the amount of K in soil solution.

It should be noted that weathering of K-containing primary minerals is very slow. Therefore, their sole addition to soil may not be beneficial for crop growth, especially when compared to soluble K fertilizers [5]. Nevertheless, a number of recent investigations suggest that addition of rock K (K-containing primary minerals) materials may increase the long-term fertility of the soil by increasing the K deposits.

Role of Potassium in Plants

The main role of K is to provide the ionic environment for metabolic processes in the cytosol, and as such functions as a regulator of various processes including growth regulation. Plants require potassium ions (K+) for protein synthesis and for the opening and closing of stomata, which is regulated by proton pumps to make surrounding guard cells either turgid or flaccid. It has important role in pH stabilization, enzyme activation, protein synthesis, stomata movement, cell extension, and photosynthesis. It plays a vital role in water relations (osmatic regulation, etc.), energy relations, translocation of assimilates, photosynthesis and protein and starch synthesis. Over sixty enzymes are required K concentration for activation in plants. In addition to its major role in metabolic processes and grain/seed yield formation, K improves the quality of agricultural produce, prevents lodging in cereal crops, imparts resistance pests and diseases and tolerance to cold and frost [4].

Essential in the formation and transfer of starch and sugars especially in potato, sweet potato, Banana. It increases plumpiness of grains and seeds. Straw of cereals become strong and stiff and thus it reduces lodging. It is considered as quality element for many crops. Imparting resistance against environmental stresses such as drought old and frost. Reduced ability to adapt to environmental stress, e.g., drought, lodging, etc. Tips and edges of leaves become yellow (chlorosis) and then die (necrosis).In some crops, K deficiency produces white necrotic spots that looks like insect damage. Older leaves turn yellow initially around margins and die; irregular fruit development. Potassium has many different roles in plants: Mainly K in photosynthesis, K regulates the opening and closing of stomata, and therefore regulates CO_2 uptake. Potassium triggers activation of enzymes and is essential for production of adenosine triphosphate (ATP). ATP is an important energy source for many chemical processes taking place in plant issues. Potassium plays a major role in regulation of water in plants (osmo-regulation). Both uptake of water through plant roots and its loss through the stomata are affected by potassium. Known to improve drought resistance. Protein and starch synthesis in plants require K as well. Potassium is essential at almost every step of the protein synthesis. In starch synthesis, the enzyme responsible for the process is activated by K. Activation of enzymes – K has an important role in the activation of many growth-related enzymes in plants.

Symptoms of Potassium Deficiency

Typical symptoms of K deficiency in plants include brown scorching and curling of leaf tips as well as chlorosis (yellowing) between leaf veins. Purple spots may also appear on the leaf undersides. Plant growth, root development, and seed and fruit development are usually reduced in K-deficient plants. Other symptoms of K deficiency: poor resistance to pests, weak and unhealthy roots and uneven ripening of fruits. Often, K deficiency symptoms first appear on older (lower) leaves because K is a mobile nutrient, meaning that a plant can allocate K to younger leaves; when, it is K deficient. Deficient plants may be more prone to frost damage and disease, and their symptoms can often be confused with wind scorch or drought. Deficiency is most common in several important fruit and vegetable crops; notably potatoes, brassicas, tomatoes, apples, currants, gooseberries, and raspberries. Sugar beets, cereals, and clover are also commonly affected.

1. In brassicas, leaves are blue-green in colour and may have a low degree of interveinal chlorosis. Scorching along the outside edges of leaves is common, and leaves are often tough in texture due to slow growth.

2. In tomatoes, the stems are woody and growth is slow. Leaves are blue-green in colour, and the interveinal area often fades to a pale grey colour. Leaves may also have a bronzed appearance and yellow and orange patches may develop on some of the leaflets. Fruits often ripen unevenly and sometimes have green patches near the stalks.

3. In apples, leaves are scorched around the edges, and interveinal chlorosis is common. Apple fruits often have a slightly acidic or woody taste.

4. In gooseberries, currants, and raspberries, dieback of shoots and branches is common and although the plant may produce many blossom buds in the early stages of deficiency, fruit yields turn out low and the fruits are of poor quality.

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Why Potassium Deficiency Becoming Severe in Recent Years?

Progressively greater removal of soil K due to increase in agricultural production by increasing fertilizer use, intensifying cropping systems, promoting high-yield crop varieties and improving irrigation. Due to use of high-analysis, K-free fertilizers, such as urea and DAP. Decreasing use of traditional organic manures and K-containing fertilizers. Leaching losses of soil K with the spread of flood irrigation to large areas. Farmers are avoiding use of crop residue as well as FYM application during crop production. These factors are mediated the K dynamics in soil as influencing soil health.

Potassium Uptake and Requirement

1. Time of K uptake and its translocation to reproductive part varies with different plants.
2. The plants generally absorb most of their K requirement during an earlier growth stage.
3. Maize absorbs 70-80% K by silking time, and 100% is absorbed three to four weeks after silking.
4. Potassium uptake is often equal to or more than that of nitrogen.
5. The K in normal healthy leaves varies between 1-4%.

Table 1. Potassium uptake by different crops under field conditions.

Crop	Yield (t ha-1)	Total K-uptake (kg ha-1)
Wheat	3.90	137
Rice	5.14	180
Chickpea	1.50	49
Mustard	2.60	133
Alfalfa	91.90	669
Banana	38.00	1053

Management Practices for Potassium

The main problem with managing soil K is that of converting the unavailable forms of the element to available forms. Available K is usually supplemented by different type of chemical fertilizers and in minor amount by crop residues and other sources like FYM. Another problem is removing K by crops from the soil without returning the crop residues [3]. Attempts should be made to return as much as possible of crop residue in soil for recycling of K into soil systems. Growing higher K demanding crop should be fertilized properly based on soil test and crop requirement, i.e., alfalfa. It needs to plan in advance to supply soil with balance K during cropping season. Treating soils with lime have been found to increase K retention in soils particularly in low pH soils. Adding large amounts of fertilizer K generally increasing K fixation in soils. Because solution K concentration is generally increased, disturbed the equilibrium between soluble and fixed K. Potassium leaching from a soil fluctuates in accordance with the quantity and intensity factors. Despite low K content in tropical soils, considerable K may be lost by leaching due to heavy rains. Application of K biofertilizers during crop period improved crop yield in many crops [2].

Epilogue

Comprehensive knowledge about the forms of K and their relationship among themselves help in assessing the status of K and its availability in soil. Use of potassic fertilizer and their management practices increased crop yield and quality of produce under K deficient soil. In management practices apply of potassic fertilizer on the basis of soil test and crop requirement are advised. Enrich compost can prepare with the help of mica in balance amount, which will be improved soil organic carbon and K content in soil. Integrated nutrient management studies are also playing crucial role to improve soil solution K and crop yield. More research should be done on different fractions of K in soils under different cropping system in different agro-climatic zones.

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COVID-19 – A Morality Tale for the New Phase of Fight Back

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Summary
The impact of on the economy is no doubt devastating. No sector has escaped its impact. Its impact on agriculture is complex and varied across diverse segments that form the agricultural value chain. Even among the different segments, its impact varies widely different regions and among producers and agricultural wage labourers. This impact will reverberate across the larger economy and will linger longer than a few months.

Introduction
The ongoing health crisis around COVID19 has affected all walks of life. Protecting lives of people suffering from the disease as well as frontline health responders have been the priority of nations. Governments have swung into actions since the Corona virus attack created an unprecedented situation. During these challenging times, how does Indian Agriculture respond to the crisis and how do government measures affect 140 million farm households across the country and thereafter impact the economy of a very important country in the developing world? We assess the immediate challenges that COVID19 has posed to the farm sector and suggest mitigation measures to ensure a sustainable food system in the post-crisis period.

Implications of COVID -19 on Indian Agriculture
1. Making the food grains, fruits and vegetables and other essential items available to consumers, both in rural and urban areas, is the most critical challenge for Government machinery during the lockdown period. Smooth functioning of the supply chain, with adequate safety measures for the people involved, is of paramount importance.

2. Transportation of public distribution system (PDS) items to last mile delivery agents, by both rail and road, has to be ensured by respective Government agencies. Distribution of the commodities to vulnerable population, while maintaining prescribed guidelines and protocol, particularly of social distancing, must be effectively monitored.

3. Foreseeable delay in supply of seeds to farmers for Kharif season which aroused due to delay in logistics of seeds also the local vigilantes threatening the closure of seed production hubs and production facilities

4. Supply of agrochemicals to the farmers might remain limited due to current domestic inventory and import of technical gradient and formulations from other countries remained uncertain.

5. Possible delays in the production of fertilizers since the fertilizer companies are dependent on the foreign import of the raw materials.

6. Drastic impact on the dairy sector as the milk collection centres are almost closed or offering lower rates.

7. Steep decline in exports of tea, meat, spices, along with a reduced demand from the domestic segment such as retailers, hotels etc.

8. Drop in arrivals of perishable commodities such as fruits and vegetables to the markets and the farmers are suffered with decrease in the price realization.

9. Lower price realization for poultry farmers i.e. average loss of Rs.130 per bird due to decreased demand for poultry products resulting from fake fear propaganda. This has led to an approximately 40% decline in maize

prices, financially impacting farmers in Bihar, Andhra Pradesh and the North eastern belt where maize is planted in Rabi and harvested from April to June.

10. Underutilization of storage capacity of cold storages and warehouses due to lack of inward movement that will result in financial losses.

Proven Mitigation Measures During this Pandemic

1. 59 % of farmers reported that there will be a positive impact in agriculture in future by savills rural research institute, England where it is a time to change traditional marketing to alternate marketing systems.
    a. Direct supply chain model.
    b. Virtual marketing.
    c. Marketing through FPO, FPC and Cooperatives.
    d. Direct linkage to the consumers.

2. In Maharashtra the FPO have pooled up themselves in providing inputs 20 percent lesser than the original costs.

3. Roadsides stall for marketing for different perishable commodities have gained 11 percent more price rather submitting their produce to APMC.

4. A solar powered vending van was used by the University of Agricultural Sciences, from COVID are definitely going to help them with sincere implementation. The focus of the Government therefore has to be to protect the lives of every citizen. However, people living on agriculture and allied activities, mostly those Dharwad in providing the produce at doorstep by incorporating humidity chambers in it.

5. Mobilizing of additional fleets of combined harvesters form other states as in case of Punjab for procurement of Wheat.

Suggestive Mitigation Measures

1. The poor sections of society are always the hardest hit in any disaster or pandemic situation. With about 85 percent of Indian farm households being small and marginal farmers, and a significant part of the population being landless farm laborers, welfare measures to contain any damage losing their income from informal employment at this lockdown period, have to be provided with alternative avenues (cash transfers) till the economy bounces back (when this health crisis is successfully overcome).

2. To sustain the demand for agricultural commodities, investments in key logistics must be enhanced. Moreover, e-commerce and delivery companies and start-ups need to be encouraged with suitable policies and incentives.

3. The small and medium enterprises, running with raw materials from the agriculture and allied sector or otherwise, also need special attention so that the rural economy doesn't collapse.

4. To obviate the immediate concerns of scarcity of farm labour, policies must facilitate easy availability of machinery through state entities, Farmer Producer Organizations (FPOs) or custom hiring centres (CHCs) with suitable incentives. It is also suggested to explore leveraging NREGS funds to pay part of the farm labour (with farmers paying the balance wage amount) to lessen the monetary burden on the farmer, while ensuring wage employment to the landless laborers and workers.

5. To answer queries relating to the announced measures of Government and addressing grievances of farmers, besides providing advisories on farm operations; availability of agri-inputs, dedicated toll-free helplines/call centres (in local/vernacular languages) must be established by the Government.

6. Agriculture in India is a State subject, and as has been observed in past years, policies and programs vary from one State to the other. However, agricultural activities, being interconnected in neighbouring regions, agri-sops or benefits must not distort the market scenario. Waiver of farm loans, evidences suggest, have not fully benefitted the majority of small and marginal farmers. Rather, it affects the future credit behaviour of the

borrowers and thus negatively impacts the agricultural credit culture altogether. As the kharif (rainy/wet) season is fast approaching, institutional lending of crop loans should be expanded and facilitated for smooth (and sufficient) flow of credit to borrowing farmers. Agri-inputs – seeds, fertilizers, agro-chemicals, etc. – have to be pre-positioned for easy availability. Private sector must play a big role with necessary policy support.

7. Under the COVID19 pandemic, being a health crisis of unprecedented proportions, the major share of future Budget allocations obviously (and logically so) would be apportioned for the health sector. However, investments should not be crowded out of the primary sector to prevent irreversible damage to the farm economy. Manufacturing and services sectors may be severely hit in the short run till the time the economy bounces back. It will be thus very appropriate to focus attention on the agriculture sector as a growth engine and also to bring resilience in food (and nutrition) security.

8. Structural reforms such as land leasing, contract farming and private agricultural markets, etc. have proven long back to bring enhanced investments into the agriculture sector and to push its growth. However, there has not been uniform implementation of these legislations by State Governments and so the full potential of the sector is unrealized. These reforms need significant political will. Concerns of a slowdown in the zeal of States, post-COVID scenario, could be tackled with suitable incentive mechanisms by the Federal Government to the States.

9. With a burgeoning population, there is a corresponding rise in food demand in India. However, the negative externalities of the Green Revolution, particularly the environmental trade-offs and staple cereals fundamentalism, have since been realized. It is thus desirable to switch over to a suitable model with a far stronger nutrition focus where diets are more diverse. A post-COVID situation offers that unique opportunity to repurpose the prevailing food and agriculture policies for a healthier population.

10. There have been global concerns, rather speculations, on restriction of exports of agricultural commodities by a few global players. Development of export-supportive infrastructure and logistics would need investments and support of the private sector, that will be in the long-term interests of farmers in boosting their income.

11. A various number of climatic models say that the 2020 would be a favourable conditon (the India Meteorological Department has also since officially announced) as the El-Nino weather phenomenon, that disrupts rainfall in India, is not evident. This is indeed good news in the COVID scenario, assuming agriculture can practice largely unscathed.

12. Good news is that Government of India has now increased its focus on nutrition (besides food)- security and raising farmers' income (rather than enhancing farm productivity). Changing the consumer behaviour with suitable programs and incentives is already in the agenda.

13. Focusing on small and medium scale industries that produce seeds by providing the credit to run since the transport and supply to the farmers is easier and cost effective.

14. Manufacturing of the technical gradient and formulations that are nearer to expire the patent in the coming couple of years by the indigenous pesticide manufacturing units would suffice to limited import of the technical gradient and it could be possible only if the government does the faster processing of generic products.

15. A gradual shift of using inorganic fertilizers to manures by encouraging technical manufacture of the organic fertilizers and composts by the fertilizer companies.

16. Establishment of bulk milk collection centre one in one village that would collect all the milk without being contaminated and packing that milk in tetra packs that last longer and also produce the processed products that arise out of milk.

17. Use of the migrant labour in the native towns or villages as the most of the industries fall short of labour by giving them pay which would suffice "Food for Work"; also, it satisfies the statement "Lives vs Livelihood".

18. To start the processing of fruits and vegetables which are in surplus by taking them directly from the farmers.

19. Meat and chicken processing units are to be run with full so as to curtail the stigma of consuming the chicken and meat during this pandemic and the cease the false propaganda.

20. Creating one mobile application which includes the area, product, its quantity and the producer who sells them. This would enable the consumers where the actually the produce is and the local bodies may provide transport via delivery boys for home delivery itself.

Conclusions

Not all solutions mentioned above are long running but are helpful just to overcome this uncertain situation till everything is normalized. But some like change from inorganic to organic agrochemicals; also manufacturing of the technical gradient and formulations in India itself is a sustainable and long running measure. If we can actually maintain a common mobile application app scrupulously for the sale of produce in a transparent manner it would create huge impact on the producers positively as well as also in the consumers. The ground level of all the solutions lies in the developing villages by providing a link to all the markets. Also, the establishment of seed production hubs in the rural areas would also create employment and increases the supply chain management in fair and transparent manner. And it is again overcoming the line “Mandate vs Expectations” that would decide governments to implement the solutions. The solutions have followed the priority viz. Health, Food, Economy which is essential not only in this situation but also in future. The solutions don’t deviate from the line “Growth vs Stability” which has become unavoidable for all to overcome this pandemic.

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Biological Control of Citrus Psylla *(Diaphorina citri)* on Nagpur Mandarin

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Introduction

Common Biological control by predators, parasites and pathogens of rural nuisances has been happening since the start of developmental procedure of yield plants. It was soon after the Second World War, the achievement of compound pesticides, for example, DDT and 2, 4-D got known. People in general in the long run showed signs of improvement pesticides for powerful control of different vermin and ailments. From that point forward, engineered pesticides improvement and their broad use in farming went up. Be that as it may, the open recognition progressively changed in regards to their utilization, particularly after the distribution of Rachel Carson's "Quiet Spring" in 1962 and a few related reports on the harmful impacts of pesticides in horticulture. Afterward, since Earth Summit in 1992, Agenda 21 plainly characterized the requirement for restorative measures to contain the utilization of pesticides for achieving economical farming and natural wellbeing.

During the previous two decades, the Asia-Pacific Region is gaining consistent ground in defending its harvests from bothers through the utilization and control of natural control specialists. As needs be, there has been developing interest recently towards scan for predators, parasites and pathogens. It is likewise evident that a specific natural control specialist may not generally react similarly and the reaction may change with the earth, territory and the degree of nuisance populace. Subsequently, for every one of the natural control specialists, a point by point logical investigation for expanded effectiveness is somewhat fundamental.

Outsider species are perceived as the second biggest danger to organic assorted variety, the first being living space annihilation. The intriguing vermin without their characteristic foes, which they leave in their unique home, cause remarkable harm. Monetary effect of intrusive irritations is colossal. Outlandish weeds (amphibian, earthbound and parasitic) meddle with development of yields, loss of biodiversity (local plant species are uprooted) and biological system versatility, loss of conceivably profitable land, loss of brushing and domesticated animals creation, harming of people and domesticated animals, disintegration following flames in intensely attacked territories, stifling of navigational and water system waterways and decrease of accessible water in water bodies

Biological control, for example protection, growth and presentation of intriguing normal adversaries, has been acknowledged as a viable, naturally non-corrupting, in fact suitable, financially practical and socially worthy strategy for bother the executives

The historical backdrop of natural control goes back to the seventeenth century and from that point forward a lot of accomplishment has been accomplished in organic techniques for bug control. In India, composed and orderly natural control inquire about started with the foundation of the Indian station of Commonwealth Institute of Biological Control (CIBC) at Bangalore in 1957.

Traditional natural control targets presenting the fascinating normal adversaries of unintentionally presented outsider life forms (which have become bugs without common checks in the new condition) so as to restore the harmony between the nuisances and characteristic foes. Presentation of host-explicit life forms from the nation of birthplace of the vermin offers some exceptionally powerful and naturally benevolent answers for the issue of attacking outsider nuisances.

Materials and Methods

Biological control alone isn't adequate in controlling organic product flies to middle of as far as possible. This must be enhanced with other control estimates sway. Taking into account very low resilience levels of organic product misfortunes and to guarantee natural product creation in pesticide free condition, procedures for controlling creepy crawly are changing worldwide from depending on one control measure to incorporated bug the executives (IPM).

Examining occurred in citrus creating regions in india. Citrus plantations will be inspected from September to December. At all locales, the testing date, the quantity of trees examined, the assortment of the trees and the nearness of Citrus psylla its visual side effects and parasitoids were recorded. Visual side effects of Citrus psylla on citrus, rather than those of *Diaphorina citri*, comprise of pit nerves projecting from the upper surface of the leaves, chlorosis and leave curving.

From those regions and trees where Citrus psylla will gathered, the psyllids were shipped to the research facility to recognize potential parasitoids, decide their relative wealth and parasitism rates in every area.

Results

Citrus psylla has become an intense nuisance in all citrus developing zones of India. It assaults all pieces of the plant over the ground. It is a known vector of the ailment 'citrus greening'. The creepy crawly discharges nectar which aggregates on the plant leaves and twigs. Dirty moulds create on the nectar and the plant gets dark meddling with photosynthesis of the plant consequently in a roundabout way influencing plant yield. Creepy crawly benefits from plant sap and under high populaces plant begin kicking the bucket.

1. Distribution: It is generally circulated in south east Asia and South West Asia and is additionally known from Mauritius and Reunion in Africa, Brazil in South America and has extended to Caribbean.

2. Seasonal Abundance: The nuisance finished its life cycle in 15-74 days and had 9 ages per year. All stages were found consistently and no hibernation happened in a specific stage. Grown-ups live long, some of the time as long as 189 days. In India citrus psyllid was discovered generally copious in February, March and September.

3. Biological control: Old style organic control is utilized for the most part against vermin of remote beginning and includes the presentation of authority characteristic adversaries from their country. The goal is long haul, for example to build up populaces of these common foes to assault the vermin and to lessen its numbers. Exceptional consideration ought to be taken so as to evade conceivable non-target impacts.

Augmentative organic control builds the populaces of the common adversaries by methods for gigantic arrivals of specialists bought from bio-industrial facilities. Augmentative natural control might be either inoculative or inundate. In the inoculative methodology, the regular adversaries are presented in little numbers from the get-go in the season. These common adversaries set up, duplicate and feed on the bug and in this way, they can stifle the nuisance populaces. This methodology is usually utilized in nursery crops against different irritations, for example, whitefly and aphids. The inundate methodology includes mass arrivals of financially raised regular adversaries. This methodology is utilized for fast bug concealment, when the number of inhabitants in normal adversaries is relied upon to be low and inadequate to control the irritation.

Protection organic control includes the control of the agrarian condition to save and improve the current populaces of normal foes. Control may incorporate the arrangement of elective food hotspots for regular foes, for example, nectar, dust, elective prey, or safe house for overwintering destinations

Natural control is the foundation for IPM an environment put together system that concentrations with respect to long haul avoidance of bugs or their harm through a mix of strategies, for example,
1. Biological control.
2. Cultural techniques (natural surroundings control, alteration of social practices, and utilization of safe assortments).

3. Pesticides (simply subsequent to observing demonstrates they are required and applied in a way that limits dangers to human wellbeing, valuable and non-target living beings, and the earth).

Conclusion

Creepy crawly insect on citrus in india have rich characteristic adversary edifices and for the most part is under normal control. The Citrus psylla is well under regular control and need no measures to be applied against them. Citrus psylla normal adversaries' buildings, anyway a portion of the farming practices sway on characteristic foes that should be recognized. There is have to create strategies which empower normal control. Parasitoids related with natural product flies are their principle mortality factors, along these lines, organic control through expansion and preservation of parasitoids coordinated with other non-pesticide estimates should be tried with all-encompassing methodology in citrus on territory wide premise. A portion of the parasitoids have been recognized in the paper for acquaintance in India with improves the current normal adversary fauna of the irritations. Citrus is an enduring harvest along these lines every negative methodology of applying bug sprays ought to be stayed away from.

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Canopy Management in Agroforestry

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Introduction

1. Canopy management: It is the manipulation of the canopy of tree species, especially agroforestry tree species, integrated on the farmland with field crops to make it compatible and suitable with associated crops. Canopy management plays a very important role in managing shade. Manipulation of tree canopy in the agroforestry system is essential as canopy size regulates the transmission of photosynthetically active radiation to the understorey crops.

2. Main purpose: To make multipurpose tree species suitable and compatible with the associated arable crops in an agroforestry system.

Prerequisite of Canopy Management

1. Full understanding of the crown architecture and growth.
2. Nature of the companion crops.
3. Objective of the agroforestry system.

Basic Principles of Canopy Management

1. To make the best use of the land.
2. To allow maximum use of available solar radiations for increased productivity.
3. To make it convenient in carrying out the cultural practices.

Canopy Management Practices

The practices for managing tree canopy are as follows:

1. Pruning.
2. Coppicing.
3. Pollarding.
4. Lopping.
5. Crown Lifting.

Pruning

Pruning is a practice of selective removal of plant parts such as branches, buds, or roots. It is a significant approach to regulate above-ground competition in the agroforestry system. Pruning helps in increasing the light transmission in the agroforestry system and thereby, increase the crop production.

1. Objectives of pruning:

a. To increase crop production.
b. To improve the wood quality (no nodular wood).
c. To enhance fodder and mulch production.

2. How to prune?

a. Cuts should be made at a 45-degree angle to reduce the surface area of the cut,
b. There should be about ½ inch distance to the next bud while cutting to avoid damage to the bud.

c. Pruning should be more concentrated on an outward-facing bud which will produce new growth farther from the centre of the plant and make it more open.

3. When to Prune?

Basic Considerations for time of Pruning:

a. In the case of dead, damaged, diseased, and dying wood, pruning can be done any time of the year whenever it becomes apparent.

b. Spring-flowering trees should be pruned after they bloom for the season since the flower is growing on wood that was produced during the previous year's growing season.

c. Summer-flowering trees should be pruned in late winter (after the threat of frost) and/or before new spring growth occurs.

d. Trees without flowers should be pruned when they are dormant, typically in mid-late winter or early spring, before new growth comes up.

4. Age of Pruning: It should be done as early as possible (at the age of two).

5. How much should be pruned?

The amount of plant parts that should be removed depends on the species, tree size, and age, as well as the pruning objectives. The optimal pruning intensity should involve a trade-off between maximizing gains both in crop production and wood quality and minimizing impacts on tree growth.

Coppicing

Coppicing is the practice of cutting back of young trees almost to ground level (around one-foot height) to harvest the wood. The new growth then develops from the cut shoots. Thereafter, the new shoots are allowed to grow until the maturity and the cut back again. Coppicing increases the ground cover per tree so that lesser plants need to be planted.

1. Purpose of coppicing: It is applied in different agroforestry systems to harvest wood, fodder, mulch, and other biomass and to reduce shade for the adjacent crops.

2. Coppicing frequency:

a. The optimum coppicing frequency to ensure survival and rapid recovery will depend upon species, environment, and amount of foliage left.

b. It can be done regularly for mulch and fodder. Depending upon the tree species used and the crop with which it is grown, coppicing can be done 4 to 5 times in a year (sometimes even more).

Pollarding

It is the removal of all the branches and top of the tree at a height of around 2 meters or so above the ground level. The pollarded tree is then allowed to resprout, and it requires regular maintenance through pruning.

1. Purpose of pollarding: Pollarding is carried out to extract fodder, wood, leaf biomass for mulch and other purposes and to minimize shade for the associated crops. It also safeguards valuable timber or poles from being browsed or damaged by browsing animals.

2. When to pollard?

The late winter or early spring is the best time for pollarding most of the trees and shrubs. However, pollarding should be avoided in those species like Acer in spring when they are prone to bleeding sap. Pollarding in such species can be done during summer. The pollarding should not be done in autumn, as decay fungi may enter the pruning cuts.

3. Age of pollarding: Pollarding can be carried out at the age of 2 to 3 years old.

4. How to pollard?

a. In case of a tree, it is more typical to leave a trunk supporting three to five branches and these branches are cut to a desired length i.e., 1 to 2 inches from the main stem.

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b. On a shrub, this might be a one stem cut to a meter above; a mass of stem will grow from the top.

Lopping

Lopping is the harvesting of the branch in a more haphazard way. Branches with good, green leafy biomass are selected. Those branches can be cut off with a cutlass at any point, not necessarily close to the trunk. Branches can be removed anywhere from the tree. However, should not cut too many branches at a time.

1. Purpose of Lopping: The main reason for lopping is to collect the fodder.

2. When to go for lopping?
The lopping can be done at any time when fodder is required.

Crown Lifting

Crown lifting is the removal of lower branches of trees that may be causing an obstruction or hampering the growth of associated crops growing beneath the canopy. It is done either by removing whole branches or those parts that extend below the desired clear heights to provide the tree with a clean bole.

Conclusion

The gains of agroforestry research concerning canopy management to date are certainly impressive. However, to transform present-day agroforestry into high tech scientific adventure in the future, there is a need to consistently update the technology to attain predictable understanding that will have wider applicability. Suitable management of tree canopies, permitting adequate transmission of photosynthetically active radiation beneath canopies has been found more critical for improving the productivity of associated arable crops.

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Regenerative Agriculture

Article ID: 31433

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Regenerative agriculture is a conservation and rehabilitation approach to food and farming systems. It focuses on topsoil regeneration, increasing biodiversity, improving the water cycle, enhancing ecosystem services, supporting bio sequestration, increasing resilience to climate change, and strengthening the health and vitality of farm soil. Practices include recycling as much farm waste as possible and adding composted material from sources outside the farm. Regenerative agriculture on small farms and gardens is often based on philosophies like permaculture, agroecology, agroforestry, restoration ecology, key line design, and holistic management. Large farms tend to be less philosophy driven and often use "no-till" and/or "reduced till" practices.

On a regenerative farm, yield should increase over time. As the topsoil deepens, production may increase and fewer external compost inputs are required. Regenerative Agriculture, which we define as agriculture that protects and intentionally enhances natural resources and farming communities. Among its many benefits, regenerative agriculture principles can pull carbon from the air and store it underground to fuel a vast array of life. Also, keeping the soil protected from erosion under an armour of living plants and crop residue can help suppress pests by promoting natural competition to reduce the need for synthetic pesticides.

Regenerative Agriculture works best when the farming or ranching operation is viewed as an ecosystem. There are six core principles of regenerative agriculture that we use as the basis for our work.

Measuring Outcomes

We believe measuring outcomes is critical to ensure that regenerative agriculture practices lead to desirable outcomes. Our approach seeks to connect regenerative agriculture practices to real and measured outcomes across five key areas:

1. Farmer Economic Resilience: By restoring and enhancing natural ecosystem processes like water and nutrient cycling, pest predation and weed competition, regenerative agriculture improves ecosystem function and builds resilience over time. This supports productivity, while reducing reliance on inputs needed to combat system stressors like pests, nutrient deficiencies, and diseases.

2. Soil Health: Soil is a complex ecosystem that forms the base of the food chain for humans and all land animals. Soil also plays an essential role in balancing the earth's ecosystem and our climate. Healthier soil can hold more water, increase resilience to floods and droughts, supply more nutrients to plants, and purify water.

3. Water: Crops, animals and communities rely on clean water to flourish. Regenerative agriculture helps maximize water use efficiency in rain-fed and irrigated systems. In addition to water utilization, these same practices can reduce agriculture's impact on water quality, helping to protect and restore clean water in nearby streams, rivers and lakes.

4. Biodiversity: Diversity in plants, grazing animals, wildlife and insects helps to improve soil health and build resilience to pests and diseases in farm and ranch ecosystems.

5. Cow and Herd Well-Being: Health of the ecosystem is linked with the health of the cow. Regenerative agriculture includes rotational grazing and feeding cows a diverse mix of crops, both practices that support cow health. Healthier cows build resiliency back into the whole dairy ecosystem.

Principle

1. Increase soil fertility.

2. Work with whole systems (holistically), not isolated parts, to make changes to specific parts.
3. Improve whole agro-ecosystems (soil, water, and biodiversity).
4. Connect the farm to its larger agro-ecosystem and region.
5. Make holistic decisions that express the value of farm contributors.
6. Each person and farm are significant.
7. Payment can be financial, spiritual, social, or environmental capital ("multi-capital"). Relationships can be "non-linear" (not reciprocal): if you do not get paid, in the future you can be given other "capital" by unrelated parties.
8. Continually grow and evolve individuals, farms, and communities.
9. Continuously evolve the agro-ecology.
10. Agriculture influences the world.

Practices

1. Permaculture design.
2. Aquaculture.
3. Agroecology.
4. Agroforestry.
5. Soil food web.
6. Livestock: well-managed grazing, animal integration and holistically managed grazing.
7. Sheer, total and utter neglect (STUN) breeding.
8. Keyline subsoiling.
9. Conservation farming, no-till farming, minimum tillage, and pasture cropping.
10. Cover crops & multi-species cover crops.
11. Organic annual cropping and crop rotations.
12. Compost, compost tea, animal manures and thermal compost.
13. Natural sequence farming.
14. Grassfed livestock.
15. Polyculture and full-time succession planting of multiple and inter-crop plantings[5].
16. Borders planted for pollinator habitat and other beneficial insects[5].
17. Biochar/terra preta.
18. Ecological aquaculture.
19. Perennial crops.
20. Silvopasture.
21. Alternative food networks (AFNs), commonly defined by attributes such as the spatial proximity between farmers and consumers.
22. Home gardens, to mitigate the adverse effect of global food shocks and food price volatilities. Consequently, there is much attention towards home gardens as a strategy to enhance household food security and nutrition.
23. Regrowing vegetables, for recycling and sustainable living.

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Processing of Paddy and their Impact on Rice Quality

Article ID: 31434

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Summary

Rice is the food for almost one-portion of the total people. Rice is created in a wide scope of areas. It is created at temperature scope of 17-330 C and elevation scope of ocean level on seaside fields to a stature of 2,600 meters on the inclines of Nepal's Himalaya. Above 100 nations of the world produce rice and over 25 nations produce more than one million tons. Practically 90% of world rice is created and devoured by the Asian nation. Outside Asia, the second biggest rice creating district is in the Americas (5.5%), trailed by Africa (3.4%) and Europe (0.67%). White rice which is processed from the paddy though parboiled rice alludes to the rice which is incompletely cooked before the processing in the husk. Rice processed without parboiling (alluded to from this point forward as rice) is white in shading subsequently is called white rice, while rice processed in the wake of parboiling (alluded to henceforth as parboiled rice) is yellowish.

Introduction

Parboiling is vitality and works escalated pre-processing process planned for improving the nature of rice. Parboiled rice got by treating paddy rice with water and warmth before it is dried and processed. In South Asia, 90% of the world's parboiled rice is created and expended. Utilization of parboiled rice appears to have been expanding as of late. Processing of paddy with no pre-treatment is profoundly defenceless to breakage and loss of minerals and nutrients. To diminish breakage and loss of minerals and nutrients. Pre-treatment known as parboiling was created. The reason for the procedure is to create physical and concoction alteration in the grain with monetary, wholesome and viable points of interest. During parboiling, irreversible expanding and combination of starch granules happens and changes starch from crystalline to indistinct structure. The agronomical conditions, particularly the climate during the reaping period, likewise decides the requirement for parboiling before processing. For instance, practically all the rice collected during the stormy season (early gathered) is parboiled to lessen the breakage during processing. Parboiled rice can be put away without refrigeration for longer than a year. It tends to be devoured during the time moving along without any more handling aside from bubbling in water and hence, it is viewed as handily arranged nourishment.

The adjustments in the previously mentioned material properties are needy upon the diverse parboiling techniques utilized, which go from conventional 'splash channel cook-dry' strategies to ' dry warmth' parboiling. To prescribe enhancements in parboiled rice handling, a superior comprehension of material properties changes happening during preparing is fundamental. Among others, dispersion is a key factor in controlling the adjustment in material properties of rice parts during the parboiling procedure. Thus, this examination has concentrated on the material changes that are brought out by dissemination forms in rice grains.

Methods of Parboiling Rice

These were the conventional technique, improved procedure and present-day the technique of which the initial two are polished in Ghana. The customary philosophy utilizes basic devices like earthen or metal cooking pots and a close-by stream or dam fills in as a wellspring of water. The paddy isn't cleaned before dousing and the power of warmth supply was high Also the volume of water utilized at splashing and steaming stage is the equivalent. The cutting-edge parboiling technique utilizes refined apparatuses like tanks, electric warmers, and steam pipes and so on and best in class gear to do the drenching, steaming and drying forms. The improve strategy is a mix in bits of the customary and present-day strategies. In the improved approach, pre-dousing exercises, for example, washing, destoning, and the partition of juvenile seed and so on are done. Dousing is done in warm water not bubbling water. Likewise, little water is utilized at the steaming stage when contrasted with the high volume of water utilized in a customary strategy that will normally be cooked the paddy toward the finish of the procedure.

Processing of Parboiling Paddy Rice

Flow chart:

Impact of Parboiling on Processing Quality

In rice processing a few components are answerable for breakage of the part splitting of the piece is one of the fundamental factors for breakage. Splits created because of postponed reaping, sifting or fast drying. In developing and white apparatus impact processing out turn and quality.

Rice breakage is identified with processing conditions, especially by the relative mugginess, temperature and degree of processing. During shelling or husking activity, breakage happens. Parboiling of paddy brings about decrease of breakage imported to a bit on account of gelatinization of starch the splits inadequate grains filling and whiteness are recuperated.

The most points of interest part of parboiling are the expansion in the head the yield of rice during cleaning, the clean rate and breakage with time however parboiled rice takes longer occasions than push the rice to achieve the same level of cleaning. Parboiled rice expects three to fourfold the amount of rough burden as column rice for the same degree of cleaning.

According to preferring for the shade of rice the need of cleaning for parboiled rice less when contrasted with push rice for instance if the shopper needs 80% wheat expulsion to accomplish this parboiled rice needs cleaning of 3% whereas push rice must be cleaned to 4% for the same amount of grain evacuation.

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Conclusion

The level of gelatinization of starch, a physical, substance and natural parameter of incredible significance in processed rice quality, was resolved, what's more, found to increment on expanding the term of hot drenching. The impact of gelatinization on parboiling made the grain more grounded, which improved processing characteristics. One significant factor for shopper inclination is physical appearance, specifically, translucency, and this was extraordinarily improved by utilizing longer hot splashing treatment delivering a gelatinization of above 57%. The degree of murkiness, different rules for customer inclination, was additionally improved by broadening the hot drenching time. At last, it might be presumed that at least around 45-min splashing at 800C followed by steaming for around 10 min under 1 air overabundance pressure is important to improve all the required characteristics of rice for better shopper inclination. These figures are the proposal that can be made to the rice mill operators to improve the processing nature of parboiled rice, just as expanding the pace of supply by decreasing the splashing time from 24–48 h to 45–120 min.

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Probiotics: Benefits and their Application

Article ID: 31435

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Summary

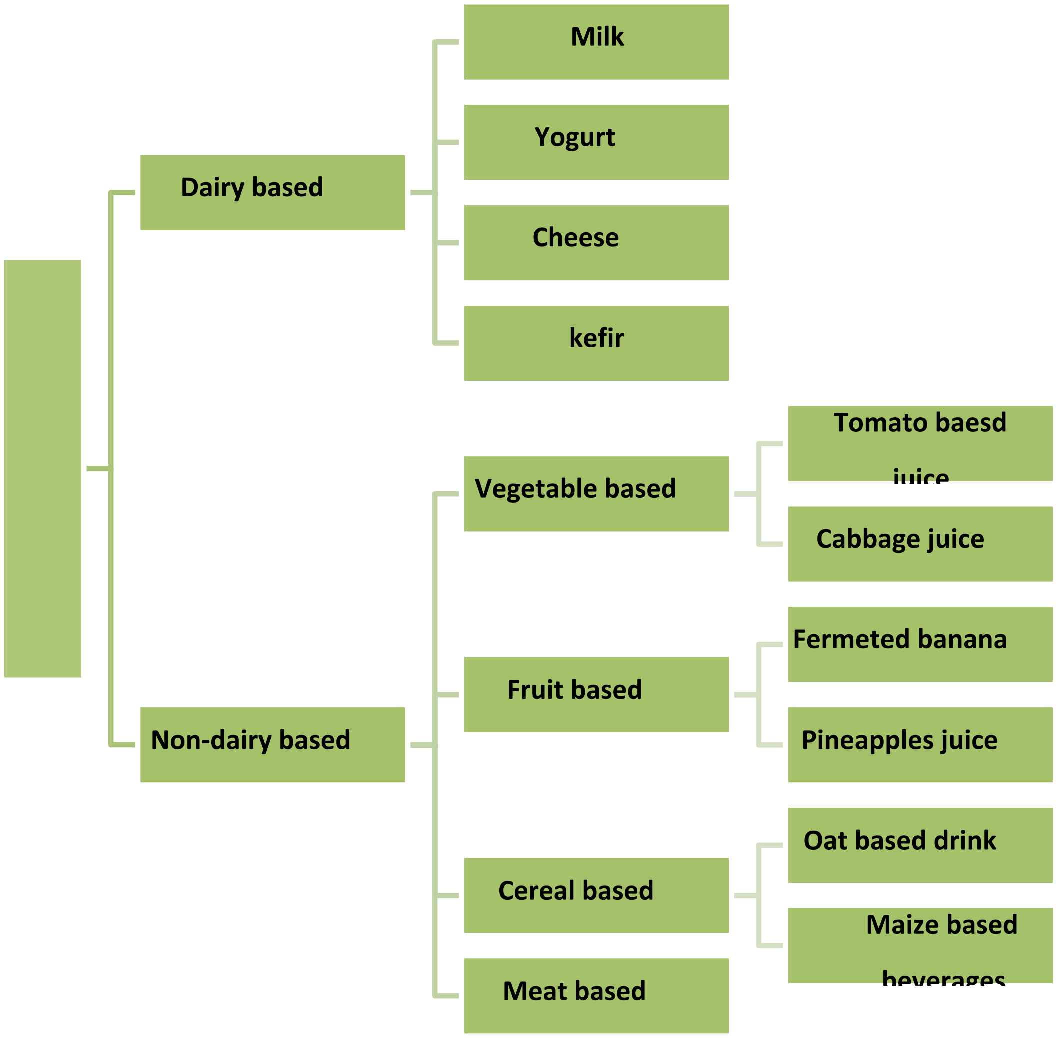
Probiotics are non-pathogenic live microorganism that can provide a numerous health benefits at the host while consumed in diverse approaches along with dairy product, food supplements and characteristic meals with specifics health claims. There was no enormous difference among the controls and the organizations receiving 250 and 750 ppm Probiotic on food consumption, meals conversion ratio and damaged egg ratio. In addition, the egg yield, egg weight, precise gravity, and peripheral immune reaction showed no statistically tremendous differences among the organizations. Several probiotics have been proven to reduce airway hyper-responsiveness and disease by producing regulative mechanisms. Promising consequences have been acquired with Probiotics in the remedy of human inflammatory diseases of the gut and in the prevention and treatment of atopic eczema in neonates and toddlers.

Introduction

Probiotics are living microorganism and yeasts which are desirable for you, in particular your digestive machine. We typically assume of those as germs that purpose illnesses. But the body is complete of bacteria, each right and terrible. Probiotics including Lactobacillus and Bifidobacterium yield specific sorts of antibacterial substances and stimulate the host immune device thru various mechanisms. The immune-modulation interest of Probiotics turned into additionally proposed in extraordinary illnesses. For instance, Probiotic supplementation may want to improve and save you signs and symptoms of autoimmune disorders. Lactic acid bacteria (LAB) are familiar and natural inhabitants of the human gut micro-flowers. LAB is likewise abundant in fermented food products, in particular dairy products along with yogurt and cheese. There is little proof that LAB contained in fermented ingredients is pathogenic to human beings, and certainly many lines can readily and thoroughly persist in the human intestine. A few lines of nutritional LAB can impart physiological benefits to their clients, which could consist of increasing gut function, reducing cholesterol, growing the uptake and assimilation of micro-vitamins, preventing GI tract pathogen infection, and enhancing immunity.

One of the usual crucial ways in which Probiotic LAB can provide physiological blessings is through enhancing immune function. This effect is particularly critical amongst those businesses of individuals who may have below-advanced or sub-optimally functioning immune structures, which include the younger, the antique or immune-compromised people. While the proper functioning of all components of the immune device is vital in retaining health, sure businesses may also revel in a more pronounced deficiency in a single specific side of immune system. First, probiotic microorganism can decorate the probity of the colonic barrier. Bifidobacterium infant increases resistance in an in vitro version of the intestinal barrier (T84 human epithelial cells), and different Probiotics, consisting of Lactobacillus Plantarum, act on tight junctions with the aid of growing the expression of zonulaoccludins proteins and occluding. They can also reduce the adhesion of pathogens and their pollutants to the gastro-intestinal region through their potential to adhere to colonic epithelial cells. In vitro studies they have established that Probiotics have their own lectin that is adhesion components which are able to bind on carbohydrates from glycoconjugate receptors of the epithelial cellular surface, hence they blocked.

Applications



Benefits of Probiotics on Human Health

1. Probiotics are helping in balancing the living bacteria which are present in your digestive system.
2. Probiotics help in preventing and treating diarrhoea.
3. Probiotics are taken as "Supplements" improve the mental health conditions.
4. Some Probiotics help in maintaining your heart healthy.
5. Probiotics may help in decreasing the chance of allergy.
6. Probiotics may accommodate to boost your immunity and also fight against various infections.
7. Probiotics may help you in weight loss and also remove extra fat from the body.

Conclusion

Useful outcomes of probiotics to hold our body in accurate health are nicely documented. However, purposeful homes of probiotics pastime are quite exceptional even inside an identical species and identity of practical probiotics stain is a large assignment. So, a ways maximum of the probiotic screening structures is based totally at the measuring of resistance in opposition to gastric acidity and bile toxicity. Prebiotics appear like interesting gear to save you hypersensitivity when they are administered in babies throughout the primary month of lifestyles. This destiny research may additionally allow us to recognize extraordinary mechanisms,

which include the status quo of intestinal flora and its effect at the immune device.

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Association Mapping and its Significance in Plant Breeding

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Association mapping is an advanced version of Quantitative Trait Locus (QTL) mapping for the dissection of complex agronomic traits, detection of QTLs and for the identification of alleles based on the linkage disequilibrium. It is a very efficient and effective method for confirming candidate genes or for identifying new genes.

Introduction

Quantitative trait locus (QTL) mapping is a powerful tool for studying the genetic basis of complex quantitative traits in living organisms. In the plant genomics era of 21th century, the development of unbiased association mapping approaches with its successful applications in dissecting a number of simple to complex traits in many crops demonstrate powerful gene tagging tool. Association mapping is a high-resolution method for mapping quantitative trait loci based on principle of linkage disequilibrium that holds a great promise for the dissection of complex genetic traits and an effective method for confirming candidate genes or for identifying new genes. It is a useful and an alternative to QTL mapping approaches that involves the correlation of molecular polymorphisms with phenotypic variation in a diverse assemblage of individuals. In QTL mapping, only a limited number of recombination events that have occurred within families and pedigrees can be studied, whereas with association mapping the recombination events that have accumulated over thousands of generations can be exploited (Zhu et al. 2008). The power of association studies is determined by the size of the experimental population, the magnitude of the target allele effect, the density of markers used, and the rate of LD decay between marker and target allele as well as errors in phenotyping and genotyping data and the desired resultant statistical significance level (Gordon and Finch 2005). It is now being increasingly used in a wide range of plants rather than in humans or animals (Zhu et al. 2008).

Types of Association Studies

1. Candidate gene association mapping: Variation in a gene of interest is tested and correlated with the phenotypic trait of interest. It involves genotyping or resequencing the genes considered to have a high probability of association with the phenotype(s) of interest within the germplasm being tested. The selected polymorphisms were then screened across a larger germplasm collection using inexpensive PCR-based SNP and/or indel genotyping assays (rather than sequencing) to confirm the associations between genotype and phenotype. In another method, the partial or entire gene is sequenced in all individuals of a germplasm panel (of several hundred genotypes) to identify significant associations, either with the causal polymorphism(s) or a polymorphism that is within LD distance to a causal polymorphism.

2. Genome Wide Association mapping: Genetic variation is explored within the whole genome, aiming to find signals of association with the complex trait. However, GWA mapping should not be regarded as a replacement of traditional QTL mapping (Yu et al. 2006).

Factor Affecting Association Mapping

Many factors adversely affect association mapping, including population structure, small sample size and low frequency of specific alleles that may increase the detection of a false positive associations. Highly significant LD between polymorphisms on different chromosomes may produce associations between a marker and a phenotype, even though the marker is not physically linked to the locus responsible for the phenotypic variation. Besides physical distance on the chromosome, many factors affect the breakdown of LD, including genetic drift, natural and artificial selection, mating system, and admixture of different populations (Flint-Garcia et al. 2003). Several statistical methods have been used to control the effect of population structure in association analyses including genomic control, structured association, principal components analysis, non-metricmulti dimensional scaling (nMDS) and the unified mixed-model approach. A two-stage dimension determination approach using both PCA and nMDS has been demonstrated to be the best approach to capture the major structure of association panels to maximize the rejection of false positives while maximizing the statistical power to identify real association. Precise phenotyping is another key constraint for any marker–trait association analysis. In animal systems, it is very difficult to obtain replicated phenotypic measurements for each genotype, but in plants, it is relatively easy. Once markers have been identified that have been shown to be tightly and robustly linked to the target trait.

Procedure of Association Mapping

The exact details of the procedure depend on the chosen study design and the population structure (Singh and Singh 2016).

1. Association Mapping Population: A large random sample from a natural population or a population derived from multi parent crosses of the concerned species use for association mapping.

2. Phenotyping: The selected sample grows in field and morphologically evaluates the various traits of interest; this is called phenotyping. Phenotyping should preferably base on replicated trials conducted over locations and years to minimize environmental effects. A precise and reliable phenotyping is critical to any mapping effort.

3. Genotyping for population structure analysis: The sample then, goes for genotyping, i.e., tested with a set of molecular markers (preferably SSR markers) that are evenly distributed over the entire genome of the species. These markers should be unlinked, i.e., is located more than 40 cm apart in the genome.

4. Structure and Kinship Analysis: The marker data then, analyse to detect and estimate the population structure of the sample using the STRUCTURE program and the extent of kinship among the individuals of the sample using the TASSEL program.

5. Genotyping for LD Analysis: The sample also genotyped with a sufficiently large number of molecular markers that cover the entire genome as densely as is feasible so that LD between markers and the loci of interest can be detected. SSR and SNP marker systems are the most widely used for this purpose.

6. AM and LD Analyses: A model-based analysis of relatedness between the phenotype and the genotype data done to detect and quantify LD between the markers and the genes/QTLs governing the traits of interest. Since these analyses are computationally intensive, suitable computer programs use for their implementation.

Statistical Approaches Uses for Association Study

LD between a single marker and a QTL can be measured by regression analysis, where the data on the trait is regressed on the individual marker genotypes, so that significant regressions will identify the markers associated with the phenotype. The most commonly used statistics include logistic regression with the possibility of structured associations implemented in TASSEL General Linear Model (Yu and Buckler 2006) and a unified mixed-model approach implemented in TASSEL Mixed Linear Model (Ehrenreich et al. 2007). The basic statistics use regression analysis with different models such as MLM (mixed linear model), MLMM (Multi Locus Mixed Model) and MTMM (Multi Trait Mixed Model).

Advantages of Association Mapping

Association mapping is a valuable tool for the detection of novel genes or QTLs of important agronomic characteristics. The extensive application of this approach in crop plants is expected in the long term because of establishment of the novel high-throughput genotyping and sequencing technologies. Results from association analysis can be used to predict the best haplotype across one or multiple genes for optimum expression of the target trait. This approach has a potential to identify a single polymorphism within a gene that is responsible for the difference in phenotype. In addition, many plant species have high levels of diversity for which association approaches are well suited to evaluate the numerous alleles available.

Linkage Disequilibrium

Refers to the non-random association of alleles between genetic loci. The term was originally defined in relation to the population of alleles that reside on the same chromosome. Many genetic and non-genetic factors, including recombination, drift, selection, mating pattern and admixture, affect the structure of LD. The key to association mapping is the LD between functional loci and markers that are physically linked. To estimate the extent of LD r2 software is being used, which estimates the correlation between allelic states of two given polymorphic loci. LD decay can also vary considerably from locus to locus. This may be due to the great variation in recombination rates along the chromosomes, including a low recombination rate in centromeric regions and a high recombination rate within genic regions due to retrotransposon insertions. One of the major uses of LD in plants would be to study marker-trait association followed by marker-assisted selection (MAS). Another important application is its use in the studies of population genetics and genetic diversity in natural populations and germplasm collections and in crop improvement programmes. When comparing linkage analysis and LD mapping for QTL detection, it is revealed that linkage mapping is more useful for genome-wide scan for QTLs, while LD mapping gives more precise location of an individual QTL.

Requirements

Large population size with replication; Large number of genetic markers; Precise phenotyping; Prior genetic and biochemical knowledge on trait of interest; Prior knowledge on LD, nucleotide polymorphism, breeding system and population structure is needed; Efficient statistical software.

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Phytoecdysteroids – Promising Molecules in Pest Management

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Summary

Phytoecdysteroids are derived from plants and are analogues to ecdysteroids occurring in insects. These phytoecdysteroids when present in insect food, leads to disruption of internal titers of ecdysone and the untimely and altered levels of ecdysone leads to disruptions in insect metabolism, growth and development. Thus, they provide a scope for utilizing interesting molecules for pest management.

Introduction

Phytoecdysteroids are the analogues of ecdysteroids which are the steroidal hormones in all classes of invertebrates and occur in certain extents of plant species. The primary role of phytoecdysteroids is the protection of plants against non-adapted insect and nematode pests. They have been reported to be present in over 100 families across the pteridophytes, gymnosperms and angiosperms. Phytoecdysteroids have been known to occur in a relatively higher concentrations (0.001-3%) in different plant parts. Though, there is no regulation that phytoecdysteroids occur in particular plant parts, majority of the concentration is observed in those tissues which are vital for their survival. 20-Hydroxyecdysone (20-HE), Ajugasterone, Makisterone, Ponesterone and Inokosterone are the major phytoecdysteroids on which bioassays have been conducted.

Effects on Growth and Development of Insects

1. Inhibition of digestive enzymes: Digestive enzymes (such as α- amylase) synthesizing epithelial cells have been reported to be affected by the phytoecdysteroids. This cytotoxic effect may be directly due to enzyme activity inhibition or indirectly due to deviation of neuropeptides (sulfakinin) which are involved in regulation and signalling of α- amylase. (Ajaha et. al., 2019)

2. Reduction in larval proteins: Phytoecdysteroids are known to cause a decrease in protein synthesis especially in the fat bodies due to the deterioration of internal tissues. Exposure of larvae to the phytoecdysteroids also causes a nutritional stress leading to strong mobilization of proteins and thus depriving the larvae of its protein content.

3. Larval death: Phytoecdysteroids are known to cause many abnormalities in insects and thus hindering their growth and development, leading to death in the juvenile stages. The effects include inhibition of growth, induction of supernumerary larval moults, head capsule apolysis, unbalanced, uncoordinated side-to-side wriggling movements, haemolymph discharge from hind gut extrusion and death during induced moulting. These development defects are reported to be caused by cytotoxic effect of phytoecdysteroids on larvae's midgut.

4. Precocious pupation and adult emergence: Exposure of late instars to phytoecdysteroids is known to cause structural abnormalities such as twisted wings, non-detachment of moulted skin and head capsule. These effects on pupation and abnormal adult emergence is due to disruption of hormonal balance with levels of ecdysone in the insect body.

5. Cannibalism: Cannibalistic behaviour has been observed in storage insect pest, when exposed to phytoecdysteroids. The stressful conditions (high population and scarce food) when phytoecdysteroids are present in larval food are similar to those of starvation and are known to induce cannibalism. (Rharrabe et. al., 2009).

6. Anti-feedant activity: The anti-feedant activity of phytoecdysteroids can be attributed to its detterant action. Maxillary and labial palps of the insects detect the phytoecdysteroids and their presence on the leaf surface deters the feeding action.

7. Reduced fecundity / fertility: Phytoecdysteroids are also known to affect the fecundity and fertility in insects. They target the ovarian development, which leads to egg abortion during oogenesis, resulting in decreased fecundity and fertility. Adult mortality is also reported to be an indirect affect. Ovarian development in adults is induced by 20-HE through several molecular cascades. The transition from one stage of ovarian development to other is governed by several pathways which respond to different titres of 20-HE. The effects observed in insects could be a consequence of disruption of ecdysteroid titres.

8. Improvement of silk yields: Phytoecdysteroids have been reported to enhance synchronous development of larvae when fed at certain stages of larval development by the silkworm, Bombyx mori. Obtainable silk yield from the cocoons have also been reported to be elevated significantly when the phytoecdysteroids are co-administered with a juvenile hormone (Chandrakala et. al., 1998). Inokosterone is recognised as an important stimulus for fibroin synthesis as well as ecdysterone. These treatments have significant potential to improve the efficiency of silkworm rearing.

Conclusion

Due to their potential in invertebrate pest management, phytoecdysteroids are attracting renewed attention. Several thousand species of plants have been surveyed extensively for the presence of phytoecdysteroids and over 200 phytoecdysteroids have been isolated in the past thirty years. The literature data and results of several bioassays indicate that phytoecdysteroids play a defensive role against insect pests. The major question thus arising is their feasibility for utilization in crop protection. There is a need for more laboratory and field-based studies. The use of compounds treated with extracts of plants containing phytoecdysteroids is difficult to conceive, except in storage conditions. It can be made possible to envision cultivated plants to produce phytoecdysteroids to protect themselves from pest when stimulated. the taxonomical distribution of plants producing ecdysteroids suggests that the genes necessary for their production are widespread in the plant kingdom. Though phytoecdysteroids are not an alternative for currently used plant protection methods, they characterize stimulating molecules which can have an important part in IPM strategies in the near future.

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Bioelectricity Generation Using Ornamental Plants

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Traditional energy sources are very limited and would be exhausted in the near future. Several renewable and sustainable energy sources have been developed and introduced into the market over the century. As a continuation of such investigation, production of bioelectricity from substrates with growing plants is completely a novel, innovative and emerging technology which is eco-friendly and renewable. This technology takes advantages of the organic compounds released through the plant roots (exudates) and electrochemically active microorganisms to produce power via plant microbial fuel cells (PMFCs). PMFCs can be implemented to produce electricity as well as conserving ecosystem using green roofs, indoor garden and ornamental trees.

Bioelectricity

Bioelectricity refers to electrical potentials and currents occurring within or produced by living organisms. It results from the conversion of chemical energy into electrical energy.

Plant Microbial Fuel Cell (PMFC)

It is a derived technology of microbial fuel cell (MFC), which uses plant roots to directly fuel the electrochemically active microorganisms (EAM) at the anode by excreting rhizodeposits to generate bioelectricity.

Rhizodeposition: All material lost from plant roots, including water-soluble exudates, insoluble materials, lysates, dead fine roots, and gases, such as CO2 and ethylene.

Components of PMFC

1. Supporting matrix: Supporting matrix used in PMFC operation includes flooded soils, wetland or garden soils, sediments, vermiculite, graphite granules in which the anode and the living plant are buried

2. Plants and their function in PMFCs:

a. Vascular plants – Having xylem and phloem to store products of photosynthesis.
b. Macrophytes(hydrophytes) – Aquatic or floating plants.
c. Wetland or marshy land grasses.

Criteria for the Selection of Plants

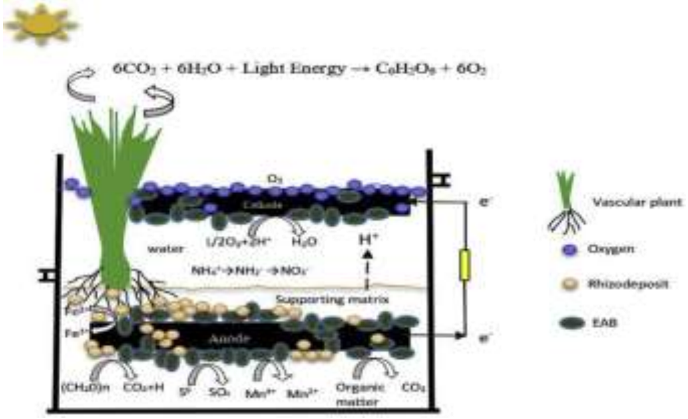
1. Hardiness.
2. Growth rate.
3. Microbial community at the rhizosphere.
4. Extensiveness of root system.
5. Tolerance and bioaccumulation abilities.
6. Local availability.
7. Adaptability.
8. Rhizodeposition - C4 plants (e.g. monocots/grass plants) exhibit high photosynthetic efficiency, which leads to an increased rhizodeposition to serve as substrate for microbial oxidation.

Microorganism in the Rhizosphere of PMFCs

Electrochemically active microorganisms (EAMs) are a group of microorganisms which are able to release electrons from inside their cells to an electrode.

Geobacter spp., *Ruminococcaceae* spp., *Desulfobulbus* spp., *Bacillus, Geothrix, Pseudomonas, Shewanella, Acidobacteria, Aspergillus, Penicillium*.

Mechanism of Substrate Conversion and Utilisation in PMFCs



1. The OM in the supporting matrix serves as the substrate and a source of energy for EABs during PMFC operation.
2. Plants produce their own food, a portion of the carbohydrate and organic substances which are not utilized or stored are excreted at the root as rhizodeposits.
3. Rhizodeposition is the loss of OM by plant roots into the root zone, which occurs through the loss of root cap or border cell, flow of organic carbon to root-associated symbionts, gas emission, solute leakage and insoluble polymer release.
4. Rhizodeposits are oxidized by EABs and other root-dwelling microbes to yield electrons.

Electron Transfer and Bioelectricity Generation in PMFCs

Rhizodeposition forms about 40% or more of the plant's photosynthetic productivity, which is broken down by EAMs found in the rhizosphere. Under anaerobic conditions, microbes oxidize the rhizodeposits for growth and development by converting the substrates into carbon dioxide, protons (H+) and electrons (e–) donated to the anode. The electrons captured by the anode are transferred to the cathode where oxygen is preferably reduced to water.

The extracellular transfer of electrons by microorganisms to the anode has three pathways:
1. Mediated electron transfer- e.g. Shewanella and Pseudomonas secrete mediators (flavins) to shuttle the electrons from bacteria to the anode surface
2. Direct electron transfer by biofilm-forming bacteria- e.g. Shewanella and Geobacter species transfer electrons through cytochromes or pili.
3. Electron transfer through nanowires- e.g. Geobacter and Shewanella use conductive appendages for electron transfer to the anode.

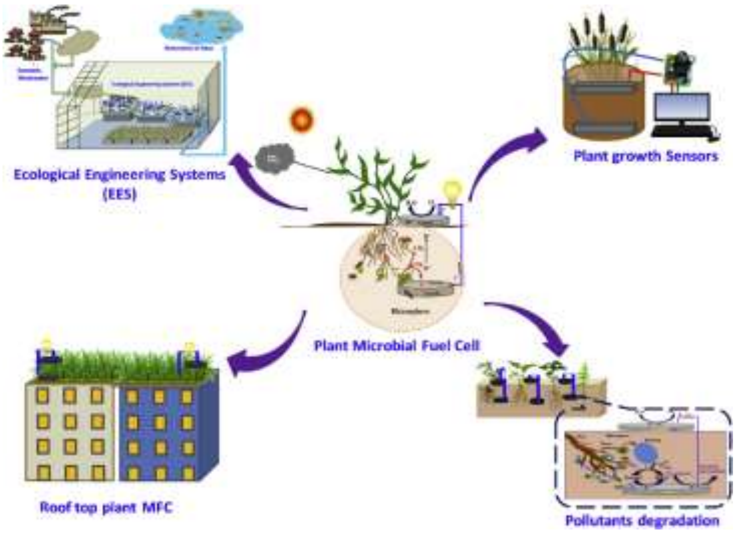
Importance of Ornamental Plants

Plants provide key environmental benefits:
1. They supply oxygen.
2. Clean the air we breathe.
3. Regulate temperature.
4. Control erosion.
5. Serve as habitat for wildlife.
6. Plants are essential to the functioning of healthy home gardens and surrounding landscapes.
Along with these benefits ornamental plants can also be used in bioelectricity generation using:
1. Green roofs.
2. Indoor garden.

3. Ornamental tree species.

Applications of PMFC

1. Monitoring of environmental conditions.
2. Biosensing of plant maturity.
3. Bioremediation of polluted waters.
4. Recovery of heavy metals from contaminated environments.



Ornamental Plant Species Used in PMFCs Configuration and Power Generation

Plant species	Maximum Power Density (PD)	References
Epipremnum aureum	620 mV	Sarma and Mohanty (2018)
Sedum hybridum	92 μW/m^2	Tapia *et al*. (2017)
Populus tomentosa Carr.	1037.4 mV	Hao *et al.* (2018)
Bryophyllum	2.25W	Khan *et al.* (2018)
Chasmanthe floribunda	0.21mWm−2	Azri *et al*. (2018)
Dracaena braunii	188mV	Sarma and Mohanty (2018)
Chlorophytum comosum	25 mA/m^2	Azri *et al*. (2018)

Conclusion

PMFC will become an alternative bioelectricity generation process to solve the problems of energy scarcity and related environmental deterioration when it is scaled up and applied in-situ using ornamental plants. Bioelectricity has the potential to become a source of alternative bioenergy in the future which is green, clean, renewable, sustainable and at much lower price than any other form of bioenergy.

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Nursery Management for Boro Rice

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Introduction

Boro rice cultivation has been an age-old practice in Bangladesh and eastern India and now has spread fast even outside traditional areas where irrigation is assured. This type of rice has been cultivated traditionally in river basin deltas of eastern India including eastern U.P., Bihar, West Bengal and Assam. "Boro" is a Bengali language word derived from a Sanskrit word BOROB". This means a special type of rice cultivation on residual or stored water in low-lying areas after the harvest of kharif rice. Boro rice system takes advantage of residual moisture after the harvest of kharif rice. Such areas with high moisture retention capacity are low-lying ditches where water is stored or gets accumulated, areas adjoining canals and roads, chaur-lands / tal-lands, etc.

Boro is a winter season, photo-insensitive, transplanted rice cultivated on supplemental irrigation. This gives the farmers a chance to grow a rabi season crop which normally they could not grow. Rapid expansion of boro rice cultivation has taken place in recent years in West Bengal and Bihar; it is likely to expand further to more areas in West Bengal, adjoining areas of Assam, parts of Eastern U.P, coastal areas of Orissa and Andhra Pradesh. Boro rice is known for high productivity (5-6 t/ha) in deep water areas of eastern India, where productivity has traditionally been very poor (<1 t/ha) during the kharif. This is mainly because boro rice is more manageable than kharif rice. For example, water management in boro rice is more systematic as it is an irrigated crop. Consequently, this crop responds well to higher doses of fertilizers resulting in higher production. Being a winter season crop, it is spared from insect-pest infestation(Singh, U.P. 2002).

Nursery Raising for Boro Rice

Boro crop is a 190-200 days crop and may require more resources and care for a longer period.Seedlings remain in the nursery for about 75-90 days. Healthy seedling raising for boro rice is a problem. Low temperature affects seedlings growth and development. The seedlings during winter period in nursery are cold affected remain stunted, show burnt look and many times are damaged severely. Cold injury in boro rice can be minimized through nursery management.

1. Land selection: Irrigated lowland is most suitable for raising nursery. Low lying tracts where water table is high or even lands for seedbeds are selected in shade are also suitable for seedling raising. Seedlings are raised near river banks or swampy lands or on the periphery of deep-water lands. This management helps in a way that root development remains normal due to soil temperature which is not greatly affected while microclimate of the site near water reservoir remain little warmer.

2. Time of sowing: To avoid cold injury during winter, nursery is raised during mid –October to first week of November before onset of winter season when temperature is congenial.

3. Preparation of nursery bed: Land should be ploughed in a proper way and at the time of sowing, it should be sown by broadcasting method. At this stage, water depth should be kept minimum for avoiding damage of seeds.

4. Seed rate: 70-80 kg of pure and viable seeds is required to transplant one hectare of land.

5. Seed treatment: Before sowing of seed in nursery bed it should be treated with carbendazim (1-2.0 g /kg seed). In wet method and after that it should be incubated in wet gunny bag for 48 hours for sprouting.

6. Fertilizer application: FYM @ 15-20 q per 1000 sq. m should be applied to seed beds 20 days prior to sowing. Again, at the time of puddling this area should be fertilized with 1:1:0.5 kg NPK for better growth of seedlings. In addition, fuel wood or straw ash is added to protect seedlings from cold injury.

7. Method of nursery bed preparation: Wet method is more ideal for nursery bed preparation for boro rice.

8. Sowing of seed: When seeds are ready, then sprouted seeds should be sown not very densely to allow seedling establishment. These operations must be completed before onset of winter to avoid cold period during crop growth. This ensures that the seedlings have sufficient growth before winter.

9. Seedling management: Proper care should be taken especially in raising of healthy seedlings for boro rice. There are many ways to protect the seedlings from cold injury.

a. Raise seedlings near river banks, swampy lands or in periphery of chaur lands where warmer soil temperature ensures proper root growth.
b. Prepare the seed bed in low lying areas near the source of irrigation.
c. Grow seedlings of boro rice even in shade.
d. Add sufficient organic manure to the seedbed.
e. Dust the seedlings leaves periodically with fuel wood ash, straw ash etc.

It has been suggested to remove the dew drops from the tips of the seedlings every morning as evaporation will induce lowering down the temperature. Keep seedbeds covered by polythene sheets or straw above the seedling at night to avoid yellowing. Due to cold yellowing and drying of leaves are common which also induces spread of leaf spot disease.

Dapog Method

In this method, sprouted seeds are kept on bamboo made pan, or on plastic seeds or on banana leaves. With this method, seedlings could be grown in courtyard or even on the roof. In this method 3 kg seed is required for every one square meter nursery seedbed. The dapog method requires a 15-20 m2 seedbed per hectare. The seedbed must be 1-1.5 m wide for easy management. Only 15-20 kg seed is required for one-hectare transplanting. The main advantage of this method is that seedlings are ready to transplant within 15-20 days.

Plastic Tunnel Method for Raising of Seedlings

In this method raised beds of 15 cm height and 100 cm width in puddled field. Then erect bamboo pegs of 140 cm length in an arc shape across the width of the nursery bed at interval of 150 cm to support polythene tunnel. Sow the pre-germinated seeds on the bed and cover the bed with plastic tunnel. Open both ends in the morning after sunrise for aeration and close in the evening. Continue the process till the seedlings are ready for transplanting. Remove plastic tunnel for one hour before 7 days of transplanting and increase the exposure time daily by one hour and remove completely on the 7th day (Rai, D.K. 2008).

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Trap Crops in Pest Management

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A trap crop is a plant that attracts agricultural pests, usually insects, away from nearby crops. This form of companion planting can save the main crop from decimation by pests without the use of pesticides. Protection achieved either by concentrating them in certain part of the field where they can economically be destroyed or by preventing the pests from reaching the crop.

The principle of trap cropping rests on the fact that virtually all pests show a distinct preference to certain crop stage. Manipulation of stand in time and space so that attractive host plants are offered at critical time in pests and the crop phenology leads to the concentration of the pests at the desired site, the crop. Trap crops, when used on an industrial scale, are generally planted at a key time in the pest's life-cycle, and then destroyed before that life-cycle finishes and the pest might have transferred from the trap plants to the main crop.

Farmers are being motivated to utilize trap cropping because of the difficulties in cropping with the pest situations in other ways. Some times the cost of chemical pesticides and the number of treatments required is so high that more economical ways have to be developed, additionally, the pests have often evolved resistance to commonly used pesticides, which requires some alternative control strategies.

Further, motivations to use trap cropping are economic and environmental benefits are often associated with this strategy. Besides, its potential role in improving the environmental soundness, trap cropping techniques may have special preference of conventional agriculture to sustainable farming in developing countries.

Additionally, the increasing sector of organic farming also could exploit this strategy of pest control. Yet another function of trap crop is their use of attracting natural enemies of pest insects to the fields and concentrating them there to enhance naturally occurring biological control.

The essential features of the trap cropping are that the trap crop must be attractive to the pest then the main crop, it should occupy small area as far as possible and it should be established an early or later or along with the main crop.

The important trap crops commonly used in pest management included, bhindi / okra in cotton to trap bollworms at the ratio of 1:10 and marigold at the boarder of the field. Sesamum is commonly being used as trap crop to attract Diamondback moth in both cabbage and cauliflower. Two rows of sesamum for every 25 rows of cabbage or cauliflower can be planted to trap the pest. In groundnut, castor or sunflower can be used to attract leaf eating caterpillar on the boarder of the field. In tomato marigold or cucumber is commonly used as trap crop for every 15 rows of the main crop to attract tomato fruit borer. In case of field beans, chrysanthemum acts as a trap crop against leaf minor. Marigold is a potential trap crop in potato and rice against nematodes and snails, respectively. To trap corn stalk borer in maize sorghum has been exploited as trap crop. Bihar hairy caterpillar in cowpea can be trapped by planting Gingelly.

Trap cropping has indicated a great benefit in economic returns on an average of 10-35 per cent increase in net profits mainly resulting from reduced pest attack and insecticide use. Trap cropping is a useful strategy in the management of several pests in various cropping systems. It offers significant economic and environmental benefits and it can successfully integrate with biological, cultural and chemical control methods.

Tips for Successful Trap Cropping

1. Make a farm plan. This will guide you on where the trap crops are to be sown or planted.
2. Learn to know and identify the pests.

3. Select a trap crop that is more attractive to the pest than the main crop. Ask for assistance from your local agriculturist.
4. Monitor your plants regularly.
5. Immediately control the pests that are found in the trap crop. Prune or remove the trap crops once the pest population is high, otherwise they will serve as the breeding ground and the pests will attack the rest of your farm.
6. Be ready to sacrifice your trap crop as an early crop and destroy them once pest infestation is high.
7. Always keep farm records.

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Livelihood and Resources of Marine Fisher Folks in Tamil Nadu

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Summary

Marine fishery is one of the fields that feeds majority of the coastal population of the world. Fish catching is an important aspect which decides the extent of revenue for the fisherman's family. The continuous demand for fish and the changing structure of catching over the world are in a need for examination and necessary action.

There are four types of fishing fleets used in Cuddalore district viz.,
1. Catamaran with sails.
2. Catamaran with outfit motor.
3. Motorized Maruti boats.
4. Mechanized boats.

The non-mechanized boat brings more fish catch and trawl netters stood first among the gear-wise catch. Fishing community is divided into different class groups' viz., the upper and lower community based on the technology of fishing. Fishermen are found to be unfit for long distance fishing voyages due to the craft-gear combination of fishermen are artisanal. On an average the fishermen are engaged in fishing effectively for eight to nine months. Low value fish were taken for home consumption by the fisher folks. Actions should be taken so as to establish dry dock and processing unit at the shore itself to create income and employment generation for the fisher folks.

Introduction

Fish is an important part of staple diet and the major source of animal protein for a majority of countries. The effects of fluctuating demand for fish all over the globe and the changing structure of market are in desperate need of examination and necessary action. Among the allied sciences, fishery is the most important sector that is being neglected for a long time since. The basic understanding of the sector itself is unknown to majority of the population. Being the allied science of Agricultural studies, one has to know at least the preliminary knowledge of fisheries sector and the knowhow about the livelihood of fishermen.

Fishing Crafts

A fishing unit is composed of a boat and fishing gear. There are four types of fishing fleets used in Tamil Nadu viz:
1. Catamaran with sails.
2. Catamaran with outfit motor.
3. Motorized maruti boats.
4. Mechanized boats.

Catamaran is the traditional boat and is essentially a sailing vessel. Maruti boats are made of fibreglass and meant for use with motors. The catamaran and Maruti boats are beach-landing boats and mechanized boat is much larger where unlike artisanal fleets, fishing also mechanized and requires harbour to land or has to be anchored at sea. Fishermen use out - board motors that can be fitted and removed easily. These are small light diesel motors consist of long shaft with propeller attached to them. These long tails are fitted on a metal bracket at the end of the Catamaran or Maruti boat. Fishermen owning catamaran constitute the majority group in the state followed by mechanized boat owners and vallam owners. Catamaran owners may be the majority group but mechanized boat owners are economically dominant and powerful group.

Fishing Gears

The Gill net owners constitute majority followed by the trawl net owners. Fishing gear used by the fishing community consists of small gillnets, large drift nets, hook and line and trawl net. Gill nets are basically netting that are hung vertically in the sea and when a shoal of fish crosses them, they are caught in the mesh of net. Separate nets are used for different fish variety. The small nets are of nylon monofilament material and large nets are made with nylon multifilament. The small gill nets are essentially factory made. The large drift nets are long pieces of nets that are used in deep water to catch larger species. These nets can be more than a kilometre long and use of these nets need special skills. Hook and line fishing are hand lines as well as long-lines. Hand lines are just a few hooks put on a line and long lines are large number of hooks put on a long line with baitfish. Trawl nets are bag shaped nets dragged on the sea bottom with two wooden boats that keep the mouth of the net open. Gill nets are predominantly used by large number of fishermen due to affordability.

Resource Wise Marine Fish Production

The non-mechanized brings more fish catch because of number effect. However, based on the gear-wise catch trawl netters stands first because of its higher efficiency which is being operated by mechanized launcher. Gill nets and Tangle nets were the other 7865 tonnes and 2851 tonnes respectively.

Class Structure

Fishing community is divided into different class groups on the basis of the technology used on their boats. The people owning sailed Catamaran, Motorised Catamaran and Maruti boat represent one group despite the differences in their income. Mechanized boat owners form a different interest group, as they constitute an upper class in the fishing community. The division within the fishing community exists not only on the basis of technology used but also due to the conflict of interest. The conflict of interest lies in the fact that mechanized boat owners use trawl net that sweeps the sea bottom, affecting catch for the small fishermen.

The ownership between Catamaran and Maruti boat owners is essentially an individual or family affair. The crew will be composed of three to four family members as well as non - owners. The non – owners of the crew are not paid wages but share the net income after deducting the expenditure incurred for the boat. Boat owners may get an additional share. Sharing system exists even in the case of mechanized boat crew, but with difference in the proportion of share. The share of the boat owners is 65 per cent and the crewmembers get allowance for trip irrespective of the catch. Thus, fishing community has a class division on the basis of ownership and technology use. Any rehabilitation or reconstruction programme should take into consideration of the division of owners of non – mechanized boats and mechanized boats as well as the wage-earning workers. The wage-earning workers do not have any means of production excepting the labour, live below poverty line and deserve special attention in the rehabilitation and reconstruction activities.

Fishing Distance

The distance in ocean and fish catching is usually denoted in nautical miles. The fishing distance of range up to five nautical miles constitutes around 28 per cent whereas the distance of six to ten nautical miles had a percentage of 55 and fishing distance above ten nautical miles constitutes about 17.5 percentages of fishermen. It is evident that the major fishing activities are within near shore areas. This could be due to the fact that the craft-gear combination of fishermen is artisanal i.e. either operated manually or partially mechanized because of its small-scale nature. In most cases they are unfit for long distance fishing voyages.

Number of Fishing Days in a Year

The number of days of fishing by fishermen is essential to know the employment generation through fishing. This information may be useful to device related employment program during idle days of fishing. More than half of the fishermen population in Tamil Nadu has fishing days of between (151-250) in a year, fishermen fishing for more than 250 days in a year constitutes thirty per cent to the total, whereas only fifteen per cent of the fishermen goes less than 150 days of fishing in a year. On an average the fishermen are engaged effectively for eight to nine months. April and may are generally lean period, in which fishing through gear is banned to allow regeneration of fish. However, line and hook fishing are undertaken during these months. Besides fishermen avails weekly rest and celebrate festivals.

Conclusion

Over the recent years fish production and marketing in Tamil Nadu has been transforming itself into a modern stage despite the infrastructure constraints and inherent complications in the marketing system. The small-scale fisher folks have no say in price fixation. The role of middlemen in fish marketing system is continuing unabated due to the absence of institutional involvement. The involvement of several middlemen in the marketing chain is detrimental to the interest of both the producers and the consumers. The market power concentration of domestic trade of fish is in the hands of few and hence found to be oligopolistic. The detrimental effects of middle men involvement and the low-price realisation for fish should be rectified through government interventions and policy measures. But then, the services of intermediaries cannot be neglected It can be taken over by the financial institution in the similar fashion to avoid exploitation. Since the annual income of sample fishermen were found to be low, efforts should be taken to establish dry dock and processing facilities at the shore itself.

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Indigenous Pest Management Practices – An Overview

Article ID: 31442

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Introduction

India, one among the richest cultural diversity nations in the world. Indigenous Traditional knowledge (ITK) is the knowledge of indigenous people inhabiting different geographical regions of the world with their own language, culture, tradition, belief, folklore, rites and rituals (Chhetry and Belbahri, 2009). ITK is the knowledge belonging to a specific community or local group of the people where most of them live in isolated places like hilly regions and undeveloped areas. Their main and important occupation is engaged in agriculture and allied activities for the economy. Lots of problems are being faced by farming people due to various biotic and abiotic factors. Among biotic factors, insect and non-insect pests are considered as the major factor for yield losses in crop production. Prior to the advent of Green Revolution, farmers have relied on indigenous methods for the management of menacing insect-pest. Those farm practices are economically cheap and would manage pests effectively without deteriorating environment. Folks of India follow different traditional pest management practices which include the use of kerosene, wood ash, table salt, lime, cow urine and dung. Indigenous pest management practices generally involve the use of locally available resources for successful cultivation of crop plants and do not use any chemicals, therefore it is eco-friendly and also sustainable. Hence, this article is on the documentation of traditional practices on pest management.

Indigenous Traditional Knowledge (ITK)

India's explored ITKs for pest management in field crops, horticultural crops and stored food materials are discussed below in detail (Chandola et. al., 2011: Gopi et. al., 2016).

S.No.	Pest	Crop/materials	Management practices
1.	White grub	Upland rice	Burn to destroy the hibernating white grubs.
			Spread well decomposed Farm Yard Manure (FYM) for reduced the attack.
			Broad cast common salt of 1 kg/*Nali* (One *Nali* is equal to one by 20 acre) for managing grub.
		Vegetable crops	Dig holes of 5 -7.5 cm and burn cow dung cakes, pine leaves and leaves of other plants.
2.	Rodent pests	Stored grains	Bait: knead 1 kg wheat flour and ½ kg ground glass with little water.
		Field	Balls: mix urea with water and place at the entrance of mouse hole to reduce the activity of rodents.
			Place Grass and thorny bushes (*Urtica dioica* and *Berberis asiatica*) at the mouth of mouse hole, which causes physical injury while moving
			Place powdered horse faeces at the entrance of mouse hole. The odour emitted by the faeces, can repel the rodents.

3.	Stored insect pests	Stored green gram	Mixture: immature turmeric, dried leaves of walnut and mustard with grains
		Stored black gram	Mix black gram with mustard oil to reduce the pest attack.
		Storing food grains	Dust ash on the heap of food grains and mix well. Its protective coating around the seeds and work acts as a physical barrier for insect pests.
		Paddy and sorghum seeds	A Paddy seed stored with dried plant leaves *viz*. walnut (*Juglans regia* Linn.) timur (*Z. alatum* Roxb.) or neem avoid pest attacks.
		storage of cereals and pulses	Mix ash thoroughly at the rate of 20 g /kg of seeds which kills insects by desiccation or restricting insect movement.
4.	Grub and caterpillars	Agricultural crops	The mixed kitchen ash with farmyard manure is applied onto plants in the field.
5.	Giant African Snails	Field and horticultural crops	Mixture: Table salt, lime and wood ash is applied over the pest for its management.
6.	Trunk borer and stem borer	Mandarin orange	Plug the trunk hole with mud after applying kerosene.
7.	Trunk borer and bark eating caterpillar	mandarin and other vegetable crops	Paint the mixture of cow dung mud on the trunk of the tree to avoid pest damage.
8.	Fruit borer, leaf beetle	Fruit and vegetable crops	Application of cow urine acts repels borers.
9.	Earhead bug, BPH, leaf folder , stem borer, caterpillars and other chewers	Rice crop	Apply cow dung extract @ 2% concentration to reduce the activity of pests.
10.	Trunk borer	Fruit trees	Insert bamboo peg, which kills the larvae by suffocation.
11.	Case worm and leaf folder	Rice field	Alternate wetting and drying of field
12.	Fruit fly	Mandarin fruits	Collect fruit flies infected fruits and place it in a big drum to ferment, which kills maggots of fruit flies.
13.	Storage Pests	Storage grains	The dried mandarin peels mix with grains, its management of stored pests in rice.
14.	Ant and termites	Vegetables	Apply fermented mixture of *Agave sissalana*, *Piper nigrum*, *Vernonia amygdalina* and *Nicotiana tobaccum*.
15.	Rat	Stored grains	Paint ghee on both sides of Moringa (*Dendrocnide sinuta*) leaves and keep inside the grain storage room, when it touches the tongue of rat gets swelled.
16.	Aphids and white flies	Tomato and chilli	Apply the mixture of fermented plant extracts *viz. Artemisia vulgaris*, *Chromolaena odorata* and *Lantana camara* which have repellent activity.
17.	Aphids	Cabbage	Apply ash, soil mixture with cow urine to repel aphids (Lal *and Verma,* 2006).

18.	Sucking and chewing pest	Mustard	Decoction: Mix *Aloe barbadensis* (1 kg) + *Nicotiana tabacum* (200g) in 5 Lit. of water and boil upto 2 Lit. To the prepared decoction add neem leaf extract (200 ml) and *Sapindus trifoliatus* (50 g) and spray.
19.	Pod borer	Pulse crop	Mix tobacco powder (200 g) and *Aloe barbadensis* (2 leaves) with 15 Lit. of water and keep undisturbed for 15 days, before spraying.
20.	Fruit fly and Sucking insect pests	Vegetable crops	Karpurakaraisal: Neem oil (1 Lit.) + pachai karpuram (camphor) (2-3 pellets) + cow urine (1 Lit.) has repellent activity.
21.	Sucking and chewing insects	Field crops, Vegetable crops and kitchen garden	Agniastram: Chilli (100 g) + garlic (500 g) + ginger (500 g) extract to prevent the damage of insects.

Conclusion

ITKs practice is an eco-friendly, cheap and organic method of pest management, was originated in the ancient period and has been practiced by people from generation to generation. Farmers follow indigenous practices in a particular region by the knowledge gained through their practical experiences. Hence, proper documentation of this traditional information is needed to pass on to next generation for sustainable crop production. For the huge benefit of crop production, the combination of traditional and the modern method of pest management is encouraged. Therefore, India's rich heritage like ITKs should be preserved, documented to prevent its extinction.

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Biotechnology: Clonal Propagation - Introduction to Vegetative Propagation

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Plant tissue culture is taken into account the foremost efficient technology for crop improvement through the production of somaclonal and gametoclonal variants. Clonal, true-to-type propagation of plants by a variety of tissue and cell culture methods, better referred as micro propagation, is now the foremost commercially efficient and practically oriented plant biotechnology. Most other plant biotechnologies (e.g., genetic engineering and the production of transgenic plants that harbour important agricultural traits) hold a greater share of the investment capital in research and development, both on a practical and basic levels. However, they need not yet been commercialized to the identical extent as micro propagation.

Introduction

Plants may be propagated by sexual (through generation of seeds) or asexual (multiplying the vegetative parts) means. Asexual reproduction through the multiplication of vegetative parts is that the only method for the in vivo propagation of certain plants, since they do not produce viable seeds (banana, grape, fig, and chrysanthemum). Clonal propagation refers to the method of asexual reproduction by multiplying genetically identical copies of individual plants and has been successfully applied to the propagation of apple, potato and various ornamental plants. Apomixis (seed development without meiosis and fertilization) is restricted to some species, horticulturists have adopted vegetative improvement methods to clonally multiplying selected cultivars.

Advantages of Vegetative Propagation

Asexual (vegetative) propagation of plants has certain advantages over sexual propagation.
1. Faster multiplication – an outsized number of plants will be produced from one individual in an exceedingly short period.
2. Possible to produce genetically identical plants.
3. Sterile hybrids of sexual origin can be propagated.
4. Raised plants go through an undesirable juvenile phase that's avoided in asexual propagation.
5. Gene banks can be more easily established by clonally propagated plants.

In Vitro Clonal Propagation

The in vivo clonal propagation of plants is tedious, expensive and sometimes unsuccessful. In vitro clonal propagation through tissue culture named micro propagation. Employment of the tissue culture technique for micro propagation was first started by Morel (1960) for the propagation of orchids, and is now applied to various plants. Micro propagation is a handy technique for rapid multiplication of plants.

Technique of Micro Propagation

Micro propagation is a complicated process and consists mainly of three stages (I, II and III). Some authors add two more stages (stage 0 and IV) for more comprehensive representation of micro propagation.

Stage 0: This is the initial step in micro- propagation, and involves the selection and growth of stock plants for approximately 3 months under controlled conditions.

Stage I: At this stage, the initiation and establishment of culture in an appropriate environment is achieved. Selection of appropriate explants is very important. The most widely used explants are organs, shoot tips and axillary buds. The chosen explant is surface sterilized and washed before use.

Stage II: It is during this stage, the most activity of micro propagation occurs in a very defined medium. Stage II mainly involves shoot multiplication or rapid embryo formation from the explant.

Stage III: This stage involves transferring of shoots to a medium for rapid shoot development. Sometimes, the shoots are planted directly into the soil to develop roots. In vitro rooting of shoots is preferred while managing large numbers of species simultaneously.

Stage IV: This stage involves the establishment of seedlings in the soil. This is done by transferring the seedlings of stage III from the laboratory to the environment of greenhouse. For some plant species, stage III is skipped, and un-rooted stage II shoots are planted in pots or in a very suitable compost mixture.

Micro Propagation Mostly Involves Clonal Propagation In Vitro by Two Approaches

1. Multiplication by axillary buds / apical shoots: Meristem and shoot tip cultures: Bud cultures, single node culture, axillary bud culture.

2. Multiplication by adventitious shoots: In addition to the above two approaches, plant regeneration processes namely organogenesis and somatic embryogenesis may be treated as micro propagation.

3. Organogenesis: The formation of individual organs like shoots, roots, directly from an explant (lacking a preformed meristem) or from the callus and cell culture induced by explants. It's of two types:

a. Direct Organogenesis.
b. Indirect Organogenesis.

4. Somatic embryogenesis: The regeneration of embryos from somatic cells, tissues or organs. Two routes of somatic embryogenesis are:

a. Direct Somatic Embryogenesis.
b. Indirect Somatic Embryogenesis.

Artificial Seeds from Somatic Embryos

Artificial seeds may be made by encapsulating somatic embryos. The embryos, coated with sodium alginate and nutrient solution, are immersed in calcium chloride solution. Calcium ions induce rapid crosslinking of sodium alginate to produce small gel beads, each containing an encapsulated embryo. These artificial seeds (encapsulated embryos) may be kept in a viable state until they are planted.

Factors that Affect Micro Propagation

According to the Cassells and Minas (1983) for successful in vitro clonal propagation (micro propagation), optimization of several factors is required.

Some of these factors are:

1. Genotype of the plant
2. Physiological status of the explants
3. Culture media:
    a. Light.
    b. Temperature.
    c. Composition of gas phase.

Applications of Micro Propagation

1. High propagation rate of plants.

2. Production of disease-free Plants.
3. Seed production in some Crops.
4. Profitable Process.
5. Automated micro propagation.

Conclusion

Rapid production of high quality, disease free and uniform planting stock is only possible by micro propagation. Micro propagation is one among the foremost convenient and beneficial ways to propagate inexpensive plants. However micro propagation technology is expensive as compared to conventional methods of propagation by means of seed, cuttings and grafting etc. Therefore, it is essential to take steps to reduce the cost of production. Low cost production of plants requires cost effective practices and optimal use of equipment to reduce the unit cost of plant production. It will be achieved by improving the process efficiency and better use of resources.

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Modern Tools and Techniques for Precise Nitrogen Fertilizer Management

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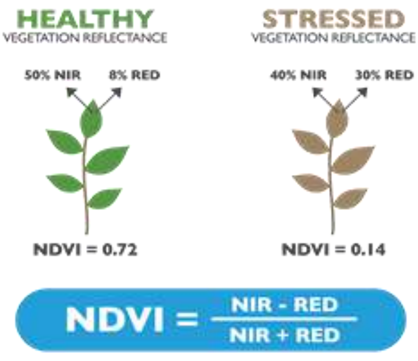
Introduction

India's 'Green Revolution' of the 1960s and 1970s made India self-sufficient in food production. All this became possible because of the availability of high yielding varieties, fertilisers, irrigation, pesticides and mechanization. To harness this potential, we need to achieve 'Evergreen Revolution'. The evergreen revolution means harvesting maximum yields from the available land, water and other resources, without causing any ecological or social harm. It is the need of the hour as India has to meet her projected requirement of 276 Mt of food grains by the year 2021. Precision agricultural techniques and technologies can go a long way in achieving this projected goal. A number of definitions and concepts are available for precision agriculture. To our understanding it can be better interpreted as 5-R definition. Accordingly, precision agriculture is defined as the science of applying 'right-input' at 'right time' in 'right-amount' at 'right place' and in 'right-manner' for improving productivity, conserving natural resources and avoiding any ecological or social tribulations. The precision nutrient management is the science of using advanced, innovative, cutting edge, site-specific technologies to manage spatial and temporal variability in inherent nutrient supply from soil to enhance productivity, efficiency and profitability of agricultural production systems. Precision nitrogen management practices can efficiently reduce fertiliser-N use in comparison to conventional nitrogen management. The precision nutrient management plan is a dynamic tool and, once developed, should be monitored and adjusted on a regular basis. The most widely and indiscriminately used nutrient in crop production is nitrogen. As the plant demand for nutrients other than nitrogen cannot be easily accessed from the spectral properties of the leaves, other techniques are being employed for making precision nutrient management decisions while considering spatial and temporal variability in nutrient supply from the inherent sources.

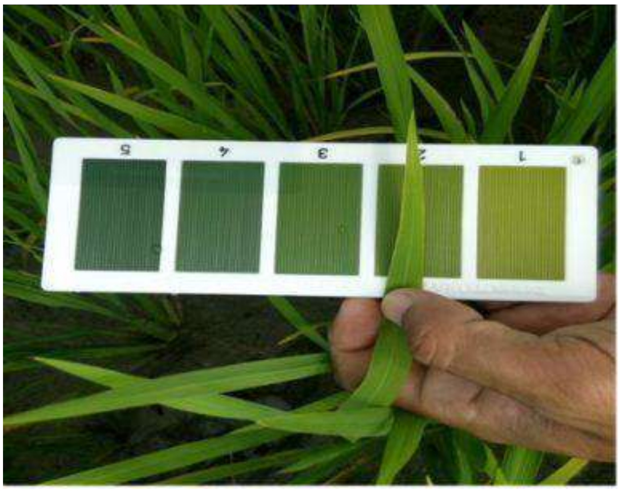
Precision Nutrient Management Tools and Techniques

1. Optical Sensors: A wide range of optical sensors are available and classified as multispectral and hyper spectral sensors. Optical sensors measure visible and near infrared (NIR) spectral response from plant canopies to detect the N stress. Spectral vegetation indices such as the normalized-difference vegetation index (NDVI) calculated as (FNIR – FRed)/ (FNIR + FRed), where FNIR and FRed are, respectively, the fractions of emitted NIR and red radiation reflected back from the sensed area, provide information about photosynthetic efficiency, productivity potential and potential yield. The Green Seeker (GS) canopy sensor is a commercially available and widely used active optical sensor that emits red (650± 10 nm) and NIR (770±15 nm) wavebands.



2. Chlorophyll Meters: Chlorophyll meters are reliable alternatives to traditional tissue analysis as plant N nutritional diagnostic tools. Most widely used chlorophyll meter is the hand-held Minolta SPAD-502. It instantly provides an estimate of leaf N status as chlorophyll content by clamping the un-plucked leafy tissue in the meter using two LEDs (light emitting diodes) emitting red (ë = 650 nm) and infrared (ë = 940 nm) light. A portion of light is absorbed and the rest is transmitted through the leaf, and a silicon photodiode detector converts it into an electrical signal. The amount of light reaching the detector is inversely proportional to the amount of chlorophyll in the path of the light.

3. Leaf Colour Chart: Leaf colour chart is a high-quality plastic strip with different shades of green colour ranging from light yellowish green to dark green. An improved version of six-panel LCC (IRRI-LCC, six-panel) was developed through collaboration of the International Rice Research Institute (IRRI) with agricultural research systems of several countries in Asia Leaf colour chart may not be as precise as the SPAD meter (as the difference between two LCC scores is 4 to 5 SPAD units), but for all practical purposes it can work like a SPAD meter. Two approaches have been followed for using LCC for synchronizing fertiliser- N application with plant needs viz., Real-time N Management Approach and Fixed-time Variable Rate Dose Approach.



4. Omission Plot Technique: Omission plot technique is used to estimate fertiliser requirements for attaining a yield target. In this technique all the major nutrients are applied except the nutrient of interest i.e. omitted nutrient. The technique provides estimate of indigenous nutrient supply of the soil. For example, if all the nutrients except for P are applied in P-omission plot, then the yield will be limited by the indigenous supply of P. The yield gap between the maximum achievable yield and the yield in the omission plot technique is then used to calculate the fertiliser requirement.

5. Nutrient Management Models: Nutrient Expert (NE) and QUEFTS model are generally used computer-based decision support systems for precision nutrient management in crop production. The models are designed to consider spatial and temporal variability in nutrient supply and ensure need-based nutrient applications. The nutrient expert (NE) develops farmers' specific fertiliser recommendation based on 3-5 years previous yield, organic and inorganic fertilisers applied, attainable yield, soil fertility indicators, residue content and growing environment information. The algorithm for calculating fertiliser requirements in Nutrient Expert is developed from a set of on-farm trial data using site-specific nutrient management (SSNM) guidelines. The researchers also worked with another empirical model – QUEFTS (Quantitative Evaluation of Fertility of Tropical Soils) model to predict the effect of fertiliser application on yield, on the basis of soil and plant characteristics. This model provides a generic approach taking into account the climate adjusted, season-specific yield potential.

6. Aerial Imagery and Site Maps: Aerial imagery or site maps and the soil survey map are also used for precision nutrient management plan. These tools, including knowledge of previous land use(s), are used to derive decisions for efficient nutrient management. Even with all this information, imagery does not help to explain within-field variations that may be induced by management decisions, climatic conditions, geologic characteristics, and/or other sources of variation. Although some researchers have worked on it but the application of aerial imagery and site maps for precision nutrient management decisions is not established yet.

Constraints in Adoption of Precision Farming

1. Small farms size, heterogeneity of cropping systems, and land tenure / ownership restrictions, high cost of obtaining site-specific data.
2. Infrastructure and institutional constraints including market imperfections.
3. Complexity of tools and techniques requiring new skills.
4. Lack of local technical expertise and high initial investment.

Conclusion

Precision nutrient management practices including use of optical sensors, chlorophyll meter, leaf colour chart, omission plot technique and crop models can help guide in deciding need- based nutrient applications and thus improving nutrient use efficiencies while achieving high yield levels in different crops. The precision practices take care of spatial and temporal variability in nutrient supply and facilitate synchronization in plant demand and soil supply. The SPAD meter, LCC and Green Seeker optical sensor are the best options for efficient nitrogen management and have emerged as quick and reliable tools to guide real-time need-based fertiliser-N applications especially in cereal crops. The real-time N management approach works well in rice and maize, however fixed time variable rate approach that combines preventive fertiliser-N application schedule with LCC, SPAD or optical sensor-guided corrective N management seems to be more promising in wheat. The nutrients other than nitrogen can be best managed using omission plot technique and crop models. The sensor-based soil analysis, aerial imagery and site maps may not be a suitable proposition for precision nutrient management. Hence for sustainable livelihood of future generations and for reduction of money spent on import of fertilizers; adapting modern tools like Nutrient Expert, optical sensors, leaf colour chart, NDVI sensor and crop models are required for proper management of fertilizers.

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Agricultural Sustainability: Challenges and Opportunities

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Introduction

Agriculture is most important private business in India providing income and employment opportunity to more than half of the population. Sustainable agricultural practices have to balance environmental health and economic profitability in order to promote social and economic equity. Therefore, stewardship of both natural and human resources is very importance. In simple terminology Sustainable Agriculture involves the processes that would enable us to meet the current and long-term societal needs for food, fibre and other resources, Agriculture have been dominant sector in India for economic prediction and the situation will remain same in future. The dependency on agriculture sector has not minimize as proportionate the sectoral contribution of agriculture decline in India's GDP from independence. The world's average of resources availability is four to six time more than our national average. This condition create pressure on agriculture sector in two way like satisfied primary need of population and diversion of land to non-agriculture uses. The current cropping intensity is 136% which grow 25% from last sixty year. The ground water resources are a dominant water source for agriculture hampered and rich at exit level. All this inverse situation negatively influences agriculture productivity in India. So, this agrarian nation has need for permanent solution on their existing problem as well as upcoming challenges. Indian agriculture is highly diverting sector in case of cropping, climate, availability of natural resources. We have golden opportunity to take advantages of its nature and meet the present and future needs from this sector. For that sustainable agriculture development is an only one way to protect our self in all types of competition.

The interest in the sustainability of agricultural and food systems can be traced to environmental concerns that began to appear in the 1950s–1960s. Today, concerns about sustainability centre on the need to develop agricultural technologies and practices that:

1. Do not have adverse effects on the environment (partly because the environment is an important asset for farming).
2. Accessible to and effective for farmers.
3. Lead to both improvements in food productivity and have positive side effects on environmental goods and services.

Sustainability in agricultural systems incorporates concepts of both resilience (the capacity of systems to buffer shocks and stresses) and persistence (the capacity of systems to continue over long periods), and addresses many wider economic, social and environmental outcomes.

The Key Principles for Sustainability

1. Integrate biological and ecological processes such as nutrient cycling, nitrogen fixation, soil regeneration, allelopathy, competition, predation and parasitism into food production processes,

2. Minimize the use of those non-renewable inputs that cause harm to the environment or to the health of farmers and consumers,

3. Make productive use of the knowledge and skills of farmers, thus improving their self-reliance and substituting human capital for costly external inputs, and

4. Make productive use of people's collective capacities to work together to solve common agricultural and natural resource problems, such as for pest, watershed, irrigation, forest and credit management.

The idea of agricultural sustainability, though, does not mean ruling out any technologies or practices on ideological grounds. If a technology works to improve productivity for farmers and does not cause undue harm to the environment, then it is likely to have some sustainability benefits. Agricultural systems emphasizing these principles also tend to be multifunctional within landscapes and economies (Dobbs & Pretty 2004; MEA 2005). They jointly produce food and other goods for farmers and markets, but also contribute to a range of valued public goods, such as clean water, wildlife and habitats, carbon sequestration, flood protection, groundwater recharge, landscape amenity value and leisure/tourism. In this way, sustainability can be seen as both relative and case dependent and implies a balance between a range of agricultural and environmental goods and services.

Review of Literature

L.L. Samantaray (2015) in his study titled "A Study on the Current Trend of Agriculture Productivity in India and its future prospects" discusses about the linkage between structural, technical and institutional policy reforms, which are responsible for successive agriculture development. The researcher has collected and analyse secondary data Agriculture, Industry and Service sector, he has explored some major drawback of farm sector in India, and showing to government that it should give priorities to key segments like marketing, price mechanism, research and development. He has been observed that the support of Govt. and privet interference the sustainable growth can be attained.

Sangeet, Sukhpal Singh, ShrutiBhogal (2013) in their research study entitled "Agriculture for Sustainable development of India" he traced on Agriculture and compared its different dimensions like employment generation production and productivity, food grain availability. The study shows that more than 60% population has dependent on agriculture which has not sustainably grow. The authors suggest that sustainable development is a vision and that is a time to think about the scare and limited resources and it's used optimally and efficiently for preserving environment.

Challenges for Agriculture

The agriculture sector has the most challenging sector in respect of economically, environmentally and socially. The Indian agriculture sector faced various traditional as well as new global challenges the key challenges addressed as follows.

1. The conservation and enhancement of ecological foundations for sustainable agriculture, which included land, water, biodiversity, and marine resources. Urbanization and non-agricultural land use to create tremendous challenge before agriculture.

2. The 80 percent farmers in India having small size of land. They are not economically sound and lack of market attachment.

3. The net income from agriculture of small and marginal farmer's quite low or some time it become negative. Because of large increase in production cost in agriculture sector.

4. The agriculture productivity is very low and hamper income of the farmers. The per unit area productivity also low in case of major crop producing in countries.

5. The fall in the ground water level generate more pressure on other irrigation facilities and create hurdles in the way of agriculture development in India.

6. Lack of competitiveness in Indian farmers is another hurdle rise in between improve agriculture development. The farmers are less risk bearing and unskilled which adversely impact on their income from agriculture.

7. Natural risk in agriculture is a common phenomenon but most of the farmers not get benefits of crop insurance scheme. The agricultural insurance schemes are inefficient to overcome various risk in agriculture sector.

8. Low profitability is a main cause behind the farmers indebtedness and suicide problem existed in many states of India in the last few years.

9. The spending on agriculture subsidy has increased year by year but problem remains same and continuously grow-up.

Opportunities for Agriculture

The following key recommendations has given to ensure higher and inclusive growth in Indian agriculture sector.

1. Increasing agricultural productivity is a key challenge for ensuring national food security. To increase production, exploiting the potential of existing yield gaps offers a tremendous opportunity.

2. Rainfed areas have a huge potential to raise production and increase farm income. These grey areas can soon be made green to harness a second green revolution.

3. Linking farmers to markets is a pre-requisite for augmenting farm production and farmers' income. Role of innovative institutions would be critical in this context to reap the benefits of emerging opportunities.

4. Water will be the most critical natural resource for the future growth of agriculture. Currently, the water sector for irrigation is invariably neglected both at the central and state levels.

5. Climate change has added a new dimension to future agricultural growth, which is a major concern. The worst affected would be small farm holders located in the marginal and under-privileged areas.

6. There is an urgent need for agricultural diversification by identifying the key crops/ commodities which can help small farm holders to raise their income.

7. Food processing and distribution sector needs to be strengthened by evolving policies for larger private sector participation in the entire value chain.

8. Globalization of agriculture create huge opportunities for enhanced agricultural production and export.

Conclusion

In short, after the brief discussion on current position of agriculture, the major challenge is to secure sustainability of agriculture. Global warming and climate change all adversely impact on overall agriculture productivity and production in India. The future demand for food grain and raw material will not be satisfied from agriculture sector. Less production from agriculture and expansion in demand create bourdon on agriculture production and food inflation in India. But another side is that the agriculture production, productivity, profitability of marginal farmers has declined. On that ground the sustainable agriculture development is only way to overcome this problem and further development.

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Role of Plant Defensive Proteins Against Insect Attack

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Many plant proteins ingested by insects are stable, and remain intact in the midgut, and also move across the gut wall into the hemolymph. An alteration in the protein's amino acid content or sequence influences the function of that protein. Likewise, anti-insect activity of a proteolysis-susceptible toxic protein can be improved by administration of protease inhibitors (PIs), which prevent degradation of the toxic proteins, and allows them to exert their defensive function.

Role of Lectins

Lectins are carbohydrate-binding (glyco) proteins, ubiquitous in nature, and have protective function against a range of pests. They act as antinutritive and toxic substances by binding to membrane glycosyl groups lining the digestive tract, leading to an array of harmful systemic reactions.

Lectins have been found to be promising against homopteran, lepidopteran, and coleopteran insects. Insecticidal properties of *Galanthus nivalis* L. agglutinin (GNA) were the first plant lectin shown to be active against hemipteran insects. Efficacies of carbohydrate binding plant lectins such as GNA, *Phaseolus*ha emagglutinin, and wheat germ agglutinin, have been studied in detail against many insect pests. Mannose - binding lectins have been reported to be effective against sucking insects, because of their interaction with a specific carbohydrate residue of the cell membrane. Expression of lectin coding genes in transgenic plants and their defense against insects has been worked out in many plants, e.g., GNA, PSA (*Pisum sativum* pea), WGA (*Triticum vulgare* wheatgerm), ConA (*Canavalia ensiformis* jack bean), AIA (*Artocarpus integrifolia* ; jack fruit), OSA (*Oryza sativa* L.; rice), ASAL (*Allium sativum*), and UDA (*Urtica dioica* stinging nettle). The *Arum maculatum* lectin has been found effective against the aphids *Lipaphis erysimi* and *A. craccivora* when incorpoated in an artificial diet. Studies on the mechanism of action of the mannose-specific lectin, GNA against brown planthopper (*Nilaparvata lugens*) in rice has shown that that GNA binds to the luminal surface of the midgut epithelial cells within the planthopper by recognizing the cell surface carbohydrate moieties of glycoproteins and/or other glycoconjugates in the gut. Plant lectins are induced by elicitors as an induced response to various stresses. JA induced the expression of *NICTABA* lectin in tobacco leaves. Induction of NICTABA by herbivores infestation including *S. littoralis*, *Manduca sexta* L. and *Tetranychus urticae* Koch has been reported in tobacco plants. Differences in feeding behavior of insects results in expression of different lectins, e.g., larvae of the fall armyworm, *S. frugiperda* induced HFR2, but not HFR3 expression while the phloem-feeding bird cherry-oat aphid, *Rhopalosiphum padi* Koch, induced HFR3 and HFR2, but latter was expressed much later (12 d) than the former (24 h) Several jasmonate-inducible lectins are expressed in leaf tissues of monocots such as rice, barley, wheat, rye, and maize.

Role of Enzymes

One of the important aspects of HPR against insects is the disruption of insect's nutrition. The enzymes that impair the nutrient uptake by insects through formation of electrophiles includes peroxidases (PODs), polyphenol oxidases (PPOs), ascorbate peroxidases, and other peroxidases by oxidizing mono- or dihydroxyphenols, that lead to the formation of reactive o-quinones, which in turn polymerize or form covalent adducts with the nucleophilic groups of proteins due to their electrophilic nature (e.g., -SH or e-NH2of Lys). Other important antioxidative enzymes include lipoxygenases, phenylalanine ammonia lyase, superoxide dismutase, etc.

Role of Peroxidases (POD)

Oxidative state of the host plants has been associated with HPR to insects, which results in production of ROS, that are subsequently eliminated by antioxidative enzymes. POD constitutes one such group of enzymes, which scavenges the ROS besides having other defensive roles. A number of process are regulated by PODs that have direct or indirect role in plant defence, including lignification, suberization, somatic embryogenesis, auxin metabolism, and wound healing. Production of phenoxy and other oxidative radicals by the PODs in association with phenols directly deters the feeding by insects and/ or produces toxins that reduce the plant digestibility, which in turn leads to nutrient deficiency in insects with drastic effects on their growth and development. In addition, PODs have been reported to have direct toxicity in guts of herbivores.

Role of Polyphenol Oxidases (PPO)

The PPOs are important enzymes in plants that regulate feeding, growth, and development of insect pests, and play a leading role in plant defense against the biotic and abiotic stresses. PPOs can function in following ways:
1. PPO-generated quinones could alkylate essential amino acids, decreasing plant nutritional quality.
2. Quinones may produce oxidative stress in the gut lumen through redox cycling.
3. Quinones and ROS produced by phenolic oxidation, could be absorbed and have toxic effects on herbivores.

The PPOs are metallo-enzymes that catalyze the oxidation of monophenols and *o*-diphenols to quinones, which are highly reactive intermediate compounds that readily polymerize, and react with nucleophilic side chain of amino acids and crosslink proteins, thereby reducing the availability of such proteins, and affect the nutritional quality of the food. Under acidic conditions, quinones form semiquinone radicals that in turn give rise to ROS, while under basic conditions; quinines react with cellular nucleophiles. Quinines are more toxic to plant herbivores than the original phenols. In addition to their role in digestibility and palatability of plant tissues, melanin formation by PPOs increases the cell wall resistance to insects and pathogens. Although PPOs accumulate in leaves, roots, stems and flowers of the plants, young tissues with greater vulnerability to insect attack exhibit greater induction. The PPOs confer resistance to *S. litura*, *H. armigera, Bemisia tabaci*, *Tetranychus cinnabarinus*, *Myzus persicae*, *Empoasca fabae*, *Aphis medicaginis*, *S. exigua*, and *Agelastica alni*. However, induced PPO levels had no or limited impact on *L. dispar*, *Orgyia leucostigma*, and *Blissus occiduus*.

Role of Lipoxygenases

Lipoxygenases (LOXs) are another group of anti-oxidative enzymes involved in plant defense against many stresses through octadecanoid pathway. They catalyze hydroperoxidation of polyunsaturated fatty acids resulting in formation of fatty acid hydroperoxides. The latter are enzymatically and/or chemically degraded to unstable and highly reactive aldehydes, γ-ketols, epoxides, and ROS such as hydroxyl radicals, singlet oxygen, superoxide ion and peroxyl, acyl and carbon-centered radicals. The unstable reactive products interact with proteins resulting in protein-protein cross linking and amino acid damage that in turn affects the amino acid assimilation. In addition, lipid peroxidation end products also act as insect repellents or antixenosis and are toxic to insect pests (antibiosis). Major substrates of LOX in plants are linoleic and linolenic acids. One of the most important aspects of LOX in plant defense is the oxidation of linolenic acid in JA signaling pathway, which in turn plays a leading role in activation of plant defense, both directly by production of oxidative enzymes and protease inhibitors, and indirectly through the production of volatile organic compounds (VOC) that attract the natural enemies of insect pests. Induction of LOX activity in response to herbivory has been studied in many plants such as soybean in response to two-spotted spider mite, *T. urticeae*, in tomato in response to aphids, *Macrosiphium euphorbiae* and *M. persicae*, in *N. attenuata* following infestation by *Myzus nicotianae* and in wheat following *Sitobion avenae* infestation. The *N. attenuata* plants deficient in LOX are more vulnerable to attack by *M. sexta,* which also attract the new herbivores such as *Empoasca* spp, as compared with the plants where LOX3-mediated defense reduced larval growth, food consumption, and frass production. Maize plants transformed with the wheat oxalate oxidase gene had upregulation of LOX transcripts and elevation of free phenolics (14-fold), which were positively associated with resistance to the European corn borer, *O. nubilalis*.

Herbivore Induced Plant Volatiles (HIPVs)

Herbivore-induced plant volatiles (HIPVs) play an important role in plant defense by either attracting the natural enemies of the herbivores or by acting as feeding and/or oviposition deterrent. HIPVs are the lipophilic compounds with higher vapor pressure which are released from the leaves, flowers, and fruits into the atmosphere, and into the soil from the roots by plants in response herbivore attack. The HIPV's produced vary according to the plant and herbivore species, the developmental stage and condition of the plants and the herbivores. An optimum quantity of volatile compounds is normally released by the plants into the atmosphere, whereas a different blend of volatiles is produced in response to herbivory. The HIPVs include terpenes, green leafy volatiles (GLVs), ethylene, methyl salicylate and other VOCs. GLVs play an important role in plant defense by attracting natural enemies. Plant volatiles such as methyl salicylates and the C_{16}- homoterpene 4, 8, 12-trimethyl-1, 3(*E*), 7(*E*), 11- tridecatetraene [(*E, E*)-TMTT] have been found to attract the predatory mites. The most frequent component of the HIPVs is methyl salicylate (MeSA), and has been reported in the headspace of many insect-infested plants including lima bean, and Arabidopsis. MeSA is a ubiquitous component of many leaf and floral blends and MeSA baited sticky cards attract many insect predators including the big- eyed bug, *Geocoris pallens* Stal., ladybird beetle, *Stethorus punctum picipes* , green lacewing *Chrysopa nigricornis* , and other natural enemies. Methyl benzoate (MeBA), which structurally resembles MeSA, has also been detected from insect-infested plants. *S. frugiperda* infestation in rice induces emission of about 30 volatiles, including MeSA and MeBA, which are highly attractant to the natural enemies of *S. frugiperda*, such as, *Cotesia marginiventris*. However, there is an ecological cost of using HIPVs to engineer natural enemies; because HIPVs has the potential of attracting crop pests. For example, Colorado potato beetles, *Leptinotarsa decemlineata* is attracted to a blend of volatiles consisting of cis-3-hexenyl acetate, linalool, and MeSA. The HIPVs defend the plants either directly by repelling, deterring and toxicity to the herbivore or indirectly by attracting the natural enemies of the attackers, and thus, protect the plants from further damage.

Conclusion

Exploiting uniquely the plant potential to combat pathogens, the induced resistance may diminish the use of toxic chemicals for disease control, and thus could be proposed as an alternative, non-conventional, non-biocidal and ecologically-friendly approach for plant protection and hence for sustainable agriculture. The future challenge is to exploit the elicitors of induced defense in plants for pest management, and identify the genes encoding proteins which can be deployed for conferring resistance to the herbivores through genetic transformation. There is a need to understand the herbivore-specific signal molecules, their identification, mode of action, and further signal transduction for use in pest management Since the biochemical pathways that lead to induced resistance are highly conserved among the plants, the elicitors of these pathways could be used as inducers in many crops.

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Flag Smut of Wheat and their Management Practices

Article ID: 31447

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Introduction

Flag smut is a fungal disease of wheat that happens in numerous wheat-creating locales of the world. Truly, Flag smut was known to happen in the north-western United States; however, it had not been identified in the Great Plains since the 1930s. In May of 2015, flag smut was detected in multiple counties within central and western Kansas. Preliminary survey results indicated the disease was present in many areas of the state, but was more common in the arid, wheat producing counties of western Kansas. The disease is a concern because some countries have import restrictions on grain produced in areas where flag smut is known to occur.

Symptoms

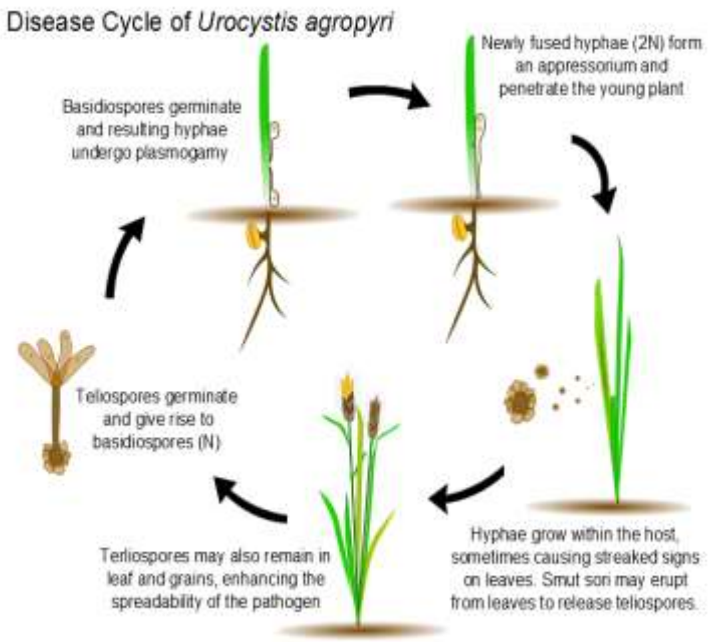
Flag smut symptoms appears during the stem elongation and heading stages of plant growth. Infected plants become increasing obvious during the early stages of grain development. Infected plants are deformed and often noticeably shorter than healthy plants. The stunted plants are often restricted to the lower third of the crop canopy. The leaves of diseased plants are often twisted and have long grey or black lesions that run parallel to the leaf veins.

As the plants mature, the lesions rupture and release large numbers of black, powdery spores of the fungus. Flag smut may infect all the tillers of a plant, but in some cases, only a few tillers become diseased. The heads of diseased tillers are poorly developed and often will not emerge from the twisted flag leaves. Heads that do emerge may have black-striped stems and glumes.

Life Cycle

The fungus Urocystis tritici causes flag smut in wheat. Plants with the disease produce large amounts of spores that contaminate the soil and can be moved within a field or to adjacent fields by wind, plant debris, and farm equipment. Spores incorporated into the soil are a major source of infections where the disease is common. The fungus can survive in the soil for at least 4 years, but viability of the spore decreases rapidly during this time.

Spores may survive longer in arid regions where the dry soil conditions prolong viability of the fungus. The fungal spores also can survive on the seed surface. Seed contaminated with the fungus can introduce the disease to new fields. Infection of flag smut takes place shortly after planting when the spores germinate and invade the young seedlings before emergence. In general, the risk of infection is greatest when winter wheat is planted into warm, moist soils. Although the spores of the fungus can germinate when soil temperatures are between 40- and 86-degrees Fahrenheit, soil temperatures between 50 to 68 degrees Fahrenheit are most favourable for infection. Once inside the plant, the fungus invades the growing point and remains dormant during the winter months. The fungus resumes activity in the spring and grows systemically within the plant, eventually producing characteristic leaf lesions and more black, powdery spores.



Management

1. Seed treatment with fungicides are the most effective way to manage flag smut.
2. There are many seed treatment fungicides labelled for control of flag smut and many of the widely marketed fungicides should provide excellent control of the disease.
3. The genetic resistance of wheat varieties grown in Kansas is unknown.
4. Crop rotations with non-host crops such as soybeans, sorghum, or corn provide time for the fungal population to decline between wheat crops and lower the risk of infection in subsequent years.
5. It also may be possible to reduce the risk of severe disease by avoiding early planting conditions that place seed into warm moist soils, which are known to favour infection by the flag smut fungus.

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Multistorey Cropping System: A Profitable Approach for Sustainable Productivity

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Introduction

Every individual is aware from the bitter truth of the overpopulation problem which is increasing day by day at an alarming rate in today's world. Due to this rise in population the farm land is going down gradually. 92 million farm households are under marginal farm category which possesses < 1 ha as operational holding and out of this, 70 % of the farmers are having an area of below 0.5 ha land. By 2050, more than 95 % of holdings are estimated to be under small and marginal category (Agarwal, 1995). In this context, it has become an essential part for the farming community to use their land holdings up to the maximum. Under such circumstances, a very effective method of farming can help the farmers to earn benefits from the same piece of land. The farming system is Multi storied cropping system. It is basically growing plants of different heights in the same field at the same time utilizing varying heights, root depths and crop canopy.

Advantages of Multi-Storey Cropping System

1. It gives maximum production from small plots. This can help farmers cope with land shortages along with income per unit area increase substantially.
2. Minimizes the risk of crop yield loss.
3. Improves physical properties and health status of the soil.
4. Including legumes in the cropping pattern helps maintain soil fertility by nitrogen fixation in the soil.
5. Different types of crops can be produced thereby providing a balanced diet for the family.
6. Weeds are suppressed due to high density planting.
7. Saves the crop from climatic aberrations like high rainfall, soil erosion, landslides etc.
8. Maintain an ecological balance.
9. Provides suitable micro-climate conditions that benefits the winter crops.
10. Efficient use of resources available.
11. Helps in maintaining ecological balance.

Components of a Multi-Storey Cropping System

A model with multiple cropping system, requires systematic planning with regard to selection of crops, planting, manuring and other management practices. The following points are to be considered while raising a garden with multi-storey cropping system.

1. Base crop: It is the main component of the system. The crop which is selected as the base crop should have tall growing, widely spaced and perennial nature. The wider spacing provides more scope for growing other crops.

2. Other crop: Locally adapted crop suits the best for growing in the interspaces of the base crop. The root system of these crops should be of varying depth so that they can draw nutrients from different layers of the soil to avoid competition among the crops. Secondly, the crop should be of different heights so that proper sunlight can be received by all the crops uniformly without any hindrances. Moreover, the canopy should be

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also of different size and structure to avail sufficient wind velocity. The crop in the inter spaces should be capable of growing under partial shade or shade to some extent because of the shade by the base crop.

Planting Method

The taller plants should be planted nearer to the base crop and shorter ones gradually away from it. This system of planting gives more effective results.

Coconut Based Multi-Storey Cropping System

According to a study conducted in Central Plantation Crops Research Institute, Indian Council of Agricultural Research, Kasargod, area under each coconut tree spaced at 7.5 m × 7.5 m is 56.25 m2. The maximum concentration of roots found to reach 12.57m2, which comprises 22.2% of the total area which means a provision of about 77.8 % is facilitated for growing other crops. The crop canopy coverage and solar energy utilization of single coconut plantation indicates that around 45–50 % of the sunlight reaches the ground surface without any hindrance which can be again an added advantage for the other crops (Nimbolkar et al., 2016). Thus, it provides opportunities for growing short and medium duration inter-crops like banana-turmeric-ginger-pineapple-vegetables-papaya, sorghum-legumes, sunflower, tapioca, sweet potato, guava etc., following crop rotation in the initial 5 years of plantation (CPCRI, Kasargod, 2014-15). After 20-25 years, since 40 % sunlight will be provided in the inter row spaces, therefore shade loving crops can be taken up as other crop in this system like Coconut + Black pepper + Cocoa + Pineapple/ Turmeric / Ginger (Mathew et. al., 1993).

Arecanut Based Multi-Storey Cropping System

With the base crop as Arecanut also, multi-storey cropping system can be followed. Studies under coastal Karnataka indicated that all the intercropping systems recorded higher yields when intercropped in arecanut plantation. The intercropping systems were viz. Amorphophallus, Chinese potato, colocasia, ginger, sweet potato, tapioca and turmeric. Crops suitable for growing in the inter spaces of Arecanut cultivation are Turmeric/ginger + Black pepper, Pineapple, short duration legume vegetables etc.

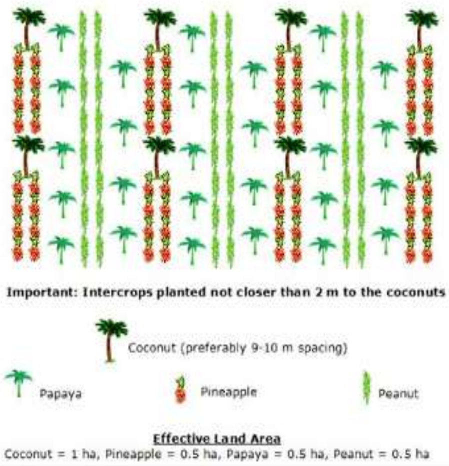

Fig 1: field arrangement for a coconut based multi-storey cropping system (Coconut+Papaya+Pineapple+Peanut)

Source: Department of Agriculture Philippine Coconut Authority, Philippines.

Some of the Successful Multi-Storey Cropping Systems

1. Coconut based:

a. Coconut+ papaya+ pineapple.
b. Coconut+ banana+ black pepper.
c. Coconut+ black pepper+ papaya+ pineapple.
d. Coconut+ banana+ ginger.

e. Coconut+ banana + pineapple.

2. Arecanut based:

a. Arecanut + Turmeric.
b. Arecanut + Black pepper + Turmeric.
c. Arecanut + Banana + Turmeric.
d. Arecanut + Cow pea + Tomato.
e. Arecanut + Chilli + Spinach.
f. Arecanut + Banana + Okra + Brinjal.
g. Arecanut + Chilli + Coriander.

Conclusion

Multi storey cropping system is a very effective technique in today's scenario of agriculture where land use under farming is degrading at a faster rate. In most of the times it has been seen that the inter spaces are left unutilized in that case a good amount of returns can be earned through this system of planting where the production will increase by at least 2 to or 3 times from the existing one along with, maintaining soil health status. This system of farming is indeed a boon to small and marginal farmers of the country.

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Allelopathy

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Allelopathy refers to the chemicals released by plants into the environment which inhibits the growth and development of the neighbouring plants.

Forms of Allelopathy

1. Weed on crop: Release of allelochemicals by weeds affect the growth and development of crop. Ex: Jungli palak affects growth and development of wheat.

2. Weed on other weeds: Release of allelochemicals by weeds affect the growth and development of other weeds. Ex: *Imperata cylindrica* affects growth and development of *Borreria hispada.*

3. Crop on weed: Release of allelochemicals by crops affect the growth and development of weeds:

a. Oat, Pea and Wheat suppresses the growth and development of *Chenopodium album*

b. Sorghum suppresses many weeds in vicinity by releasing hydrocyanic acid

c. Barley inhibits weed growth by producing gramine

d. Maize inhibits growth of *Chenopodium album, Amaranthus retroflexus* by releasing allelochemicals through roots

e. Sorghum inhibits growth of *Setaria viridis, Bromus pectinatus* and *Amaranthus hybridus* by releasing allelochemicals through shoots and foliages

f. Cucumber inhibits growth of *Echinocloa crusgalli*

g. Sweet potato suppresses growth of *Cyperus rotundus* and *Cyperus esculentus*

h. Rye inhibits growth of *Digitaria sanguinalis* and *Ambrosia artimisifolia* by releasing allelochemicals through shoots and foliages.

Types of Allelopathic Chemicals

1. Phenolic acids.
2. Flavinoids.
3. Terpinoids.
4. Scopulatens.
5. Coumarins.

Types of Allelopathy

1. True allelopathy: In true allelopathy substances which are released from the plant are toxic in the form they produced in the plant

2. Functional allelopathy: In functional allelopathy substances released by the plant are toxic after transformation by micro-organisms.

Factors Affecting Allelopathic Effect

Varieties, specificity, auto toxicity, crop on crop effects and environmental factors are the factors that affect allelopathy.

Advantages of Allelopathy

1. Limits competition for space, nutrients, water and sunlight.
2. Chemicals produced the plant inhibits the germination of its own seeds.
3. Suppresses weed growth so can be used in organic weed management
4. Allelochemicals lack common mode of action because of its diverse nature.

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Marker Assisted Back-Cross Selection: A Tool for Speed Breeding

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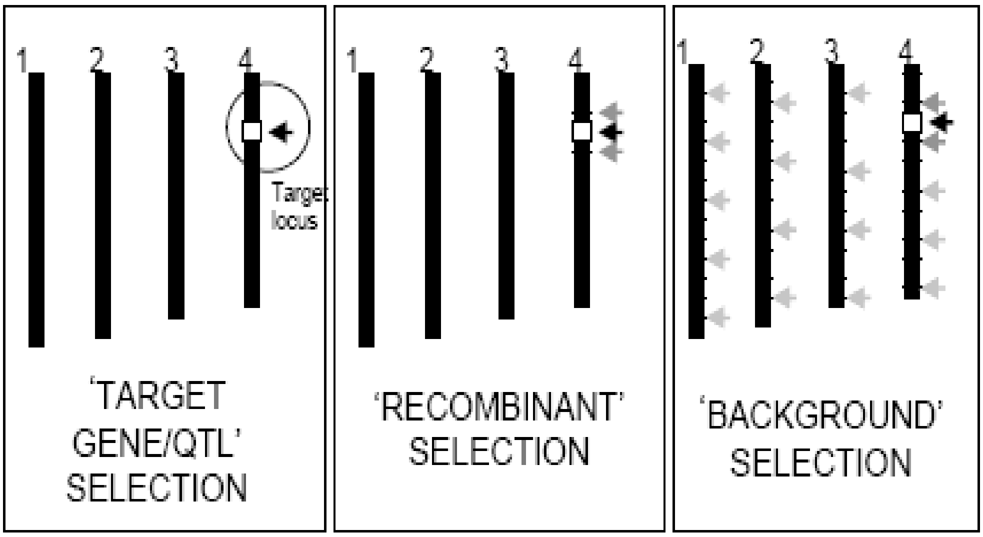
Introduction

Backcrossing is a conventional breeding method frequently engaged for the transfer of genes at one or more loci from a donor to an elite recipient variety (Allard 1960, Reyes-Valde 2000). It takes almost six backcross generations for the recovery of recurrent parent (RP) genome and i.e., 99.2%, which is most similar to improved variety. Conventional backcrossing method can take up to five generations to recover the recurrent parent along with the desired trait(s). But the number of backcross generations can be reduced with the help of molecular markers to assist backcrossing programs. In addition to that it is also helpful in decreasing the recovery time of the recurrent parent. By using marker-assisted backcrossing, not only the genes of interest can be tracked, but also the contribution of the recurrent parent genome can be anticipated and observed during the process.

So basically, it is a process of using markers to select for target loci, minimize the length of the donor segment (to reduce linkage drag) containing a target locus and to accelerate the recovery of the recurrent parent genome during backcrossing (Hospital 2011). Thus, the predicted product is an improved line/genotype contains solely the targeted gene from the donor parent into the genome of the recipient parent. Hence, the Marker Assisted Back-Crossing is superior to conventional backcrossing programme both in precision and efficiency than the conventional back-crossing programme. Marker-based genome scrutinization in Marker Assisted Back-Crossing allows a rapid retrieval of most of the recurrent parent genome in a few crosses (Frisch 2005). This method includes three selection steps are as follow:

1. Foreground selection: Marker-assisted foreground selection was first suggested by Tanksley in the year in 1983. This type of selection is utilized by the breeder for the selection of those plants which are having the marker allele of the donor parent at the target locus. The primary goal is to keep-up the target locus in a heterozygous condition i.e., one recurrent parent allele and one donor allele till the last backcross is completed. Then, the selected plants are selfed and progeny plants homozygous for the donor allele are identified and selected and the process is called foreground selection.



2. Recombinant selection: The second level involves the selection of recombinant back-cross progeny between target locus by the use of flanking markers and the occurrence of recombination between the target locus and linked flanking markers is termed as 'recombinant selection'. The principal target of this selection is to reduce the chromosome size of the donor parent because many undesirable genes that have negative impact on the performance of crop may be linked to the target gene (linkage drag). Through conventional back-crossing many back-cross generations are required to reduce this linkage drag. But by the use of flanking markers it can be minimized by using two back-cross generations (Frisch et al. 1999).

3. Background Selection: By the use of unlinked markers to the target locus the back-cross progenies are selected which contain greatest proportion of recurrent parent genome and the selection is referred to as 'background selection'. In background selection, selection of all genomic regions can be done by using recurrent parent marker alleles and the selection of target locus is done on the basis of phenotype. Background selection usually indicates the use of tightly linked flanking markers for recombinant selection and unlinked markers for recurrent parent selection.

Advantages of Marker Assisted Back-Crossing Over Conventional Backcrossing

1. It takes six backcrosses to recover the recurrent parent genome through conventional backcross breeding. But there is quick recovery of recurrent parent genome through this method and it may be recovered by BC4 or BC3 even BC2.

2. The molecular markers are consistent from any environmental effect thus make selection more precise.

3. One of the main advantages of this method is that it minimizes the linkage drag within two to three back-cross generations thus reduce the breeding programme.

4. It is easy to discard all the progenies from the programme except our targeted lines with the help of molecular markers. Thus, increase the efficiency of the programme than conventional method.

Achievements through MABC

1. Improved Sambha Mahsuri: Bacterial Blight resistant.
2. Pearl-millet (HHB-67-2): improved growth in low fertile soil.
3. Maize (Vivek-QPM9): Submergence tolerance: Sub1A.
4. Improved Pusa Basmati: resistance to Bacterial Leaf Blight.

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Options and Way Forward for Reducing the Menace of Parthenium

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Introduction

Parthenium hysterophorus is an aggressive annual herbaceous plant, native to the tropical America. It is now widely distributed in a number of tropical and sub-tropical countries threatening natural ecosystems, agro-ecosystems and biodiversity worldwide. It has been considered a great cause of skin allergy in mankind and animals too in many countries around the globe. Parthenium has achieved major weed status in India and Australia and posing lurking threat to many African and South–Asian countries. Earlier, it was not considered a major threat to agricultural crops in India and other countries, but now, all types of crops are infested with the weed in India. The infestation of this weed causes yield losses up to 40% in several crops and reduces forage production up to 90%. The rapid spread of Parthenium in India would be a bigger risk to the expansion and sustainable production of many crops, orhcards and grassland ecosystems in protected forests. Various management approaches namely cultural, mechanical, chemical and biological have been used to minimize losses caused by this weed, but most of these approaches are ineffective and suffer from one or other limitations. Although management using herbicides and exotic bioagents *Zygogramma bicolorata* for biological control has been found to contribute effectively to suppress Parthenium in India, nevertheless, the weed remains a significant problem. Integrated Parthenium Management is advocated to fight against this invincible weed. Hence, an attempt has been made to review its options for reducing to menace and management in context to world in general and India in particular.

It is most popularly known as 'congress grass' throughout India while in Hindi speaking belt known by the popular name of 'gajarghas' (carrot grass) besides vernacularly called as 'kadvighas' [bitter grass], or 'safed topi' (white top). It is one of the most aggressive herbaceous weeds of the family Asteraceae. It is an annual short-lived herbaceous plant that invades preferably vacant land, disturbed sites, road sides, railway tracks sides, wastelands, water courses, agricultural crops etc. It degrades natural ecosystems by reducing biodiversity (Holm *et al*. 1997) and can cause serious allergic reactions in man and animals.

Current Spread of Parthenium Weed

It is widely found in almost all the parts of world such as in Asia (Bangladesh, India, Israel, Pakistan, Nepal, southern China, Sri Lanka, Taiwan and Vietnam), Africa (Ethiopia, Kenya, Madagascar, Mozambique, South Africa, Somalia, Swaziland and Zimbabwe), Australia and the Pacific (New Caledonia, Papua New Guinea, Seychelles and Vanuatu (Dhileepan and Senaratne, 2009). India has become one of the most Parthenium affected countries in the world as this weed is occurring in all of her states and presenting a major problem in many those states that have large areas of non-cropped and pastures rain-fed land (Sushil Kumar, 2012). The spread of Parthenium has been reported from all states of India in varying intensity. In general, overall spread in terms of density and infestation level was highest in Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Haryana, Karnataka, Maharashtra, Madhya Pradesh, Punjab, Tamil Nadu and Uttar Pradesh; medium in Assam, Gujrat, Himachal Pradesh, Jharkhand, Jammu & Kashmir, Uttarakhand, Odisha, West Bengal and Rajasthan; low in Andaman & Nicobar, Arunachal Pradesh, Goa Kerala, Lakshadweep, Manipur, Mizoram, Meghalaya, Nagaland, Pondicherry and Sikkim. The overall average infestation of Parthenium varied in different states of India.

Table 1. Spread and infestation level of Parthenium

Name of state	Over all spread and infestation level of *Parthenium*	Name of state	Over all spread and infestation level of *Parthenium*
Andaman & Nicobar islands	Low	Kerala	Low
Andhra Pradesh	High	Madhya Pradesh	High
Arunachal Pradesh	Low	Maharashtra	High
Assam	Medium	Manipur	Low
Bihar	High	Meghalaya	Low
Chattishgarh	Medium	Mizoram	Low
Chandigarh	Medium	Nagaland	Low
Delhi	High	Orissa	Medium
Goa	Low	Pondicherry	Medium
Gujarat	Low	Punjab	High
Haryana	High	Rajasthan	Medium
Himachal Pradesh	Medium	Sikkim	Low
Jammu & Kashmir	Medium	Tamil Nadu	High
Jharkhand	Medium	Uttar Pradesh	High
Karnataka	High	Uttarakhand	Medium

Source: Sushil kumar (2012)

Increase in Land Area Infestation with Parthenium in India

Sushil Kumar and Varshney (2010) studied the spread and infestation of Parthenium problem since its first occurrence in India in 1955 in Pune. They found that in beginning, Parthenium was only a problem in wasteland and vacant land, but not in the crop areas. Reports stared to appear about its infestation in field crops after 1980. Likewise, reports of Parthenium infestation in forest area also started to appear after 1990. On the basis of published information of Parthenium infestation in wasteland, crop land and forest area, they estimated about 35 million hectares of land infested with Parthenium in India. The increase of Parthenium infestation in crop area in recent past was alarming.

Menace of Parthenium in Crop Production, Orchards, Pasture and Forest Ecosystems and Human and Animal Health

The harmful effects of Parthenium have been reported world over in different ecosystems with different intensity. In the beginning of its infestation in India, Parthenium was known as a weed of wasteland as it used to seldom occur in crops but now it has spread in almost all types of cereal, pulse and vegetable crops besides pasture and forest ecosystems. In agricultural fields, where only one crop is taken in a year, it grows profusely in fallow period with the occurrence of mild rains. It has become a serious problem on grass availability in pastures land. In many forests, National Parks and Reserved forests, the weed has achieved the alarming status and has become a major concern for the survival of carnivores, which survives on herbivores that are mainly dependant on grasses. In India, this weed has been considered as one of the greatest sources of dermatitis, asthma, nasal-dermal and naso-bronchial types of diseases. In general, Parthenium is a poisonous, pernicious, problematic, allergic and aggressive weed posing a serious threat to human beings and their livestock.

1. Impact on crop production: Due to the invasive capacity and inhibitory role of allele chemicals, phenolics and sesquiterpene lactones, mainly parthenin, it inhibits the germination and growth of plants including pasture grasses, cereals, vegetables and other plant species. In India *Parthenium hysterophorus* causes a yield decline of up to 40% in agricultural crops (Khosla and Sobti, 1981). (Maharjan et al., 2007) showed that increase in concentration of extract was invariably associated with decrease in germination and seedling characteristics of the crops. The germination and growth of agricultural crops, like rice, wheat, maize, pigeonpea, blackgram, sorghum etc. are inhibited by its allelopathic effect. The weed affects nodulation in legumes due to inhibition of activity of nitrogen fixing and nitrifying bacteria, namely, Rhizobium, Actinomycetes, Azotobacter, and Azospirillum.

2. Impact on orchards and forests ecosystem: Earlier, it was not considered a weed of orchards and forests but now it has spread rapidly in these areas too. Parthenium grows luxuriantly in orchards due to less frequent weeding in such ecosystems. The Parthenium has become a problem in Van Vihar National Park in Bhopal (Madhya Pradesh, India), where large area of grasses was replaced by the weed. This situation compelled the authorities of National Park to uproot the weed by deputing large number of labours to restore the grasses. Among the eight species recorded in the area, Parthenium showed maximum density and importance value index which posed a significant threat to economic development and ecological integrity. Parthenium rapidly invaded new surroundings and replaced the indigenous species and posed a serious threat to biodiversity, reducing pasture productivity and hence fodder supply.

3. Impact on human and animal health: In India, this weed has been considered as one of the greatest sources of dermatitis, asthma, eye irritation, and sinusitis (hay fever) types of diseases. Pollens in contact with body causes swelling and itching of mouth & nose. Consumption of weed roots causes excessive water loss from the body due to contact of *Parthenium hysterophorus* causes acute toxicity in cattle and milk becomes bitter tasting due to the presence of parthenin compound, which is also hepatotoxic in nature. Due to Contact of this weed causes inflamed udder, fever and rushes in cows, allergic inflammation in the mouth of cattle. If it is present in animal diet then causes dermatitis with pronounced skin lesions and a significant amount (10–50%) of *Parthenium hysterophorus* in the diet can kill cattle and buffalo.

Parthenium Management

Ever since the weed became a menace, efforts are being made to manage the weed by different methods world over. So far, no single method has been proved satisfactorily as each method suffers from one or more limitations such as impracticability, temporary relief, environmental safety, high cost etc. A brief of different methods in practice is being given below in context to their applicability and practicability in different type of situations and ecosystems.

1. Preventive management through legislative measures: The proverb 'prevention is better than cure' is applicable in all the countries affected with Parthenium. It may be implemented by enforcing suitable legislative tools and following up action by the government. This is done by washing with a high-pressure hose or by using roadside washdown facilities.

2. Mechanical and manual management: This method is applicable in all type of ecosystems in limited area in spite of high cost involved. The relief from this method is temporary and needs to be repeated on reappearing of the weed. Mechanical removal with the help of tractor, plough, etc. is possible up to certain extent and that too only in open fields without crop or if crops are sown in lines. Cuttings of Parthenium with the sword enhance its regeneration. After cuttings, large numbers of shoots are sprouted from the cut stems and flowers are produced on such shoots early than the normal plant. Therefore, cutting should be avoided under physical management. If mechanical or manual methods are to be adopted, Parthenium should be uprooted and such operations should be completed before flowering. Uprooting is practicable only during rainy season when soil becomes wet and plants are easily uprooted with tap roots, which is not possible during summer or winter season. Uprooting should be done by using hand globs of leather, cloths or plastic to avoid direct close contact with the skin. Uprooting of Parthenium by farmers is practicable only in high valued crop or in small area due to high labour cost.

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3. Cultural management: This method may be applicable in crop ecosystem. It has been observed that in some crop fields, Parthenium grows profusely. To reduce the seed bank in such crops, some fast-growing species of fodders like barseem and sorghum can be taken to suppress Parthenium and its seed bank in the field (Sushil Kumar, 2012). Reductions in the stock in rate and more appropriate rotational timings between grazing events are other useful methods for managing Parthenium weed in pastures (Adkins and Shabbir 2014).

4. Chemical management: Chemical control of Parthenium over a vast area like wastelands, rangelands, community land or within forests where the weed commonly found is not cost effective. Sushil Kumar and Varshney (2010) estimated the requirement of Rs. 126000 million or Rs. 12600 crores to control 35 million hectares of Parthenium infested land in India for one-time spray of chemical. The chemical approach may be applied in wasteland, crop land, and orchards type of ecosystems depending on the situations and area infested. It is easy to use herbicides in wasteland situation where there is no danger of crop damage but in crop ecosystem, expert knowledge is required to apply suitable herbicide depending on the crop in the field (Sushil Kumar 2012). In wasteland situation, if grasses are to be saved and Parthenium is to be killed, metribuzin (0.3 to 0.5%) should be used. 2,4-D (1 to 1.5 kg/ha) and metribuzin (0.3 to 0.5%) can safely be used in crops of grass family like sorghum, sugarcane, wheat, rice, oat etc (Brar and Walia 1991). For complete vegetation management including Parthenium, glyphosate (1 to 1.5 kg/ha) in 500 litre spray effectively controlled Parthenium at all growth stages is recommended.

5. Biological management: Several insects and pathogens have been tried from time to time. The leaf-feeding beetle *Zygogramma bicolorata* and the stem-galling moth *Epiblema strenuana* are widely used in several countries to manage Parthenium. *Z. bicolorata* is now widely used in India to control Parthenium.

6. Competitive replacement by plants, especially Cassia tora, could be treated as one of the avenues for further studies and implementation. The use of herbicides, side by side with other methods of control, also need to be developed and standardized. Development of new cost-effective and persistent herbicides with less residual effects is the need of the day. Also, development of resistance against commonly used herbicides needs to be monitored. Lastly, utilization aspects of the weed as green manure, growth inhibitor and phagostimulant in medicines should be promoted so that the population is controlled through exploitation.

Uses

Parthenium is reported to have insecticidal, nematicidal and herbicidal properties. It is also used for composting and vermicomposting. Parthenium can also be used as green manure. The odour of the plant is apparently disagreeable to bees and they can be easily kept away by carrying a handful of Parthenium flower heads. A root decoction of the plant is used in treating amoebic dysentery. Sub-lethal doses of Parthenin, a toxin recovered from Parthenium, exhibited antitumor activity in mice and the drug can either cure mice completely or increase their survival time after they had been injected with cancer cells. Parthenin is also found to be pharmacologically active against neuralgia and certain types of rheumatism.

Conclusion

It is clear that Parthenium cannot be controlled by adopting any single method. Sushil Kumar and Saraswat (1997) strongly advocated that Parthenium can be managed effectively only by adopting integrated approaches involving people participation. They suggested Integrated Parthenium Management (IMP) scheme involving the integration of all the available methods at different time of the year keeping in view the biology and germination of Parthenium. For example, manual removal involving public participation during rainy season when soil is wet and uprooting is easy, use of chemicals during winter and summer as spot treatment, use of botanical like Cassia tora and exotic insect *Z. bicolorata* during rainy season. For effective implementation of Parthenium management programme, it was advocated to continue the efforts for at least 5-6 years to exhaust the available seed bank in the soil. Further adequate quarantine measures should be adopted to check the immigration and emigration of the weed. Therefore, combined efforts by researchers, social workers, department of agriculture and forestry are required.

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IT Prelude in Indian Agriculture

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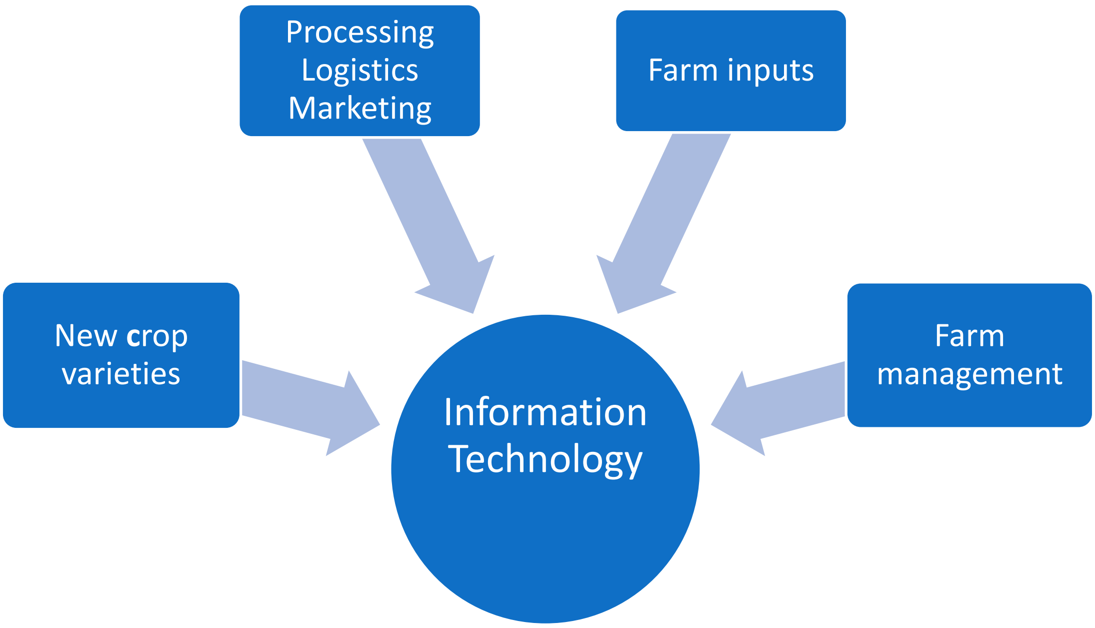
Introduction

The word "information technologies" has been used by academic researchers since the 1980s. The abbreviation "ICT" became used by Dennis Stevenson in his 1997 report to the UK government.

Information technology which is a set of various practical tools and resources supports to communicate, transmit, deposit and handle information. It includes computer, internet, network devices, software, and satellites, broadcasting technologies like radio, television and telephony. Apart from this it requires services and tasks linked with it for example email, web portals, video-conferencing, SMS, etc. The role of information technology is to ensure that the users get the right information, in right form, in right time. Thus, information technology is helpful to communicate the knowledge.

In developing country like India transformation in agriculture with information technology is the need of hour as agriculture is the main source of national income. The generation and application of agricultural knowledge is progressively important, particularly for small and marginal farmers, who require relevant information in order to improve, sustain, and expand their farm enterprises.



IT In Agriculture

Objectives

Information technology and agriculture, both were considered incongruous to each other a decade ago, but now the scenario has changed. Today, information system is being widely incorporated with agriculture. Information technology always had the potential to increase the quality of farming and farming products, but it demands efficiency and information in every area of agriculture. The world Trade Organization has recently made a laudable effort in promoting the information technology as an integral part of farming sector around the world.

Information Technology (IT) has a substantial role to play in all facets of Indian agriculture. In addition to facilitating and improving the efficiency of farmer's productivity in agriculture and allied activities; bringing the potential of IT for the qualitative improvement of life of farmers by providing timely and data inputs for decision making is inevitable.

Pre-sowing	Pre-harvest	Post-harvest	Market information
Information on agro- inputs like seed, pesticides, fertilizers Soil testing Weather condition	Techniques of harvesting Packaging Pest management Good agricultural practices	Logistics Market information End-products storage, grading and management	Commodity prices Mandi information Alternative market channels Consumer feedback

Table 1. Objectives of IT in agriculture

Importance of IT in Agriculture

1. Bridge the gap between agricultural researchers, extension agents and farmers, thereby enhancing agricultural production.
2. Gain and improve access to climate-smart solutions with appropriate knowledge.
3. Facilitates market access for inputs as well as product marketing and trade.
4. Increase access to financial services for rural communities.
5. Widen the reach of local communities and enhance the income of the farmers.
6. Assist in implementing regulatory policies, frameworks and ways to monitor progress.

Constraints of IT Led Agriculture

There is great potential for IT led agriculture in developing countries however application such as precision agriculture and e-commerce in agriculture can only work in an environment where there is good Information communication technologies (ICT) infrastructure.

Participation in e-commerce activities requires that both buyers and sellers have access to the internet and that they are able to use the required hardware and software effectively. Unfortunately, in most developing countries, there are many constraints blocking the development of IT led agriculture.

These include:
1. Lack of sustainable ICT infrastructure.
2. Absence of appropriate skills among potential users of ICTs especially farmers, rural communities, extension staff and researchers.
3. Lack of appropriate content.
4. Lack of access to ICT facilities.

Conclusion

IT is a simplest form as an electronic medium for creating, storing, manipulating receiving and sending information one place to another. It tempers message delivery faster, and convenient, easy to access, understand and decode. ICTs bridge the gap between extension personnel's, agriculture researchers and farmers thus enhancing agricultural production. Thus, IC is capable to enhance agricultural produces and build up Indian farmers' economic condition also. Increase access to financial services for rural communities. Bridge the gap between agricultural researchers, extension agents and farmers, thereby enhancing agricultural production. IT can consume time, with reducing cost of Indian farmers.

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Blast in Pearl Millet: Current Status, Symptoms and Management

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Introduction

Pearl millet [*Pennisetum gluacum* (L.) R. Br.] is an important crop and extensively cultivated in India and Africa. It is mainly grown as Kharif season crop in India but in some part of country it is also grown in Rabi and Summer season.

The status of pearl millet is increasing continuously and plays a crucial role in energy security and food to rural people. Pearl millet yield and growth is affected by number of diseases caused by fungus, virus, bacteria and oomycetes, among them some are economically much significant, especially downy mildew, ergot, blast and smut.

Among the various obstacles in achieving high grain yields in pearl millet downy mildew is considered a major problem. Meanwhile, there has been a major outbreak of blast in the Indian subcontinent over the last five years and has come out as a very serious hazard in pearl millet.

Current Status of Blast in India

Blast has been prevailing in pearl millet robust zones of India since the 1970s; an increase in its number has been seen recently in many pearl millet cultivating regions such as Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Uttar Pradesh, Delhi and Karnataka The data of disease incidence from 2002-2016 specifies that the disease is becoming more and more prevalent (AICPMIP Annual Reports, 2002-2016).

Year	Range of Blast % incidence	Blast affected states
2002-03	0.5-60	• Gujarat • Rajasthan
2015-16	1-60	• Rajasthan • Maharashtra • Madhya Pradesh • Gujarat • Tamil Nadu • Karnataka

Causal Organism and its Host Range

Blast disease caused by *Magnoporthe grisea* is a major concomitant disease in India. Pennisetum is a genus with more than a hundred species (Oliver, 1934). It is not yet clear how all types of Pennisetum are acquired through *Magnaporthe grisea* infection. Available data indicate that the pathogen infects mainly *Pennisetum glaucum, P. squamulatum, P. macroforum, P. pedicellatum* and *P. ciliare*. *M. grisea* is extensively peculiar in its host range but highly versatile.

Favorable Factor for Blast

The seedling and tillering stage of the crop is at high risk for this disease. The presence of M. grisea spores in air, full sky, drizzles, recurrent rain, high RH (90% and above), wet leaf temperature ranges from 25-28 ° C and application of high dose of nitrogen fertilizer cause the blast infection.

Disease Symptoms

Symptoms of Magnaporthe eruption in pearl millet are often referred to as grey leaf spot on the leaves and stem. The most common symptoms of the blast initiates with lesions or small specks that enlarge and become necrotic, leading to the emergence of chlorosis and the proliferation of small leaves. Lesions generally initiate near the tips of the leaves or margin of the leaves or both and extend to the outer edge (s). The small lesions are pale green, which later turn yellow and grey with age. As a result, among humid climates, especially those with overgrown vegetation, blast disease becomes more prevalent. Foliage lesions are elliptical or diamond shaped approximately 2.5-3.5 x 1.5-2.5 mm. The centres of the lesion are grey and water soaked when young but turns brown and often surrounded by a chlorotic halo that will turn necrotic, giving the appearance of concentric ring. Symptoms appear from seedling to the flower stage, stem and boot leaf.

Disease Management

1. Cultural practices:

a. Burning of crop residue like diseased stubbles and straw.

b. Planting of diseased free seeds.

c. Avoiding excessive application of nitrogen fertilizers and early sowing.

d. Salt solution of 200 g/l or 230 g/l ammonium sulfate is used to separate mature seed, followed by chemotherapy for seed disinfection.

2. Chemical control:

a. Two foliar sprays at the interval of 15 days during initial onset of the disease with tricyclazole, 0.05% or isoprothiolane, 0.05% or iprobenfos, 0.1% were very effective in reducing blast intensity.

b. Two Carbendazim sprays of 0.05% (ICBR 1: 3.85) or one gram per liter for 15 days interval before the incidence of the disease are recommended.

c. Three spray of Nativo@ 0.4g/l or Tilt @ 1ml/l were found effective in controlling blast disease.

3. Biological control: Three spray of *Pseudomonas fluorescens* (Pf1) @ 2 g/l of water, first spray just after seeing the symptom, second and third sprays at the time of flowering stage for 15 days interval.

Conclusion

Blast is very severe disease in last some decades and its incident increasing continuously year after year which cause a significant loss in yield. Under these conditions management of blast is necessary for healthy crop growth and higher yield. Management of blast can be done by utilizing different methods (chemical, biological and cultural).

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Impact of Climatic Change on Eco-behavioural Pattern of Insect

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Introduction

The productivity and profitability of an agro-ecosystem is greatly influenced by the herbivorous insects. Despite the well-known sensitivity of insects to abiotic effects such as temperature, their potential responses to ongoing climate change remain unclear. Majority of the insect pest show response affecting their severity as pests by topography, geographical region, population dynamics, life-history traits, and/or trophic interactions. The agricultural pests show strikingly more diverse and generally weaker responses to climate change than the forestry pests. However, the agricultural pests seem to increase more in detrimental ecological impact than do the forestry pests. The impact of climatic change can be seen in either way, by increasing or decreasing socioeconomic and ecological impact. Furthermore, the type and/or direction of responses differ regionally.

Insect pests have major detrimental impacts on agricultural and forestry production that are likely to increase with anticipated rise in demands for food, bioenergy, feedstocks and other agricultural products. Many forest pests, such as the gypsy moth *(Lymantria dispar)* and mountain pine beetle *(Dendroctonus ponderosae)*, also have severe ecological impacts: displacing native species, causing widespread defoliation and tree mortality, disrupting ecosystem functions and diminishing biodiversity. Further, managing insect pests is financially costly. For example, estimated global costs of managing only one pest species, the diamondback moth *(Plutella xylostella)*, are 4-5 billion USD annually.

Present Scenario

The present anticipated and ongoing trends in climatic changes would result in increased pest populations and resulting in biodiversity and economic losses. Alternatively, pests can be constrained by their environmental niche requirements, physiological tolerances, and phenological or life-history responses to climate, leading to local population declines or extinctions as climates change. The increasing uses of automobiles and exhausts from industries have certainly elevated the level of CO_2 in the atmosphere. This increased CO_2 concentration adversely affects the nitrogen composition in plants. Invariably, most of the studies have shown that herbivore performance is positively correlated with leaf nitrogen concentrations.

The better growth of plant results in succulent plant canopy which will have more phytophagous insect. The increased CO_2 levels are also detrimental to natural enemies, which will help pest to increase the population. Entomologists predict additional generations of important pest insects in temperate climates as a result of increased temperatures. The aphid exhibits extended seasons of viability and more rapid growth where lower temperatures are currently limiting, and reductions where higher temperatures are limiting. The Codling moth undergoes a facultative diapause in the larval stage, and across its range voltinism varies, generally decreasing at higher latitudes. The rising temperatures over the past 50 years have been associated with increases in the number of generations completed each season. By driving these models with data of future climate change scenarios, predict further increases in voltinism, as well as an expansion in distribution into higher latitudes. The increased temperature also benefited coffee berry borer to increase the generations per year in some part of the country.

The temperature gradient along with the fluctuation in rainfall pattern resulted in the pest outbreak of fall army worm (FAW) in India, which is an invasive pest and competes with the indigenous maize pests for resource utilization and their survival (Sidramappa, 2020). The late and continuous rains were proved to be congenial for the pest population. In earlier stage it helped to increase the population in newer invaded places; whereas late rain washed away the natural enemies of the population. This resulted in low levels of biological control of the pest as well as it adversely affects the natural enemies to establish their population. Likewise, continuous changes in local climatic conditions caused locusts to shift into a high-density, gregarious, migratory phase, with profound negative impact on local ecosystems in Rajasthan, Madhya Pardesh, Gujarat, Uttar Pradesh till now (Murali and Shreedevasena, 2020). Scientist claim the cause of outbreak as warm temperatures with dry condition or droughts/floods. The tomato pinworm, *Tuta absoluta* has spread into many parts of Asia, owing to the favourable climatic conditions and absence of natural enemies in newly invaded regions (Han et al. 2019).

Conclusion

Climate change is a gradual process and certainly happening. It is not precisely understood how these changes will affect crops, insects, diseases, and the relationships among them. If climate is warmer will increases in yield offset losses to pests, or will losses to pests outweigh yield advantages from warmer temperatures. Alien or invasive pests will become established in new environment which affects the indigenous species of the ecosystem. A few pests may be less likely to attack crops as change occurs. The actual impacts of climate change on pests is not known until they occur. Clearly, it will be important for farmers to be aware of crop pest trends in their region and flexible in choosing both their management methods and in the crops they grow. Farmers who closely monitor the occurrence of pests in their fields and keep records of the severity, frequency, and cost of managing pests over time will be in a better position to make decisions about whether it remains economical to continue to grow a particular crop or use a certain pest management technique.

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Nematophagous Fungi

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Introduction

Nematophagous fungi are natural enemies of nematodes. They comprise three main groups of fungi: the nematode trapping and the endoparasitic fungi that attack vermiform living nematodes by using specialized structures, and the egg and cyst parasitic fungi that attack these stages with their hyphal tips. The reason for the continuing interest in these fungi is, in part, their potential as biocontrol agents against plant and animal parasitic nematodes. From this point of view especially, the egg and cyst parasitic fungi have been investigated in depth because of the promise of these fungi as biocontrol agents. Another reason for the continued fascination in nematophagous fungi is the remarkable morphological adaptations and the dramatic capturing of nematodes by both nematode trapping and endoparasitic fungi. In addition, both fungi and nematodes can be grown in the laboratory fairly easily, providing an excellent model system for interaction studies.

The nematode trapping and endoparasitic fungi are found in all major taxonomic groups of fungi, and they occur in all sorts of soil environments where they survive mainly as saprophytes. The ability to use nematodes as an additional nutrient source provides them with a nutritional advantage. The fungi enter their parasitic stage when they change their morphology and traps or mature spores are formed. The development of infection structures is a prerequisite for the trapping of nematodes.

Nematophagous (Nematode destroying) fungi comprise more than 200 species of taxonomically diverse fungi that all share the ability to attack living nematodes (Juveniles, adults and eggs) and use them as nutrients. The fungi differ in their saprophytic/parasitic ability. While many of the trap forming and egg parasitic fungi can survive in soil saprophytically, the endoparasites are mostly more dependent on nematodes as nutrient (obligate parasites). Nematophagous fungi are found in all major groups of fungi, including lower (Oomycetes, Chytridiomycetes, Zygomycetes) and higher fungi (Ascomycetes, Basidiomycetes and Deuteromycetes). Most nematophagous fungi, including both nematode trapping and endoparasitic species are Deuteromycetes (Asexual fungi).

Types of Nematophagous Fungi

1. Nematode trapping fungi: Nematophagous fungi present a high diversity not only in respect of taxonomic distribution but also in respect of the trapping structures formed. The type of nematode-trapping structures formed depends on species or even strains of species as well as on environmental conditions, both biotic and abiotic. The most important biotic factor is living nematodes, which not only induce the formation of trapping structures by touching the mycelium but also serve as a food source for the fungi after they have been invaded by the fungi. Thus, the relationship to nematodes is 2-fold: first, nematodes may induce the formation of the structures in which they are later captured; and, second, after invasion of the nematodes by the fungus they serve as an additional food source. Ex.- *Arthrobotrys* spp.

A. oligospora Fres. 1852, the first recognized nematode trapping fungus (Zopf, 1888), is the most commonly isolated and by far the most abundant nematode trapping fungus in the environment (Duddington, 1954). *A. oligospora* is capable of paralyzing the nematodes by producing a chemical substance, nematotoxin, has provided fundamental insights for the field of nematode toxic fungi (Olthof and Estey, 1963). Numerous experiments on *A. oligospora* have made this species a popular model system for studying many aspects of nematophagous fungal biology, ranging from morphogenesis to pathogenesis. It has the characteristic ability of forming adhesive trapping nets once in contact with nematodes. These studies have addressed a range of biological questions, especially on the interactions between fungi and nematodes, and such knowledge has benefited application of nematophagous fungi as potential biological control agents.

2. Endoparasitic fungi: These are different from predacious fungi. They don't have trapping structures, instead they infect nematodes with their conidia, conidia are either ingested or adhere to the cuticle of the nematode. *Drechmeria coniospora* forms large numbers of conidia in comparison to production of hyphal material. In a single infected nematode, *D. coniospora* may produce as many as 10000 conidia while the endoparasite *Hirsutella rhossoliensis*, which sporulates singly, produces 100–1000 conidia per infected nematode. Both fungi develop an adhesive bud on their conidia with which they infect the nematode.

D. coniospora spores with adhesive buds shown with arrow marks and nematode infected by conidiospores of the same fungus.

3. Egg parasitic fungi: The fungi that parasitize the non-motile stages of nematodes, i.e. eggs, use a different strategy. Hyphae of *Pochonia chlamydospora* and other fungi grow towards the eggs and appressoria are formed on the hyphal tips which penetrate the eggshell (Fig 3). The fungi then digest the contents of the egg, both immature and mature (containing juveniles) eggs. Ex. *P. chlamydosporia.*

Tri-Trophic Lifestyle of the Nematophagous Fungus *P. chlamydosporia*

The three trophic modes of *P. chlamydosporia* as nematode-egg parasite, soil saprophyte and root endophyte.

Nematode-Fungus Interaction Mechanisms

1. Recognition and host specificity: How nematophagous fungi recognize their prey is complex. No simple host specificity has been found in any of the nematode-trapping species, while experiments with the endoparasite *D. coniospora* have revealed somewhat higher host specificity. Nevertheless, it appears that there are recognition events in the cell–cell communication at several steps of the interaction between fungus and nematode, which might elicit a defined biochemical, physiological or morphological response. Nematodes are attracted to the mycelia of the fungi in which they may induce trap formation and they are attracted even more to fully developed traps and spores. This is followed by a 'short range' or contact communication: adhesion. This step may involve an interaction between a carbohydrate binding protein (lectin) in the fungus and a carbohydrate receptor on the nematode. Recognition of the host is probably also important for the subsequent steps of the infection, including penetration of the nematode cuticle.

2. Attraction: Nematodes are attracted by compounds released from the mycelium and traps of nematode-trapping fungi, and the spores of endoparasites. Both the morphology and consequently the saprophytic/parasitic ability strongly influence the attractiveness of the fungi. Fungi that are more parasitic appear to have a stronger attraction than the more saprophytic ones; that is, the endoparasitic species infecting nematodes with conidia are more effective in attracting nematodes than the more saprophytic species with different kinds of trapping devices.

3. Adhesion: In *A. oligospora* the three-dimensional nets are surrounded by a layer of extracellular fibrils even before the interaction with the nematodes. After contact, these fibrils become directed perpendicularly to the host surface, probably to facilitate the anchoring and further fungal invasion of the nematode. The endoparasite *D. coniospora* shows a completely different type of adhesive that seems to be composed of radiating fibrils irrespective of whether contact with the nematode has been established or not. Furthermore, the spores of *D. coniospora* adhere specifically to the sensory organs at the tip of the head of the nematode, thereby blocking nematode attraction. The chemical composition of the surface fibrils of nematophagous fungi is not known in detail but they do contain both proteins and carbohydrate containing polymers.

4. Penetration: The adhesion of the traps to the nematode results in a differentiation of the fungi. In *A. oligospora*, a penetration tube forms and pierces the nematode cuticle. This step probably involves both the activity of hydrolytic enzymes solubilizing the macromolecules of the cuticle and the activity of a mechanical pressure generated by the penetrating growing fungus. The nematode cuticle is composed mainly of proteins including collagen, and several proteases have been isolated from nematophagous fungi that can hydrolyse proteins of the cuticle. In all cases these proteases belong to the family of serine proteases, and after obtaining data from sequencing, it has been demonstrated that they have a high homology to the subtilisin type of serine proteases. In the endoparasite *D. coniospora*, a chymoptrypsin like protease appears to be involved in the penetration process.

5. Digestion and storage of nutrients: Following penetration, the nematode is digested by the infecting fungus. Once inside the nematode, the penetration tube of *A. oligospora* swells to form a large infection bulb. The development of the bulb and trophic hyphae occurs in parallel with dramatic changes in the ultrastructure and physiology of the fungus. The dense bodies are degraded in the trap cells and in the bulb. The bulb and the trophic hyphae typically contain normal cell organelles, endoplasmatic reticulum being particularly well developed. At later stages, lipid droplets accumulate in the trophic hyphae, which are probably involved in the assimilation and storage of nutrients obtained from the infected nematode.

6. Constricting rings: Although the patterns of nematode infection of other predatory fungi, which use adhesive layers for capturing nematodes (nets, hyphae or knobs), are less thoroughly studied, they appear to be largely similar to those described for *A. oligospora*. In contrast, the trapping mechanism of constricting rings is completely different. When a nematode move into the ring, it triggers a response such that the three cells composing the ring rapidly swell inward and close around the nematode. Other stimuli, such as touch by a needle of the inside (luminal) surface of a ring, or heat, can also trigger the closure of the trap. The reaction is rapid (0.1s), irreversible, and is accompanied by a large increase in cell volume leading to an almost complete closure of the aperture of the trap. Following capture, the fungus produces a penetration tube that pierces the nematode cuticle. Inside the nematode a small infection bulb is formed from which trophic hyphae develop.

Conclusion

Nematicides cause great threat to human health and environment. Biological control has become one of the most promising tools for the existing chemical pesticides. One important aspect of nematophagous fungi is the possibility of using them for biological control of plant and animal parasitic nematodes. Plant parasitic nematodes, e.g. root knot and cyst nematodes, are global pests in agriculture and horticulture, causing severe yield losses. Owing to the ban of many nematicides, e.g. methyl bromide, nemagon, fumazon etc., because of health and environmental concerns, new alternatives for nematode control are therefore needed. Biological control may be such an alternative.

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Nutritional and Medicinal Properties of Fenugreek

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Introduction

Fenugreek (*Trigonella foenum-graecum* L.) is an annual plant and belongs to family Fabaceae. It is locally known as "Methi" and is a traditional medicinal plant native to India. Besides India, it is found in Southern Europe, the Mediterranean region, and Western Asia. The fenugreek is mostly grown in Rajasthan, Madhya Pradesh, Gujarat, Uttar Pradesh, Maharashtra, and Punjab. The area under fenugreek is 122 thousand hectares with a production of 189 thousand MT and productivity 1.54 MT/Ha (Anonymous, 2018).

Nutritional and Biochemical Composition

Fenugreek is well known for its gum, fibres, alkaloids, flavonoids, saponins, amino acids, and volatile contents. It provides nutrients essential for the human body (Yadav et al., 2011). It has a strong spicy and seasoning type of sweet flavour.

Table 1: Chemical constituents of fenugreek

S. No.	Chemical constituents of fenugreek
Alkaloids	Trimethylamine, Neurin, Trigonelline, Choline, Gentianine, Betain, Trigocoumarin, Trimethylcoumarin
Amino acids	Isoleucine, 4-Hydroxyisoleucine, Histidine, Leucine, lysine, L-tryptophan, Argenine.
Saponins	Graecunins, Fenugrin B, Fenugreekine, Trigofoenosides
Flavonoids	Quercetin, Rutin,Vitexin, Isovitexin
Fibers	Galactomannan
Others	Lipids, Vitamins, Minerals, Proteins

Medicinal Properties

Fenugreek is well known for its miraculous medicinal properties. Fenugreek works as an antidiabetic, anticarcinogenic, antioxidant, antibacterial agent, gastric stimulant, and anti-anorexia agent. The Phenolic and flavonoid compounds present in fenugreek help to enhance its antioxidant capacity. The major alkaloid of Fenugreek, trigonelline is promising natural antioxidant and used in the treatment of many diseases, especially diabetes mellitus.

(Hamadi S., 2012). The mechanism for antioxidant activity involves:
1. Lowering of plasma MDA (Malondialdehyde).
2. Increasing the plasma GSH (Glutathione) markers.
3. Lowering of LPO (Lactoperoxidase).

The saponins produced from fenugreek reduce the body's absorption of cholesterol from fatty foods and the galactomannan is used mainly in the reduction of plasma glucose level and has an anti-diabetic effect. Fenugreek also cures anemia and respiratory disorders (Kaviarasan et al., 2004), relieves skin irritation and is used in the treatment of indigestion and flatulence (Sauvaireet al., 1991).

Conclusion

Fenugreek is one of the most promising herbs, known from ancient times, having nutritional and medicinal properties. It is one of the well-known spices in human food. It has various health benefits that can be enhanced by isolating each compound and can be used for the treatment of many diseases. Due to various health benefits, it can be made a part of our daily diet.

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Lactoferrin a Possible Solution Against COVID-19

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The disease, which rapidly spreads and snatches the life of huge population in very limited times, is characterized as Pandemic. The effects of pandemic to the society is very devastating in terms of economics and social life point of view. History has recorded many pandemics including Asian Flu, cholera, black death etc over periods of time. The novel coronavirus 2019 (COVID-19), causing by severe acute respiratory syndrome coronavirus 2 (SARS CoV 2), is a devastating threat throughout the world for modern human society. The first novel coronavirus or COVID-19 case was registered in China; however, within few months it has been spread all over the world in 197 countries and snatched the life of almost 3 Lacks people around the globe. World Health Organization recognized this disease as Pandemic on March, 2020.

What is COVID-19?

Coronavirus are single-stranded RNA viruses and crown-like spikes are present on the surface of this virus, therefore it is named as Coronaviruses. The size of this virus has been noted as 80–120 nm (diameter). According to the genomic make up there are four sub groups of Coronaviruses have been identified; among these only two types of Coronaviruses have been identified for infecting mammals. However, in December 2019 in Wahun city of China a novel coronavirus has been identified and first time named as novel coronavirus 2019 or COVID-19.

Mechanism of COVID-19 Action on Human

The novel COVID-19 genome is encoded with a large, non-structural polyprotein consisted of 4 structural proteins and 5 accessory proteins the four structural proteins are mainly associated with spike surface glycoprotein, the membrane protein, the envelope protein and the nucleocapsid (N) protein. Spike proteins that contain a variable receptor-binding domain (RBD). This RBD binds to angiotensin-converting enzyme-2 (ACE-2) receptor found in the heart, lungs, kidneys, and gastrointestinal tract thus facilitating viral entry into target cells. The spike surface glycoprotein uses to attach to host cells that use to infect human. That cause inflammation in respiratory tract and even cause death.

Presently no vaccines are available against this virus. However only maintaining social distance and immune boosting through consumption of healthy foods can be useful against this viral disease's infection.

What is Lactoferrin?

Lactoferrin, is an 80-kDa iron-binding glycoprotein mainly present in milk and saliva. Different studies suggested numerous biological function that included antimicrobial, antioxidant and immunomodulatory and many more. Therefore, now these days it is supplemented in many food and pharmaceutical products.

Lactoferrin as Immno-Boosting Bio Agent

Scientific researches acknowledged that lactoferrin possessed immunomodulatory, antiviral and anti-inammatory activities. The key immunomodulatory role demonstrated as limiting tissue damage by modulation of chemokines , cell surface receptors involved in cascades of signalling pathways and cytokines.

Possible Mechanism of Lactoferrin Against COVID-19 Virus

Lf has been found to experimentally inhibit viral entry via binding to host cell surface of human corona virus. However, Nobel COVID-19 virus infections pathway is very similar to other coronavirus so lactoferrin treatment could be potential against this virus too.

Another major aspect of Lf bioactivity relates to its immunomodulatory and anti-inammatory functions. Low immunity and inflammation in respiratory tract have been identified main cause of death during e to novel covid-19 virus infection. In this situation lactoferrin could provide protection against this disease.

The mortality from COVID-19 is not simply due to viral infection but is a result of a cytokine storm syndrome in select patients associated with hyper-inammation leading to acute respiratory distress and subsequent mortality. Due to this virus infection majority of the cases it has been recognized that increases in cytokines and acute phase reactants such as interleukin IL-6, tumour necrosis factor-a (TNFa) and ferritin. In this regard, lactoferrin has been proved to reduce IL-6, TNFa and ferritin . That could another possible mechanism of lactoferrin treatment against COVID-19 virus infections. However no published research has directly demonstrated the effect of lactoferrin on COVID-19 disease but antiviral drugs along with lactoferrin supplement could be an alternative treatment against this pandemic.

Other Health Benefit of Lactoferrin

Conclusion

The numerous bio-functions of lactoferrin makes it attractive for the designing of new nutritional supplements. Currently, the use of infant formulas supplemented with bovine lactoferrin has been widely accepted. All though direct co-relation with lactoferrin against COVID-19 has been proved but researches are going on. Milk is a potent source of this magical bio component, therefore mothers' milk after born and thereafter a glass of milk that not only quench your thirst and provides basic nutrients but it boosts immune system against many viral diseases including COVID-19.

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Coconut Eriophyid Mite: An Overview

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Introduction

Coconut, commonly referred to as "Tree of Life" as well as "Kalpa Vriksha" provides livelihood to billions of people across the world. It is grown in almost 93 countries mainly in India, Indonesia, Philippines and Sri Lanka together accounting for 78% of the total world production (Kumara et al., 2015). In India total coconut growing area were 2.082 million hectares with the production of 23904.10 million nuts and productivity of 11481 nuts/ha. whereas, in Gujarat total area were 24.44 thousand hectares with the production of 336.65 million nuts and productivity of 13775 nuts/ha, which holds 7th rank in India (Anonymous, 2017). In Navsari, total coconut growing area was 554 hectares with the production of 46.65 lakh nuts and productivity of 8421 nuts/ha (Anonymous, 2017). However, this crop has been affected by various insect and non-insect pests i.e., rhinoceros beetle, red palm weevil, black headed caterpillar, eriophyid mice, rats, etc. One of the less known pests, viz., Eriophyid mite (*Aceria guerreronis* Keifer) in coconut though recorded at Mexico in 1965. In India it was first reported in Ernakulam district of Kerala in 1998 (Sathiamma et al., 1998). It may reduce 7.5-60% yield losses of coconut (Julia and Mariau, 1979). An outbreak of eriophyid mite on coconut in South Gujarat was observed, around 84 per cent of palms were infested and approximately 79.80 per cent of marketed nuts in Gadat of Navsari district were damaged. This was to be first report of coconut eriophyid mite infestation in Gujarat (Desai et al., 2003). Coconut eriophyid mite, which causes necrosis and malformation of nuts, as well as premature nut fall. These may reduce yield and quality of copra, leading to substantial economic losses.

Coconut Eriophyid Mite

1. Scientific name: *Aceria guerreronis Keifer*

2. Family: Eriophyidae

3. Order: Acarina

4. Host range: Coconut palm (Cocos nucifera), Miniature coconut palm or Weddell's palm *(Lytocaryum weddellianmum)*, Palmyra palm or Tody Palm *(Borassus flabellifer)* and Queen palm or Cocos palm *(Syagrus romanzoffiana)*.

5. Marks of Identification: Eggs: Eggs are laid singly on the meristematic tissue of young buttons and on the inner surface of the perianth. Eggs are ovoid, glossy, translucent and white coloured.

6. Nymph: Two nymphal stages:

- **a. Protonymph:** White coloured with two pairs of legs.
    - i. Protonymph passed through the quiescent stage, by holding on to the perianth surface before moulting into deutonymph.
- **b. Deutonymph:** Elongated, white colour with two pairs of leg.
    - i. Protonymph and deutonymph, lacks genital organs instead of that genital setae are present.

7. Adult: The adult mite measures about 200 to 250 microns long and 36 to 52 microns wide. The body is elongated and worm like with a yellowish white in colour. The adults have two pairs of legs at the anterior end of the body and needle like mouth parts. Life cycle of the mite is completed in 7-10 days.

8. Dispersal of mite: through wind, another insect.

Different stages of *A. guerreronis*

Damage of *A. guerreronis* on nuts

Nature of Damage

The mites infest the lower surfaces of the perianth and the part of the fruit surface covered by the perianth. They penetrate between the tepals of the perianth and fruit surface a month after the fruit begins develop. The mites feed by piercing the superficial plant tissue and suck the sap. Early infested fruits when expands from beneath the perianth and becomes exposed to air, it develops a triangular pale or yellow patch close to perianth and later turn into brown patches with longitudinal deep fissures. If mite feeding is concentrated on one side of the fruit meristem, growth of the fruit may be uneven. Severe damage results in drying and shedding of buttons/ young nuts, oozing of the gummy exudation from the affected surface.

Morphology of Nuts Which Favour Eriophyid Mite

Various stages of mites are seen in the lobes of perianth and tender portion of developing nuts. The pest is infesting the young buttons in post fertilization period. When the female flowers open up for pollination, the attachment between perianth and button becomes less tight giving sufficient space for the entry of minute-size mite into space between perianth and button. Also, the pest damages nut during various stages of growth. About 3 to 5 months old nuts harbour maximum number of mites. Mites are not observed in unfertilized female flowers where bracts are tightly pressed to nuts. Similarly, fully mature nuts with hard tissues do not lodge any mites in perianth region. Moreover, when button grows, husk becomes harder making it unattractive for feeding.

Economic Importance of *A. guerreronis*

The infestation had caused premature nut fall, reduced nut size, reduction in nut yield as well as copra yield. All quality deterioration which has resulted in low market price for the affected nuts. Due to the severity of the pest problem the fibre length, fibre quality and yield of fibre per nut were also reduced considerably which resulted in low availability of quality fibre. Mite damage caused significant reduction in quality of fibre from moderate to severely infested nuts suffered 26 to 53 per cent reduction in length (Naseema et al., 2003).

Management

1. Collection and destruction of all fallen buttons of the affected palm.
2. Use resistant or tolerant varieties. (i.e., Bombay, Chowghat Orange Drawf, Gangabondam, West Coast Tall, etc).
3. Providing adequate irrigation.
4. Soil application with NPK with Recommended Dose of Fertilizer + borax @50g + MgSO4 @500g + gypsum @1kg + neem cake @5kg.
5. Entomofungal pathogen Hirsutella thomsonii @5 g/lit can be used for management of coconut eriophyid mite.
6. Botanicals like Neemazal 5% spraying + Neemazal 5% root feeding can also be effective.
7. Integration of recommended dose of fertilizers (FYM 40 kg + 2.25 kg urea + 1.680 kg MOP + 3 kg SSP / palm / year) and micronutrients (Fe 2.50%, Mn 1.0%, Zn 3.0%, Cu 1.0%, Mo 0.10%, Bo 0.50%) combined with application of Neemazal 5% through root feeding can also be effective for management of coconut eriophyid mite.

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Potential threat of Desert Locust *(Schistocera gregaria)* to Indian Agriculture

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Introduction

India is the agrarian country where more than 60% of its people involved in agriculture and allied sectors directly or indirectly. Country's economy is mainly depending on progress of agriculture sector. India produced a record high of 283 million tons of food grains during 2018-2019 indicating the countries self-sufficiency in food production. Nevertheless, the growth in agricultural production needs to be sustained in coming years, but bringing additional land under cultivation is highly impossible. Thus, the focus has to be made on increasing production and productivity in limited land and resources to meet the ever-growing population of the country. On the other hand, intensive agriculture has brought serious problems of pest and diseases, abiotic stresses, environmental pollution under changing climatic conditions (Dhaliwal et al., 2004; Raghu et al., 2018). Among the problems of agriculture, pest and diseases generally a significant problem causing epidemics in various regions of the country. Number of pests continuously affecting crops over the years and new pests are being introduced in one or the other way. Invasive alien species (IAS) are the potential threats to agriculture and cost billion dollars of monetary losses in terms of production and quality losses. One such pest in desert locust *(Schistocera gregaria)* causing enormous damage to almost all the crops in many parts of the country especially the states like Rajasthan, Gujarat, Punjab, Haryana, Delhi and Uttar Pradesh are worst affected from last three to four years. The pest is polyphagous and migratory insect having the potential of large-scale destruction.

What are Locusts?

Locusts are the members of the grass-hopper family Acrididae, which includes most of the short-horned grass hoppers. Locusts differ from grasshoppers because they have the ability to change their behaviour and physiology especially with respect to colour and morphology (Shape). Locusts have the ability to form swarms (Fig 1) which contain thousands of millions of individuals and behave as one unit (Symmons and Cressman, 2001). They can fly rapidly across great distances in a short period of time destroying almost all the crops on their way. Desert locusts caused severe epidemics which threaten agriculture production in Africa, Asia and Middle East countries several times in past decades.

Biology of Desert Locust *(Schistocera gregaria)*

Desert locust *(Schistocera gregaria)* belongs to genus Schistocera, Sub-family: Cyrtacanthacridinae, Family: Acrididae, Superfamily: Acridoidea, Suborder: Caelifera, Order: Orthoptera. Desert locusts, like other locusts and grass hoppers have three stages of life cycle: egg, nymph (hopper) and adult. Female lays eggs in bare dry soil which hatch into larvae or nymphs called hoppers. Nymphs undergoes six instarts / metamorhoposis / moulting with growth and development. The final moult from wingless fifth instar develop into winged adult which is called as fielging. The fielging has soft wings which will dry and get harden before it flies. The adults are sexually immature initially but eventually mature and can copulate and lay eggs (Fig 2).

Locusts have two phases of life.
1. Solitary.
2. Gregarious.

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When locusts are present in small densities, the individuals are solitaries. As the number increases, the cluster gets dense and become gregarious. This phase of transition from solitary to gregarious and vice versa is called transient phase. Gregarious phase is most destructive causes huge damage.

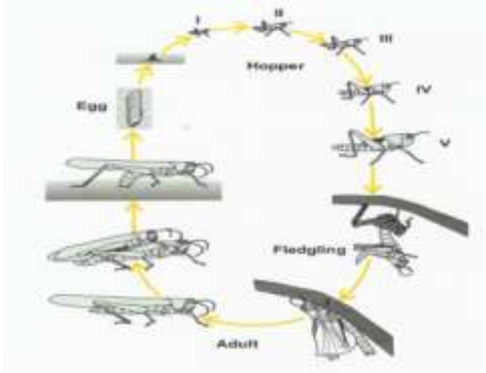

Fig 1. Life cycle of desert locust

Fig 2. Locust Swarm in India during 2020

Locust Warning and Management

An early warning for desert locus is being used in India considering its importance. An account of the locust warning organization (LWO) was compiled by Ram Asre (2004). The Indian LWO is operates as centralized forewarning system for the desert locust to keep the state government and its authorities in attention to take regulatory and timely management measures. Regular survey and surveillance are conducted by desert area by LWO staff. LWO Field headquarters located and Jodhpur centres will analyse the data on various aspects taking weather data into consideration. This analysis will be helpful in forewarning and bulletins will be issued by Directorate of Plant Protection, Quarantine and Storage, Faridabad after compilation of the data, every two weeks throughout the year.

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Entomopathogenic Nematodes

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Nematodes which are capable of killing, sterilizing or seriously hampering the development of insect and completing at least one stage of their life cycle in the host. They are also called as entomogenous, entomophilic, insect parasitic nematodes etc.

Important groups of EPNs
1. Family: Mermithidae: (Order - Enoplida).
2. Family: Steinernematidae (Order - Rhabditida).
3. Family: Heterorhabditidae.

Special Qualities of Steinernematidae and Heterorhabditidae

1. Quick mortality of the host (24 – 48 hr).
2. Wide host range (> 200 insect species of 10 Orders).
3. Wide distribution – found all parts of the world except Antarctica.
4. Symbiotic association with bacteria (*Xenorhabdus; Steinernematidae* and *Photorhabdus; Heterorhabditidae*)
5. Infective stage (3rd stage) is non feeding, free living, durable and capable of withstanding adverse climatic changes.
6. Can be mass produced both on natural host and artificial diet.
7. Good shelf life.
8. Easy to apply.
9. Safer to non-target organisms.

Advantages of Microbial Agents as Component in IPM

1. Exploitation for pest control is environmentally safety due to host specificity.
2. Micro-organisms have natural capability of causing epizootic levels due to their persistence in soil and efficient transmission.
3. Compatible with chemicals insecticides.
4. The cost of development and registration of microbial insecticide is much less than that of chemical insecticides.
5. Large scale culture and application is relatively easy and inexpensive.
6. No resistant development.

Factors Affecting Biological Control

1. Tolerance limit of crop to insect injury - Successful in crops with high tolerance limit.
2. Crop value - Successful in crops with high economic value.
3. Crop duration - Long duration crops highly suitable.
4. Indigenous or Exotic pest - Imported NE more effective against introduced pest.
5. If alternate host available for NE, control of target pest is less.
6. If unfavourable season occurs, reintroduction of NE required.
7. Presence of hyperparasites reduces effectiveness of biocontrol. Downloaded from www.agrobiosonline.com.
8. Tritrophic interaction of Plant-Pest-Natural enemy affects success of biocontrol, e.g. *Helicoverpa* parasitization by *Trichogramma* more in tomato than corn.
9. Use of pesticides affect natural enemies.

10. Selective insecticides (less toxic to NE required).
11. Identical situation for successful control does not occur.
12. Depends on life cycle of NE.

Factors Affecting Biological Control

1. The host (pest) population will continue to exist at a level determined by the properties of the host, its natural enemies and of the habitat they occupy.

2. The effectiveness of natural enemies must be considered relative to man's economic thresholds.

3. The attainment of biological control of one major pest on a crop necessitates the elaboration of a system of integrated control for other pests of the crop, if any exist; and the research necessary in seeking a biological control solution to a problem is often demanding in terms of scientific and technical staff, funds, and time, and a solution cannot be guaranteed in advance.

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Pollination by Bumble Bee

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In comparison with other pollinating insects like honeybees, bumblebees are very effective pollinators. They are first of all fast workers (for instance, they visit twice as many flowers per minute as honeybees) and because of their size, they can carry relatively heavy loads, which enables them to make long foraging trips. Also due to their relatively large size they often achieve better contact with stamens and pistils than smaller insects. Furthermore, bumblebees make relatively few demands on the circumstances under which they work. They feel more at ease in greenhouses/tunnels than honeybees for instance, particularly where restricted areas are concerned. Bumblebees are still active at relatively low temperatures (around 10°C) and low light intensity levels. Even strong wind and drizzle will not keep them from doing their job.

In 1987 it became known that bumblebees could be an excellent alternative for the fruit set of tomatoes. This was a very labour-intensive job. At that very moment Koppert started producing bumblebees: Bombus terrestris for Europe and Asia, B. impatiens for North and South America. Meanwhile bumblebees are used world-wide for the pollination of tomato crops. Resulting in enormous savings in labour costs, improvements of fruit quality and sometimes even increased production. One important advantage of bumblebees over honeybees is the absence of a communication system. Honeybees inform each other by means of the so-called ‘bee dance’ of the presence of an attractive food source outside the crop in which their pollination activities are required, as a result of which the bees may leave collectively. Bumblebees do not have such a communication system. Should an individual bumblebee find an attractive food source elsewhere, it cannot inform its companions, so that the other bumblebees will continue to work in the crop in which their services are required.

Another advantage of bumblebees over honeybees, which manifests itself particularly in fruit crops is the fact that they are not so much tied to a specific area in the crop. They change trees more often and more easily than honeybees. This benefits the cross-pollination which is often required in fruit. Some three hundred bumble bee species are known, most of which live in temperate regions in Europe, Asia and North America.

When selecting a suitable candidate for large-scale production, the following criteria are used:
1. The species must be widely spread.
2. The species must produce large, long-lived Colonies.
3. It must be possible to produce the species in captivity.
4. The species must be suitable for pollination of a wide range of crops.
5. The species must show the vibrating behaviour (buzz pollination) that is required for pollination of a number of crops, including tomato and aubergine.
6. Strong homing instinct.

Advantages

1. Labour saving: take over pollination work (able to do pollination around 600~900 m² area)
2. High fruits production: Reduce poor fruits and increase productivity
3. Competitive quality: Increase weight, size, seed, sweetness, and acidity of fruits
4. Effective pollination: Able to pollinate flower with long throats, which honey bees can’t do
5. Environmentally friendly: Reduce use of pesticides
6. Buzz pollination (sonication): Pollinates by vibrating its chest muscle
7. Bees having long tongue length able to forage flowers with long throats
8. Forage even in low temperature or in bad weather, such as cloudiness, light snow, windy or rain.

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Predictive Models for Plant Disease Forecasting

Article ID: 31462

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Introduction

Plant diseases vary in consistency of occurrence and severity; thus, epidemics are irregular feature. The growers are often faced with the dilemma: whether to spray or to wait? Agrios (1997) very aptly described epidemics they resemble hurricanes. They come, devastate and vanish. Pathologists have been successful in understanding the factors responsible for initiation, build-up and demise of epidemics. Fortunately, epidemics follow a predictable course. The understanding about interactions of four elements of epidemics has been exploited for prediction of disease/epidemics. Our ability to predict diseases is an indicative of developments in science of plant pathology. Disease forecasting or warning systems are boon to the growers as it encourages judicious use of pesticides. This not only saves the money and energy of the growers, without risking crop health, but also avoids the environmental pollution.

Basis for Forecasting

Forecasting research concentrates on particular topics of these factors:

1. For the pathogen: spore germination, primary inoculums, primary infection, growth in the host, sporulation, spore germination, pattern and distance of secondary spread.

2. For the host: response at different growth stages to the activity of the pathogen

3. For environment conditions (weather): the particular elements and intensities that influence pathogen and host at different stages, both individually and in their interaction with each other

4. For time: the duration of each separate stage and of the complete disease cycle, the timing of critical stages, and the length and sequence of significant weather periods in relation to the appearance and severity of the disease.

Plant Disease Forecasting Models

1. Empirical models
2. Fundamental models

Plant disease forecasting models are referred as prediction or disease risk models developed based on the epidemiological knowledge obtained from controlled environmental or field studies.

Empirical Models

Empirical is a method in which correlation between the results of disease surveys and the corresponding weather conditions in a particular area or near the same area for as long a time as possible, has to be related to the biology of host and pathogen. These models include Descriptive and Predictive models.

1. Descriptive models: provide hypothesis or generalized experimental results, but they don't usually reveal the mechanisms underlying the processes.

2. Predictive models: Mathematical description of an attempt to forecast the future development or appearance of a disease in a crop, based on climate measurements made within the crop. These are generally used for estimation of yields and forecasting diseases. Regression and differential equations are generally employed. Predictive models are based on the weather conditions like temperature, relative humidity, leaf wetness etc and on understanding of how fungus reproduces and infects under field conditions.

Steps Involved in Building a Predictive Model

Development of any model involves three major steps:

1. Model development:

a. Developed from combination of laboratory and field studies, goal is to predict risk of disease and or development of inoculums

b. Need to identify key environmental and host variables

2. Model validation:

a. Models developed are frequently validated by researchers in other areas, may need region specific modifications.

b. Plants treated according to model are compared to disease levels managed by traditional spray schedules as well as unsprayed plots.

3. Model implementation: Based on local weather inputs.

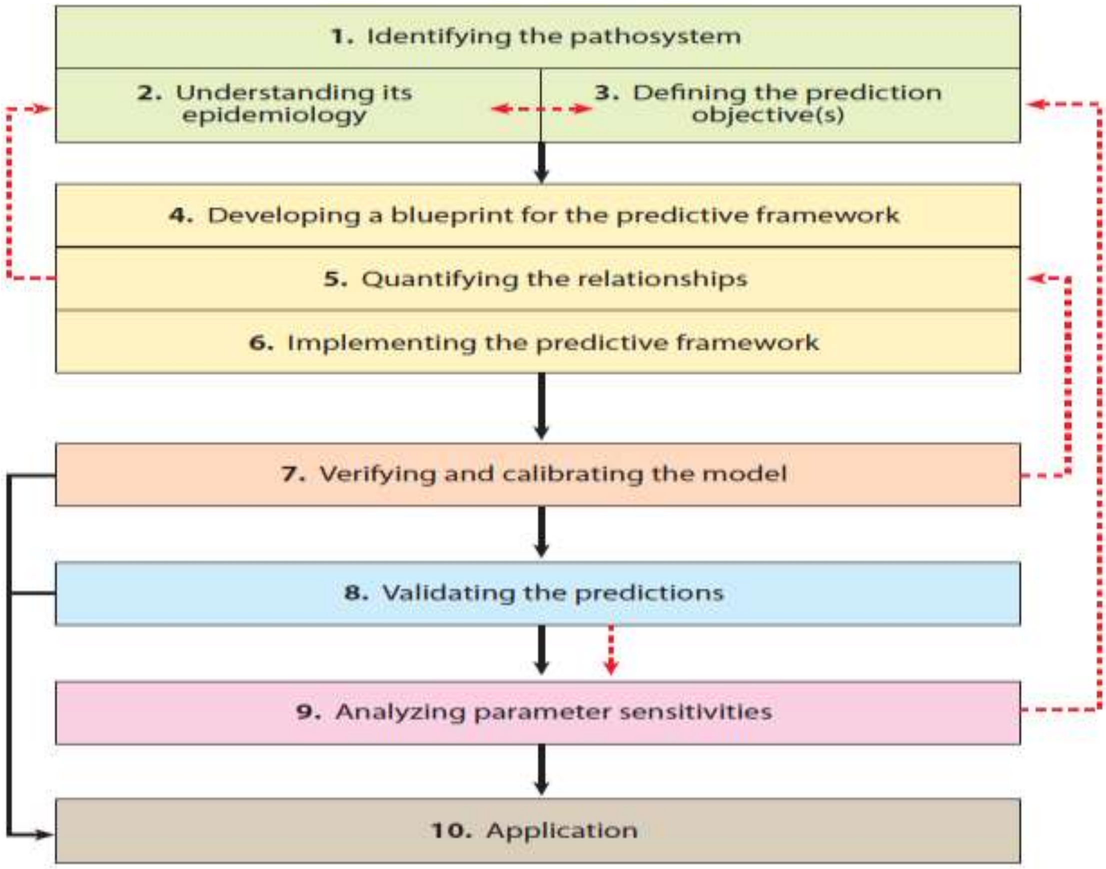

Fig 1: Steps involved in building a predictive model

Examples for Predictive Models

1. TOMCAST (Pitbaldo, 1992): TOMCAST (Tomato disease forecasting) is a computer model based on field data that attempts to predict fungal disease development, namely Early Blight, Septoria Leaf Spot and Anthracnose on tomatoes. Field placed data loggers are recording hourly leaf wetness and temperature data. This data will be analysed over a 24-hour period and may result in the formation of a Disease Severity Value (DSV); essentially an increment of disease development. As DSV accumulate, disease pressure continues to build on the crop. When the number of accumulated DSV exceed the spray interval, a fungicide application is recommended to relieve the disease pressure.

2. BLITECAST- Late blight of potato: BLITECAST is an integrated computerized version of both the Hyre and the Wallin model. The first part of the program forecasts the initial occurrence of late blight 7-14 days after the first accumulation of 10 rain-favourable days according to Hyre's criteria, or the accumulation of 18 severity values according to Wallin's model. The second part of the program recommends fungicide sprays based on the number of rain-favourable days and severity values accumulated during the previous seven days. Accumulation of rain-favourable days and severity values begins when distinct green rows can be seen in the potato field, and ends at vine kill. The first spray is recommended when the first late blight forecast is given. Subsequent sprays are recommended according to an adjustable matrix which correlates rain-favourable days with severity values.

Advantages

1. Risk of large unexpected crop loss is reduced.
2. Provide means to lower pesticide application to the crop.
3. Ideal tool for integrated pest management.

Limitations

1. Predict sporulation or infection based on historical microclimate data.
2. They can overestimate sporulation or infection events.
3. They may require tolerance of very low level of symptoms in the field.

Conclusion

Economically viable and eco-friendly production is the objective for integrated production. Under integrated farming, farmers only treat their crops when necessary at right time, with appropriate dose. Warning systems provide real time, country level forecast of disease. Forecasting is extremely useful to farmers in practical management of crop losses. Disease forecasting allows the prediction of probable outbreaks or increase in intensity of disease and therefore, allows us to determine whether, when and where a particular management practice should be applied.

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Garcinia: An Under Exploited Multi-Purpose Tree Species for Improving the Economic Condition of Farmers

Article ID: 31463

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The slowest growing Garcinia (*Garcinia* sp), belongs to the family of Guttiferae and one of the most important indigenous tree species known for its multipurpose uses. These species are cultivated throughout the South Asia especially Thailand and India. It is common in forest of Western Sri Lanka. In India, it thrives well in the evergreen forests of Konkan, Kerala Coast and Western Ghats. The genus *Garcinia* consists of about 434 species and are existing in tropics of Asia and Africa but only 36 species are reported available in India and many of them are having economic importance, even though it has not been exploited for commercial cultivation in India due to one or other reason. Here, will discuss in brief about habitat, occurrence, part utilized and some important uses like medicinal, industrial etc. of the commercially valuable species of Garcinia available in India.

Garcinia indica (Kokum)

It is a tree, found in Konkan Southern parts, Western Ghats, Coorg and Wynad. A product, Kokum is prepared from this species by drying the outer rind and used to garnish curries and for preparing cooling syrup (Amrit kokum). Besides kokum, nector, juice, squash, agal are also prepared from rind.

Edible fat "kokum butter" is obtained from the seed, used in soap and candle manufacture and suitable for ointment (used for local application to ulceration, fissure of lips, chopped hands and feet etc.), cosmetics and other pharmaceutical preparation. This species also has antithelmentic, antiscorbutic, antiseptic and cardiotonic properties.

It is useful in curing piles dysentery and tumours pain. Widely used as fish preservatives and a good source of acid for coagulating rubber. Juice used in indigestion, preparation of chutneys, as antiseptic for washing wounds of cattle, rinsing of mouths etc. Due to high content of desaturated and monosaturated glycerides, it is in demand as a substitute for cocoa and extender in chocolate and confectionary products.

Garcinia gummigatta (Cambogia)

Also known as kodumpuli or Malabar tamarind. It is small or medium tree found in Western Ghats, Shoal forests of Nilgiris. It is an indigenous species and Western Ghats is supposed to its centre of origin. Economic part is rind and leaf. The fruit rind is used as spice in curries and its juice is used for reducing fat and also prevents blood clotting by reducing triglycerides. Also used as fish preservatives in Kerala, South Tamil Nadu and in some part of Karnataka (Kodagu and South Canara). The rind of ripped fruits is processed and used as a condiment in fish and prawn preparation to impart flavour and taste and also to improve keeping quality. It has immense value in drugs production for reducing the obesity and rinsing mouth. Seed yields an edible fat, tree yields translucent yellow resin, which is used as varnish and having purgative properties. The bark and fruit rind decoction are used against rheumatism and bowel complaints and are good vermifuge. The dried fruits and leaves are used for curing diarrhoea, dysentery and dyspepsia. The rind is also good for polishing gold, silver and as a substitute for acetic and farmic acid in the coagulation of rubber latex.

Garcinia mangostana (Mangosteen)

Small/medium tree, found in South India on the lower hills of the Nilgiris and Courtrallam. Fruit is edible, soft and delicious. It is considered as 'Queen of fruits' and it is the only fruits where glucose is readily available. The entire fruit has certain medicinal properties. The rind is astringent which is used in chronic diarrhoea and dysentry and also effective against skin infections. Bark and young leaves are used as gargle for sore mouth.

Garicinia morella (Indain Camboge Tree)

It is a small or medium tree, found in Assam & Khasi hills and Western Ghats of India. The economic parts of this tree are gamboge, stem and seed. Rind is used as tan, seed yields fat which is used in cooking, confectionary, candle making and medicines. Gamboge, the yellow resin obtained from stem used for preparing water colours and varnishes for metals and also for dyeing silken fabrics.

Garcinia xanthochymus (G. tinctoria)

This is medium size tree and found in lower hills of Eastern Himalayas, South Western Ghats and Andaman Islands. The economic parts are fruit, seed, bark and stem. Fruit is edible and used for preparation of preserves and jams. The gamboge obtained from stem is of inferior quality. The exudates from bark and fruit is used as dye. Seedlings are good rootstock for grafting of mangosteen.

Hydroxy Citric Acid (HCA)

A by-product from Garcinia and its importance. The dried rind of Gambogia and kokum contains 30% and 10% Hydroxy Citric Acid (HCA) respectively which is commercially known as ‘citrin’. It is widely used against obesity and weight management.

The mechanism of action of HCA is said to be that it reduces the conversion of carbohydrates into stored fat by blocking / inhibiting the enzyme (ATP citrate lyase) activity which is responsible for storing fat in the human body system. It can also decrease the production of melonyl CoA involved in the synthesis of body fat.

This slows down the formation of lipids- the fat precursors and enables the body to metabolise fat more efficiently. It is also reported that liver produces more polysaccharide glycogen in presence of HCA and reduces the weight through suppression of appetite. HCA also enables the body to burn glucose for fuel before it is stored as fat.

Further, HCA slowdown the oxidation of protein and hence loss of clean tissues is minimized while reducing obesity. It also affects Basal Metabolic Rate (BMR), the minimum amount of energy required for a resting body to stay alive is enhanced by the presence of the compound. No adverse effect or interactions has been reported on the use of HCA, as it is a natural product. HCA supplements are available in many forms including tablets, capsules, powders, snack bars, chewing gums etc.

Limitations for its Commercial Cultivation

Inspire of unique medicinal and industrial properties, this crop is not being exploited for a commercial cultivation due to:

1. Limited availability of scientific information on cultivation.
2. Dioceous nature of plant where the sex is confirmed only after 7 to 10 years i.e. after completion of juvenile period.
3. 50% plant being male, if it is propagated through seed.
4. Wide variation in quality and quantity of fruit due to seedling progenies.
5. Late bearing and harvesting period, which extends in rainy season leading not only to difficulty in harvest but also loss of fruits.
6. Lack of scientific studies on sex identification/variability and productivity of different species.

Future Thrust

1. Collection, evaluation and selection of high yielding genotypes.
2. Documentation of available information.
3. Standardization of location specific cultural practices.

4. Standardization of propagation techniques for fast multiplication.
5. Varietal improvement.
6. Value addition and by product utilization.

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Thermal Imaging System – A Tool for Pest Detection

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Introduction

Thermal remote sensing or thermal imaging system is the branch of remote sensing, is a modern world pest detection tool that deals with processing and interpretation of data collected from thermal infrared region within the infrared radiation emitted from the earth's surface. It is a device for easy and quicker detection of hidden pest problem which is difficult to identify with naked eye.

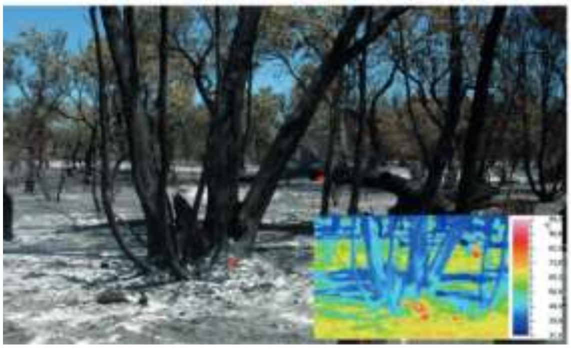
Application of Thermal Imaging System

Thermal imaging or thermography is a potential tool for many applications in agriculture, meteorological studies and especially in pest management starting from nursery management, irrigation scheduling, harvesting, yield forecasting, plant disease detection, termite attack, post-harvest insect pest management, maturity evaluation, bruise detection, detection of foreign bodies in food, determining heat distribution in the cooking of food etc. Some examples of the major insects have been detected using thermal imaging are summarized here.

In 2018, viability of thermal imaging was tested in detecting the nests of *Vespa velutina*, an invasive hornet species in Europe by Lioy *et.al.* In this case also thermography proved to be an effective tool in detecting *V. velutina* nests before the beginning of their reproductive phase and ultimately contributed in the pest management strategies. During 1983, The rusty grain beetle, *Cryptolestes ferrugineus* (Stephens) (Coleoptera: Cucujidae) was found to be most serious pest of stored grains in western Canada, which caused up to 45% damage of farm granaries.

Manickavasagan *et al.,* 2008 used infrared thermal imaging system to detect *Cryptolestes ferrugineus* infested wheat kernels and found that in pair wise discriminations it was 83.5% and 77.7% for a quadratic function and 77.6% and 83.0% for a linear function in infested and sound kernels respectively. In 2012, Chelladurai *et al*. used thermal imaging system and thermal images of un-infested and infested mung beans with egg, larval, pupal stages of Cowpea seed beetle, *Callosobruchus maculatus* along with completely hollowed out beans were acquired.

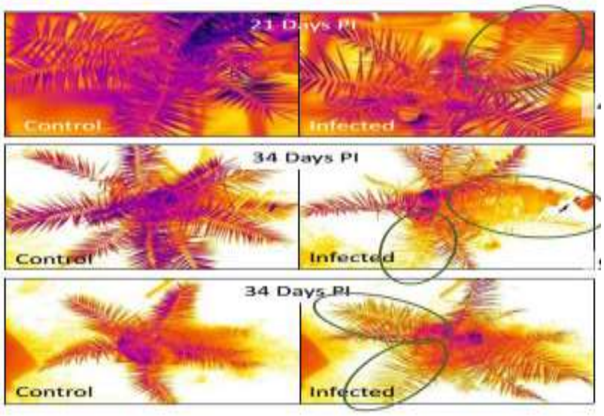
As cowpea beetle is an internal feeder and the very first detection of infestation can only be known by the presence of numerous flying beetles, its early detection through naked eyes is quite difficult. By thermal imaging system they concluded that by QDA (Quadratic Discriminant Analysis classification model correctly identified more than 80% mung beans infested with initial stages of *Callosobruchus maculatus* infestation.



(Source: Schmitz et.al., 2015)

In tall trees and orchards detection and management of insects was found to be difficult. Schmitz *et.al.,* 2015 used thermal imaging remote sensing to study the behaviour and detection of Australian fire-beetle, *Merimna atrata* (Buprestidae) in burnt woods after a bushfire. These insects have two pairs of infrared receptor organs on the abdomen. Adult beetles invade a freshly burnt area as they are attracted by the smell of burning woods to complete their life cycle. As soon as area gets cooler and the smell of burning declines, they leave. Schmitz concluded number of beetles detected after first day of fire and even if the fire had extinguished some beetles can be sited on the scorched area that can be detected by thermal imaging cameras.

Maldague, 2001 used thermal imaging system for early detection of the galleries created by wood worm, *Anobium punctatum* L. (Coleoptera: Ptinidae). Grubs usually make tunnels inside wood and wooden materials and adults emerge out by making small holes on the wood surface. Red palm weevil, *Rhynchophorus ferrugineus*, is a major pest of palm trees. After hatching larvae of palm weevils makes tunnels inside the tree and in case of heavy infestation leads to defoliation and death of tree. As direct visual early detection is quite impossible, in 2013 a canopy temperature based thermal imaging system was developed to detect red palm weevil infestation. Larvae caused water stress in infested palm trees, which was reflected by higher canopy temperature as compare to healthy trees that can be extracted from thermal images.



(Source: Doski et. al., 2016)

Now-a-days, thermal imaging system has been widely used by building maintenance professionals as an early and easy pest detection tool for household insect pests like termites, fire-ants, hornets, rodents and wood boring insects.

Mechanism of Thermal Imaging System

Components: Detector and lens, thermal imaging camera, data analysis tool.

Every ground object which are above absolute zero (0 K or -273.15 °C or –459 °F) emit some radiation in the infrared range of the electromagnetic spectrum. These radiations are measured by thermal remote sensing system, which depends on two factors; kinetic temperature and emissivity. Kinetic temperature is the surface temperature of an object and emissivity (ε) is the emitting ability of a real material compared to that of a black body. Thermal imaging detectors detect differential temperature of the object caused due to incoming infrared radiation and is converted into image by thermal imaging camera. Data collected by the system were recorded on film or magnetic tape. The thermographic image with warmer temperatures shown in light tones, and cooler temperatures in dark tones. Each pixel of the image is analysed in false colour images which were related to the temperature value of the object’s surface (Doski et.al., 2016).

Conclusion

Thermal imaging system is a non-destructive, fast and easy pest detection tool that deals with helping individuals to see even in darker places what the naked eye cannot. Although having a high potential in pest detection, very few work and research has been done in thermal imaging. So now there is a definite need to

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promote research work and use of thermal imaging data by both scientists and application communities to fetch required targets.

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Coloured Sticky Traps an Eco-friendly Approach in Pest Monitoring and Management

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Introduction

Agriculture is vastly being affected by different insect pest, and to combat those problems we are solely depending upon hazardous chemical pesticide which has negative implication on the environment and human health. Therefore, safe analogous control measures are needed. Trapping which is one of the most important cultural and eco-friendly method can be used as most convenient and inexpensive tool for pest monitoring and management. Different traps are used for insect management e.g. light trap, pheromone trap, light interception trap, sticky trap etc. Among them coloured sticky traps are simple low-cost method for identifying the relative abundance of insects and are used to monitor flying insect species in numerous crops.

What are Coloured Sticky Traps?

Sticky traps are usually made of paper or plastic of different attractive colour with a strong adhesive backing designed to trap insects upon contact. The main mechanism involve in coloured sticky traps are similar to the light traps where insects are being attracted to contrasting bright light and being trapped and killed. Coloured sticky trap targets the insect behaviour by targeting its visual cues and when insects being attracted and land on glued surface they trapped and killed. The efficiency of sticky traps can be enhanced by using essential oil where we can trap the insects by targeting both of its visual and olfactory stimuli. Two primary colours are mainly used for insect trapping because maximum number of insects are being attracted to these two primary colours i.e. blue and yellow. Yellow sticky traps are attractive to a wide range of insects including Tomato Potato Psyllid (TPP), Western flower thrips, whiteflies, fungus gnats, shore flies, leaf miners and winged aphids, whereas blue cards are attractive to thrips. Sticky traps demonstrate that it will give the status of pest population in a cropping ecosystem but solely can be used as a management tools in controlling the entire pest population so it can be holistically integrated with other IPM tactics to effectively manage the pest population. Sticky ribbons which are closely related to sticky traps made up of long rolls or ribbons coated with sticky glue which can be effectively used in pest management by encircle the crop with it.

Installation of Sticky Traps

1. Fix the sticky traps to a wire, wooden stake or other instrument which allows the movement of sticky trap as the crop grows.
2. Place the traps at equidistance in a Z or M pattern across the crop area.

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3. Make sure that the bottom of the sticky trap is close to the crop canopy to get effective result.
4. Positioning of the traps are based on the type of pest you are intended to target e.g. face the trap to the soil if monitoring for fungus gnats, but for general use, position the traps or cards vertically.
5. Avoid as much as possible to install the traps near sprinkler.
6. Install the traps near entrance and vents to detect any pest migration
7. When using the traps in an unprotected area place the traps down to wind direction as dust may degrade the glue and make trap ineffective.
8. Small production areas < 500m2can be monitored as one unit while larger areas can be divided into sections to facilitate easier monitoring (www.nurseryproductionfms.com.au).

Inspection of Sticky Traps

Number of sticky traps to be used is strictly based the crop, pest pressure, budget, timing and season. More number of traps definitely increase the sensitivity of the monitoring; however, this requires more time and labour to manage and monitor and may not be economically viable for the farmer or growers. According to Bio secure HACCP guidelines this is the recommendation of minimum number of sticky traps to be used for pest monitoring.

Recommendation of Number of Sticky Traps to Use

Number of sticky traps to be used is strictly based the crop, pest pressure, budget, timing and season. More number of traps definitely increase the sensitivity of the monitoring; however, this requires more time and labor to manage and monitor and may not be economically viable for the farmer or growers. According to Biosecure HACCP guidelines this is the recommendation of minimum number of sticky traps to be used for pest monitoring.

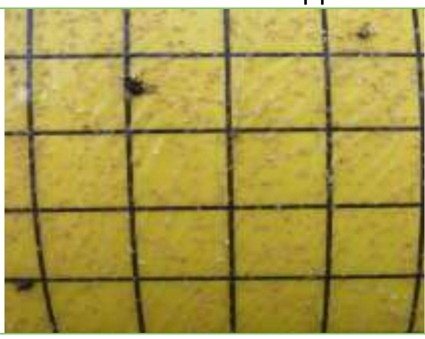
Open Field/ Growing Beds		Greenhouse/ Polyhouse/ Glasshouse	
Total Area (ha)	No. Of Traps	Total Area (m3)	No. Of Traps OF TRAPS
<0.5	6	0-200	1
0.5-1	10	200-500	2
1-5	12	500-1000	4
5-10	15	1000-5000	6
>10	20	5000-10000	10

Table 1., Number of traps/Area to be used.

Inspection of Sticky Traps

1. Inspection of traps to be done at least once per week and can be increase up to 2-3 times a week in high risk periods/high risk crops.
2. If insects are trapped on the sticky panel count insects within a 2.5cm2 area down the sticky trap.
3. Record should be taken if any beneficial insects present on the sticky trap.
4. If a trap needs replacing, remove it from the trap attachment and the detachment panel should be loosely wrapped in clear plastic and counting of number of insects trapped in different location.

Fungus Gnats on Sticky trap



Whitefly on Sticky trap

Sticky trap used in a Nursery

Benefits of Using Sticky Trap

1. It is an eco-friendly approach of pest management which avoid indiscriminate usage of pesticides.
2. It acts as an effective monitoring device in cropping ecosystem.
3. This technique is very easy to use, simple in design and easy to set.
4. Sticky traps are disposable which makes clean-up convenient.
5. Sticky traps are comparatively cheaper and affordable.
6. Sticky traps are easily integrated with other IPM tactics to effectively manage the pest population.

Conclusion

Coloured sticky traps are useful tools for monitoring the occurrence and abundance of pest population. The use of sticky traps is an effective and easy to use method of early pest population control. However, sticky traps solely may not able to restrict the build-up of pest population during the entire growing period. So, sticky traps can be integrated with other IPM tactics to control the pest most efficiently.

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Shiitake Mushroom

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Introduction

India is known for the large cropping diversity with vast variety of agricultural crops grown every year leading to the enormous production of agro wastes like crop residues, tree wastes, and weeds of land and aquatic system which make the potential renewable resources. Numerous methods have been implemented for the better exploitation of agro wastes in which one among them being mushroom cultivation. Mushroom cultivation is an eco-friendly method of solid waste management that helps in the biological degradation of natural resources. Mushrooms are protein rich food and the recent developments in the scientific understanding of mushroom cultivation has aided in improvement of its cultivation technology (Puri, 2011).

Shiitake mushroom species are the edible mushroom which have originated from East Asia and cultivated and consumed in numerous Asian nations. Initially, Barkley (1877) described the fungus as *Agaricus edodes* and later put in the Genus *Lentunula* by David Pegler in 1975. In Japenese, 'Shii' refers to the tree, *Castanopsis cuspidate*, which gives the dead logs to the development of mushroom and 'take' refers to the mushroom (Wasser et al, 2004) , while 'edodes' refers to the eatable in Latin (Halpren, 2007).

Shiitake mushroom is broadly developed everywhere throughout the world and contributes around 25 per cent of aggregate yearly generation of mushrooms. While China represented roughly 90 per cent of the world's Shiitake mushroom in 1997 (Chang and Miles, 2004), increasing cultivation in developed nations including Japan and the US, highlight the capability of the business. The shiitake mushroom cultivation has expanded from 14.3 per cent to 25.2 per cent and 180 thousand metric tons to 1564.4 thousand metric tons worldwide in the last three decades. While in India it has increased from 1000 thousand metric tons to 1250 thousand metric tons (Singh and Mishra, 2006).

Uses

Hayes, (2013) reported the important uses of shiitake mushroom, such as:

1. Shiitake are additionally dried and sold as fortified nourishment. These are rehydrated by absorbing water before utilizing.
2. The stems of shiitake are once in a while utilized as a part of Japanese and different foods, because the stems are harder and take more time to cook than the delicate meaty tops.
3. One sort of high-review shiitake is called 'donko' in Japanese and another high-review of mushroom is called 'huagu' in Chinese. Both of these are seen at lower temperatures.

Medicinal Used

1. Shiitakes give good amounts of protein (18%), potassium, niacin and B vitamins, calcium, magnesium and phosphorus.
2. They have antiviral and resistance boosting properties and are utilized nutritiously to battle infections, bring down cholesterol and direct pulse.
3. 'Lentinan' an immune stimulant from shiitakes, has been utilized to treat growth, helps for diabetes, endless exhaustion disorder, fibrocystic bosom sickness and different conditions with amazing outcomes.
4. The crude shiitake eaten every day for one week brought down serum cholesterol by 12 per cent (Suzuki and Oshshiana, 1976).

Cultivation

Shiitake mushrooms develop actually on rotting wood of hardwood trees and have generally been developed on short length cut logs. Currently, it has demonstrated fruitful on both logs and optional substrates like wood shavings and peat greenery (Royse and Sanchez, 2001). There has been no much investigation of the potential for Indian timberland proprietors to use little logs of local or farm woods species for shiitake mushroom creation. The first report of the cultivation of the shiitake in India is from Solan, Himachal Pradesh (Shukla, 1994). Kaur and Lakhanpal (1995) also carried out the traditional and synthetic cultivation of this mushroom for the first time in India.

Lentinula edodes is a white rot fungus that secretes a class of lignocellulolytic enzymes, which permit it to grow on lignocellulosic substrates rich in lignin (Leatham, 1986). Therefore, it is having the potential to convert inexpensive lignocellulosic substrates into valuable protein at a low cost. It plays a major role in the biodegradation process by releasing several lignocellulolytic enzymes and the production of these enzymes depends on the substrate composition.

Different combination of saw dusts and agricultural residues had very good mycelial growth, good numbers of pin head formation and numbers of fruiting bodies with maximum biological efficiency (Chittaragi et al, 2017a). Alone these substrates were not so effective. The yield of mushrooms was affected by different substrates (Puri, 2012). While a number of tree species have been utilized for shiitake cultivation, the most widely recognized species utilized are of oaks (Quercus spp.).

The outcomes recommend that the decision of wood species can influence yield and timing of mushroom formation but none have revealed any effect of species on the nourishment estimation of the mushrooms (Sabota, 1996). The availability of the agro-residues after crop harvest like straws of various crops as that of wheat, sorghum, pearl millet, rice has been used as a basal substrate for the cultivation of shiitake in recent times (Chittaragi et al, 2017b).

The use of locally available agro-residues provides a way to minimise the cost of cultivation and also helps to reduce the environmental pollution that occurs due to burning of various agro-residues in the field after the harvest. The potential use of these substrates will also reduce the cutting down of trees for the shiitake cultivation and there by maintaining the environmental stability. Many workers have found the good combination of the agro-residues that supported the growth and development of the shiitake. The growth of shiitake was found faster on agro-residues compared to the natural log cultivation (Puri, 2011).

Conclusion

There is need to advance the cultivation of this mushroom as it is essential regarding nutritious and restorative qualities. The yield of mushroom may be changed because of the utilization of heterogeneous blend of sawdust. It is a sort of medium, which supports great development of mushroom mycelium yet does not support development of contender. Mushroom substrate might be characterized as a sort of lignocellulose material which supports the development, advancement and fruiting of mushroom (Chang and Miles, 1988). Shiitake mushroom is routinely cultivated on wooden logs. Inaccessibility of tree logs requires a look for optional substrates for shiitake and general mushroom cultivation.

The continuous and easily availability of saw dusts of various timber plants offer a great potential as optional substrate for shiitake mushroom cultivation in India. There is need to assess the development and yield of shiitake mushroom on locally available sawdust of timber plants and other agro-residues and to choose an appropriate substrate for better cultivation of shiitake mushroom. Bioconversion of lignocellulosic biomass by mushrooms offers a promising way to convert low-quality biomass into an improved human food. This may also give an additional income to the farmers and balance the income throughout the year.

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Method of Pulsing, Impregnation, Vase Solution and Irradiation Techniques in Floriculture

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Abstract
Treating the flowers with high concentration of sucrose and germicide for a short period of time, in order to improve shelf/vase life and to promote opening of flower is pulsing: helpful for long storage/transportation. Impregnation is loading flowers in high concentration of silver nitrate or nickel chloride for short period: helpful in reducing the attack of micro-organisms. Irradiation done for improving the vase life of flowers.

Pulsing
The term pulsing means placing freshly harvested flowers for a relatively short time in a solution specially formulated to extend their storage and vase life. The absorption of chemical solutions containing sugar and germicides through the lower cut bases of flower stems is known as pulsing. Pulsing may be used by growers, wholesalers or retail florists in order to enhance the cut flowers subsequent vase life in water. Pulsing is employed with higher concentrations of sugar, mainly sucrose, the percentage of which varies with species and cultivars.

Pulsing is found to be of great value in prolonging life, promoting opening and improving the colour and size of rose petals through osmo-regulation (Kuiper et al, 1995). The treatment is also effective in increasing anthocyanin concentrations in petals (Ichimura, 1998). Sucrose replaces the depleted endogenous carbohydrates utilised during the post-harvest life of flowers. It helps in the continuation of the normal metabolic activities after harvest and inhibits the production and action of ethylene. Fructose is equally effective as sucrose in preservative solutions for cut flowers. It has been reported that lactose and maltose are active in low concentrations while the non-metabolic sugars like mannose and mannitol were inactive or harmful (Halevy and Mayak, 1974b). D-fructose at 3 % - effective treatment which improved the vase life and increased fresh and dry weight.

Pulsing Treatments in Flower Crops
1. For rose and chrysanthemum – 2-6% sugar (Bhattacharjee and De, 1988).
2. BOP, Gypsophilla and carnation – 10% sucrose (Crilley and Paull, 1993).
3. Gladiolus – 20% sucrose (De et al.,1996).

Impregnation
The cut ends of the flower stems are impregnated for a short time with chemicals. This treatment protects the blockage of the water vessel in the stem by microbial growth and stem decay. Impregnation of cut bases of flowers with high concentrations of silver nitrate (AgNO3) or nickel chloride or cobalt for 10-15 minutes greatly improves the longevity of several flowers, such as aster, gerbera, carnation, chrysanthemum, gladiolus.

1. In gladiolus cv. ‘Dhanvantari’ impregnation with AgNO3 (1000 ppm) for 10 minutes before pulsing (De et al, 1996).

2. Tuberose – impregnation with AgNO3 (1000 ppm) for 15 mins and CoCl2 (1000 ppm) for 30 minutes (De and Barman, 1998).

3. Cut roses – nickel sulphate (10 mM) for 20 mins increases vase life (Reddy et al, 1988).

Vase Solution

Vase solution is to improve the life of flowers after harvest. It should contain:

1. Low concentration of sugar (0.5-2.0%).
2. pH- low.
3. Germicide.
4. Retailers or customers – bulk produce.
5. Sugar, biocide, citric acid.

Irradiation

It is used for increasing vase life or shelf life of flowers.

The irradiation was carried out in a panoramic cobalt-60 source and in an electron beam accelerator (0.5–1.5 MeV). The dose rates in the gamma source varied from 147 to 159 Gy/h and in the EB accelerator the dose rate was 133 Gy/s. After the irradiation the flowers were maintained in a preservative solution composed of 0.005% of 8-hydroxyquinoline hemisulfate salt, 1 ppm of ampicilim sodium salt and streptomycin sulfate. All the samples were maintained at room temperature, varying from 18°C to 25°C and exposed to electric light for 9–10 h.

1. *Lilium speciosum* (Liliaceae): Tolerant to gamma and e-beam radiation. High doses caused bud opening inhibition. E-beam was more damaging than gamma rays.

2. *Alpinia purpurata* (Zingiberaceae): Tolerant to gamma and e-beam radiation. Browning symptoms appeared with high doses.

3. *Curcuma alismatifolia* (Zingiberaceae): Tolerant to gamma rays, but not tolerant to e-beam. The damage that appeared was the browning symptom.

4. *Lisianthus* sp. (Gentianaceae): Tolerant to gamma and e-beam radiation. High doses caused bud opening inhibition and petal withering.

5. *Eustoma grandiflorum* (Gentianaceae): Tolerant to gamma rays, but not tolerant to e-beam. The damaging symptom was the petal withering.

6. *Zingiber spectabile* (Zingiberaceae): Not tolerant to gamma and e-beam radiation. The dose of 300Gy caused browning process.

7. *Gerbera* sp. (Compositae): Not tolerant to gamma rays, but tolerant to 300Gy of e-beam. The gamma radiation caused the bent stem and curling petal symptoms. Even with 500 Gy of e-beam the flowers did not present the bent stem and only a slight petal curling symptom.

8. *Strelitza reginae, Heliconia psittacorum* and *Heliconia rostrata* (Musaceae): Not tolerant to gamma and ebeam radiation. The most evident damage caused by irradiation was the browning, followed by drying up.

9. *Dendrobium phalenopsis* (Orchidaceae): Not tolerant to gamma and e-beam radiation. The petal withering and flower drop were the undesirable symptoms.

Reviews

Influence of holding and pulsing solution on cut spikes of Anthurium cv. Temptation, they are treated with (P1 - Aluminium sulphate - 300 ppm, P2 - Calcium hypochlorite - 500ppm, P3 - Sodium hypochlorite - 500ppm, P4 - Calcium hypochlorite - 1000ppm, P5 - Sodium hypochlorite - 1000ppm, P6 – Control) and 11 different holding solutions. Among the pulsing solutions, sodium hypochlororite 500 ppm took delayed spadix blackening (20days), spathe blueing (21days) and loss of glossiness (19days) and recorded an increased vaselife period of 16 days over control. Holding solutions of sucrose 5 per cent+ $NaOCl.16H_2O$ – 50 ppm + kinetin – 25 ppm took maximum days for anther bursting (18days), discolouration of the spathe (29days) and vaselife period (30days) could be recommended for cut flower industries.

Sugar and Salicylic Acid (50-ppm) was the best chemical treatments for tuberose flower quality and vase life which was followed by Sugar and Citric Acid (50 ppm) [Jamal Uddina et al., 2016]

The pulsing of gladiolus spikes with 8HQC 200 ppm+10% sucrose would be helpful in increasing the vaselife and improving other postharvest attributes (Ritu Jain, 2015).

Heliconia flowers treated with 100 ppm of GA3 shown significantly maximum water uptake, fresh weight retention, flower opening percentage, number of bracts open, TSS, carotene content and useful vase life (15.50 days) [Patel et al., 2017].

Conclusion

Now a days, flowers are mostly used in many purposes like decorations in functions, making boquets, also as gift. Therefore, flowers are treated with different methods (Pulsing, holding, impregnation) for improving its life.

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Plant Ionomics

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Introduction

Plants, being sessile in nature, take nutrients in the water-soluble form as ions. Based upon the plant requirement, nutrient ions are classified into three categories:

1. Macronutrients: Those nutrients which are required by the plants in concentrations more than 100 ppm which include C, H, O, N, S, P, Ca, Mg and K

2. Micronutrients: The elements which are required by plants in concentration less than 100 ppm are put in this category. Those are Fe, Mn, Zn, Cu, B, Cl, and MO

3. Beneficial elements: Na, Co, Al, Se, Si, which promote growth and may be essential to some of the plants. Moreover, the better growth and development of the plant depends upon the balanced supply of those nutrients to the plants.

The plant system itself has an inbuilt mechanism for ion homeostasis in which it regulates the ion accumulation and deficiency. With the advancement in the field of genomic study the genomic level regulation of the ions in the plant system has been studied which pave the path for the discovery of the novel gene with its function.

Ionomics mainly focuses on the total ionome profile of the organism and how these ions are regulated in the organism's body for a balanced metabolic process. Hence, like transcriptomics, proteomics and metabolomics, ionomics is also a novel approach for the plant functional genomics study. Hence, ionomics is one of the most important pillars of the functional genomics.

Ionome is defined as 'the mineral nutrient and trace element composition of an organism, representing the inorganic component of cellular and organismal systems'. It is a dynamic network of elements that are controlled by the physiology and biochemistry of the plant, which are ultimately controlled by the genome, in response to the environment which include both essential and non-essential mineral elements. Hence, the ionomics is defined as the, "study of quantitative complement of low molecular weight molecules present in cells in a particular physiological and developmental state of the plant".

Why Ionomics?

Micronutrient deficiency is the major problem in developing as well as developed countries. Majority of the people dependent on staple food crops such as wheat, rice and maize for their sustenance. Fortified foods are very much necessary to meet out their mineral requirements. Thus, mineral enrichment, i.e., biofortification (genetic enhancement) of staple food crops has been considered a sustainable strategy to tackle the problem of mineral deficiencies. However, the first and foremost prerequisite to develop biofortified crop for enhanced mineral content is understanding the genetic control for mineral accumulation inside edible parts of the plant (e.g., seed, fruit). The amount of mineral content in these tissues depends on a series of processes like, mobilization from the soil, uptake by the roots, transport and redistribution within the plant, import and accumulation in the seeds, etc. Collaborative work of these processes makes accumulation of minerals in storage parts of plant a very complex process. Besides, most of these procedures are individually controlled by more than one gene, thus, this becomes a more complex polygenic trait. To dissect such a complex trait, the analysis of molecular machinery and understanding its functioning through high throughput technologies are the need of time. In this regard, plant ionomics could be a useful technology to explore the relation of gene(s) with transport and accumulation of ions.

The Three Main Properties of Ionomics Analysis (Salt, 2004)

1. Cost-effective: The per sample cost can be as low as $10, and will likely continue to fall as high-throughput methodology improves.

2. High throughput: With an autosampler, hundreds of samples can be run on an ICP per day. This throughput enables genetics and modelling studies, which frequently require thousands of samples per project.

3. Comprehensive: Like transcript profiling, ionomic profiling can simultaneously measure most of the relevant components within the class of molecules under study.

History of Ionomics

The idea of plant ionomics begins with the mixing of metabolomics and mineral nutrition. It was started with the opinion given by Robinson and Pauling in the late 60s and early 70s that the metabolite profile of an organism contains a rich source of information that is reflection of the physiological status of that organism. Later, remarkable progress has been made in describing and understanding the basic biology of nutrient ion homeostasis in plants, since its establishment as a scientific discipline in the 19th century .

Lahner et al. (2003), first time included all the metals, metalloids, and non-metals present in an organism in the ionome. In 2003, Eide made the first ionome profiling in yeast. In 2008, Salt and colleagues have described the term ‘plant ionome’ for the total concentration (i.e., all forms) of selected elements in a sample of plant tissue. It provides the qualitative and quantitative information about the functional status of the cell, tissue or organism. Studies on the functional connections between the genome, transcriptome, metabolome, and proteome are under way, in contrast, the study of the ionome, is still in its starting stage. Ionomics is getting stronger day by day with the help of bioinformatics and other genetic tools, such as sequenced genomes, DNA microarrays, etc. (Singh et al., 2013).

Work Flow of Ionomics

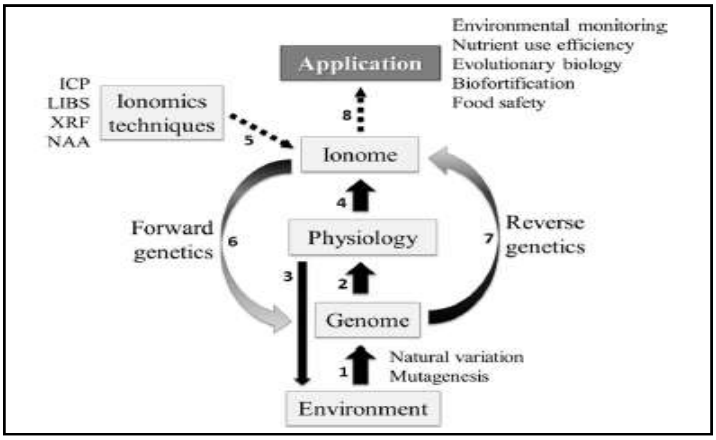

Fig. 1. Biological processes affecting the plant ionome and main steps for ionomics studies (Derived from Barbosa et al., 2019)

1. The environment (e.g.: water and nutrient supply, water and soil pollution, soil composition, stress) provide selective pressure, resulting in genomic variations in plant populations. Mutations in the genome can arise spontaneously during replication, by environmental mutagenic agents; or can be generated artificialy for identifying interesting genes related to the ionome.
2. Mutations can affect elements absorption and distribution.
3. In turn, plants can differentially affect the bioavailability of elements in the surrounding environment (e.g.: by secreting chelators in the rhizosphere) affecting the elemental profile in plant tissues, which can affect selection.
4. The ionome is determined, thus, by its underlying physiology, which is determined by the genome and environment interaction.

5. The ionome can be analysed by several methods.
6. The genetic basis of elemental accumulation can be studied by forward genetics, when regulatory genes are identified from a set of ionomics mutants or natural variation (i.e., from phenotype to genotype).
7. By reverse genetics, when a gene is mutated (or has its expression modified) and the ionomics phenotype is characterized (i.e., from genotype to phenotype).
8. The obtained knowledge can be applied for understanding plant evolution, improve plant nutrition, environmental monitoring (phytoremediation and bioindication), and to increase food safety.

Analytical Techniques Used in Plant Element Profiling (Singh Et Al.,2013)

1. Based on electronic properties of elements:

a. Atomic absorption spectrometry (AAS).
b. Ion beam analysis (IBA).
c. X-ray fluorescence spectroscopy (XRF).
d. Inductively coupled plasma-mass spectroscopy (ICP-MS).
e. Inductively coupled plasma-optical emission spectroscopy (ICP-OES).

2. Based on nuclear properties of atoms: Neutron activation analysis (NAA).

Bioinformatics in Ionomics

The advancement of high throughput phenotyping technologies has created a huge amount of data which cannot be maintained without a data management tool. Bioinformatics provides an easily accessible tool for the data storage and retrieval system. The Purdue Ionomics Information Management System (PiiMS) (www.purdue. edu/dp/ionomics) provides integrated workflow control, data storage, and analysis to facilitate high throughput data acquisition, along with integrated tools for data search, retrieval, and visualization for hypothesis development. PiiMS is deployed as a World Wide Web-enabled system, allowing for integration of distributed workflow processes and open access to raw data for analysis by numerous laboratories.

PiiMS currently contains data on shoot concentrations of P, Ca, K, Mg, Cu, Fe, Zn, Mn, Co, Ni, B, Se, Mo, Na, As, and Cd in over 60,000 shoot tissue samples of Arabidopsis (Arabidopsis thaliana), including Ethyl Methane Sulfonate, fast neutron and defined T-DNA mutants, and natural accession and populations of recombinant inbred lines from over 800 separate experiments, representing over 1,000,000 fully quantitative elemental concentrations (Baxter et al., 2007).

Applications of Ionomics

Ionomics mainly focuses on the change in the ionome in response to "physiological stimuli, developmental state, and genetic modifications." In this regard these are some of applications of ionomics (Xin-Yuan and David, 2016).
1. Studying genetic variation in elemental accumulation provide major insight into how plants adapt to heterogeneity of soil.
2. Identification of QTLs/genes or gene network that govern the elemental accumulation (Table1) and also correlation studies between the elements in the organisms.
3. Ionome as biomarkers - the study establishes the multivariable ionomic signatures of physiological states associated with mineral nutrient homeostasis.
4. Rapid characterization of plant mutants with an altered ion-profile can be done.
5. Phylogenetic analysis - We can use ionome profile for understanding the evolution pattern of organisms.

QTL for	Marker interval/Marker	Chromosome	Organism	Reference
Fe	Xwmc382-Xarc124	2	Wheat	Vijay et al., 2009
Zn	Xcfd31-Xcfa2049	7	Wheat	Vijay et al., 2009
Mn	RM3475	1	Rice	Ana et al., 2009
P	umc59e	3	Maize	Domagoi et al., 2011

Ca	e721b	8	Yellow monkey flower	Lowry et al., 2012

Table 1: Mineral nutrient QTLs discovered in different crops

Limitations of Ionomics

1. Require highly skilled labours.
2. Daily calibrations of the instruments and variations in the growth environment have significant effect on the data produced.
3. Root ionome cannot be detected, soil contamination greatly affects the ionomic measurement.

Future Thrust

1. We need to develop the bioinformatic tools for data analysis and storage.
2. Ionomics can be used for Marker Assisted Selection for introgression of desired gene.
3. We can apply ionomics in the field of nutrigenomics and phytoremidiation techniques.
4. Transfer of QTLs which are responsible for specific elements across the species.
5. Regulation of toxic ions by manipulating ionome profile at genomic level.
6. Ionomic study should extend to more species.
7. Quantification of minerals at cellular and subcellular level in their native state is needed.
8. Reduction of cost of technology for ionome profiling and analysis of data.

Conclusion

The ionomics, which is one of the pillars for the functional genomics study, helps us to widen the area of the functional genomics study. It will help in the identification of the gene and the gene network and coordination among the different genes controlling different ion accumulation in the plant system. It will also help in the better understanding the relationship between the ions and identification of the gene and environment interaction at different stages of growth. The identification of the gene regulating the accumulation of the particular ion and its location in the plant help in the marker assisted breeding of the plant with introgression of the gene into the other plant. In this way, the ionomics helps in the nutrigenomics approach for the production of the micronutrient rich food. Many of the ions are toxic for the plant as well as the human beings and the herbivores. Hence, by the knowledge of the genes that regulate the accumulation of the ions, we can manipulate the ionomic profile of the plant system. Plant ionomics is functional tool required to feed and fuel the world.

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The Impact of Climate Change on Agriculture

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Introduction

Climate change encompasses changes beyond the average atmospheric conditions caused by both by natural factors such as the orbit of earth's revolution, volcanic activities, crustal movements and various artificial factors such as the increase in the concentration of greenhouse gases and aerosols. Climate change by global warming refers to the average increase in global temperature that has become a megatrend that will lead to significant global changes in the future. The UN Inter-Governmental Panel on Climate Change (IPCC) presented considerable scientific evidence in its fourth report on climate change (2007), concerning the impacts of climate change. The Club of Rome Report of 1972 had officially raised global warming as an international issue and in 1985, World Meteorological Organization (WMO) and United Nations Environment Program (UNEP) had officially declared carbon dioxide as the principal contributor of global warming. Further, in order to effectively cope with the global warming issues, IPCC was organized in 1988 and carried out systematic research and in-depth studies on issues of climate change.

Diagnosis of Climate Change

Agriculture contributes to climate change both by anthropogenic emissions of greenhouse gases and by the conversion of non-agricultural land such as forests into agricultural land. Climate change occurs by the change in each component of the climatic system including the atmosphere, biosphere, hydrosphere, cryosphere and lithosphere or by several complicated interactions amongst these components. The causes of climate change are largely categorized into natural causes and artificial causes. Natural causes include the changes in solar activities, volcanic eruptions, seawater temperatures, ice cap distributions, westerly waves and atmospheric waves. Whereas, artificial causes include carbon dioxide emissions from industries and agricultural production activities, acid rain, deforestation and destruction of the ozone layer.

Sectoral Impacts of Climate Change

Agriculture is the main occupation for 50 percent of the population in India. Agriculture and allied sectors contribute 15.4 percent of the Indian GDP (OECD, 2017). Farming activities are carried out by the selection of crop which is specific to suit the climate, soil type, resource availability, etc. Therefore, farming production and productivity are completely dependent on the climatic condition.

1. Field Crops: The effect caused by increased temperature will depend on the optimal temperature for growth and reproduction for any crop. In some areas, warming may benefit a few types of crops which are typically planted there or sometimes may allow farmers to shift to crops that are currently grown in the warmer areas. However, if the higher temperature exceeds the optimum temperature of the crop, yields will certainly decline. Higher carbon dioxide2 levels can also affect crop yields. Nevertheless, some laboratory experiments suggest that elevated carbon dioxide levels can also increase plant growth. However, other factors, such as the changing temperatures, ozone, water and nutritional constraints, may counteract and this may affect yields. For example, if the temperature exceeds the optimal level for a certain crop and if sufficient water and nutrients are not available, yields may be severely reduced. The elevated CO_2 levels have also been associated with the reduced nitrogen and protein contents in some crops like alfalfa and soybean, resulting in heavy losses, especially in their quality. The climate change has also affected grain and forage quality that has further reduced the ability of the pastures and rangelands to support the grazing by livestock. This creates a huge problem in areas where these lands are the sole source of feed. Moreover, extreme temperatures and precipitation can prevent the majority of crops from growing to their desired limit. Extreme events, especially floods and droughts, can also possibly harm crops and reduce yields.

2. Horticultural Crops: High temperature causes a burning or scorching effect of blossoms, predominantly on young trees. Fruit setting stage of navel oranges is recorded to be severely affected by high temperatures during flowering (Davies, 1986). High temperature induces moisture stress condition leading to sunburn and cracking symptoms in fruit trees like apricot, cherries and apples.

3. Livestock: Global climate changes affect numerous factors that are associated with production, reproduction, health and adaptability of every animal. Dairy breeds are more vulnerable to heat stress than the breeds used for meats. An increase in metabolic heat production in higher milk-producing breeds leads to higher susceptibility to heat stress, while the low milk-producing animals are resistant. (Dash et al., 2016).

4. Poultry: Poultry is extremely sensitive to temperature-associated issues, specifically heat stress. Endocrinological changes caused by prolonged heat stress in broiler chickens enhance lipid accumulation, reduced lipolysis and induced amino acid catabolism. Due to heat stress, feed intake of poultries will be reduced (Deng et al., 2012), which leads to less body weight, egg production and quality of meat, and also reduces the thickness of eggshell and even increases the egg breakage.

5. Fisheries: The rise in even 1° C of temperature will affect the mortality of fishes and its geographical distribution. The temperature rises of 0.37° C to 0.67° C altered the pattern of monsoon seasonal variations, eventually shifting the breeding period of Indian main carps from June to March in West Bengal and Orissa's fish hatcheries. This clearly proves the effect of temperature on their life cycle and distribution patterns.

Adaptation and its Co-Benefits of Mitigation in Agriculture Sector

Adaptation led Mitigation to climate change is one of the only options to prepare our community, locality, society and country as a whole for the severe consequences of climate change. Practically, adaptation means changing the regular activities because of change in climate, but not completely different, rather we should ponder upon purposefully modifying the existing practice. While mitigation is a technological modification that is responsible for reducing the addition of inputs and their emission freely into the atmosphere per unit of output (IPCC, 2007). Adaptation in the agriculture sector means disseminating knowledge on the negative impacts of climate change to reduce farmer’s vulnerability by improving their adaptive capacity.

Conclusion

Global climate change, its causes and impacts are one of the most emerging issues in the science and technology domain. India being a tropical country, is facing the impact of climate change through droughts, floods, cyclones, heatwaves, hailstorms, and coastal salinity which has become a threat to sustainable development. Extreme temperatures and its erratic events disrupt the activities of all the existing lives on the planet through severe damage or loss. Understanding the need for climate change is the most urgent need not only in terms of agriculture, but to sustain the vegetation and wildlife too. To understand the basics of climate change is the need of the hour and this would help the scientists and researchers to employ several techniques to face the challenge effectively and smoothly.

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e-National Agricultural Market (NAM) In Telangana: A Way Forward

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Introduction

Telangana, is the 29th State of India, carved out from the erstwhile united Andhra Pradesh on 2ndJune 2014. It is the twelfth largest state and the twelfth -most populated state in India with 35,193,978 residents as per 2011 census Telangana is bordered by the states of Maharashtra to the north, Chhattisgarh to the east, Karnataka to the west, and Andhra Pradesh to the east and south. Total geographical area of the state is over, 112.08 lakh.ha (2018-19), divided into 31 administrative districts. Agriculture remains the mainstay for 65% of the state's population and contributes 17.2% to the state's GDP (2012-13). Gross sown area was 57.74 lakh ha and Net sown area was 46.60 lakh hectares accounting for 61.2% and 41.58% of the total geographical area respectively. Over 85% of the farmers in the state belong to the small and marginal category with an average landholding size of 1.0 ha. Total number of farm holdings in the state are 55.54 lakhs of which marginal farmers are 34.41 lakhs, small farmers are 13.27 and others constitutes 7.86 lakhs.

The Agriculture sector provides livelihood to 55% of the state's workforce. Therefore, rapid growth in the sector is vital for overall economic progress and development. Committed to improving the state's capacity across the agricultural supply chain, the Government of Telangana has made a number of provisions to support the agriculture sector, including its flagship schemes such as:

1. Rythu Bandhu Scheme (investment support).
2. Rythu Bhima Scheme (farmer life insurance).
3. Provisions of high-quality inputs such as credit, seeds, tractors etc.
4. Construction of irrigation projects.
5. Revival of all tanks under Mission Kakatiya. Beyond cultivation, the Government has endeavoured to facilitate the sale of produce and to ensure that farmers receive a fair compensation for their efforts.

In the direct marketing to provide a physical marketplace to sell their produce 43 Rythu Bazars, including a modern Bazaar in Siddipet, have been setup. Work is in progress to set up 16 more Rythu Bazars. The Mana Kuragayalu Project is an extension of the Rythu Bazar concept. Under this pilot project 15 collection centres, 1distribution Centre, and 62 retail outlets have been set up with the objective of linking farmers looking to sell produce with urban consumers looking to purchase at affordable prices, 1.22 lakh MT of produce was traded in these markets.

e-NAM in Telangana

The e-National Agricultural Market (e-NAM) platform has been implemented in 47 Agricultural Market Committees. These are aimed at higher price realization by farmers through the integration of Agriculture Produce Market Committees (APMCs) across the country through a common online market platform to facilitate pan-India trade in agriculture commodities, providing better price discovery through transparent auction process based on quality of produce along with timely online payment. The state is a leader in the roll out of this platform – it is the first to implement the weighment integration and digital payments.

NAM is envisaged as a win-win solution for all stakeholders. For the farmers, NAM promises more options for sale at his nearest mandi. For the local trader in the mandi, NAM offers the opportunity to access a larger national market for secondary trading. Bulk buyers, processors, exporters etc. benefit from being able to participate directly in trading at the local mandi level through the NAM platform, thereby reducing their intermediation costs.

Five (5) Agricultural Market Committees (Nizamabad, Warangal, Badepally, hyderabad and Thirmalagiri) are selected for pilot launch on 14th April'16. In the first phase 44 Agril. Market Committees are selected for implementation of NAM in Telangana State. In the second phase 13 new Agril. Market Committees were selected to implement e-NAM in March, 2020. As of now total 57 AMC's out of 187 regulated markets in Telangana were integrated in e-NAM. A quantity of 31.46 Lakh MTs was traded on this platform worth of Rs.9, 476 crores.

Conclusion

The regulated marketing model of agricultural produce marketing in Telangana will continue along with emerging alternative formats. The introduction of e-NAM envisages improving efficiency in the system with suitable application of IT such as e-tendering. it is suggested that to complete implementation of e-NAM made farmers to realize the better price for their produce in Telangana.

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Regaining Values of Indigenous Pest Management Knowledge

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Abstract

This topic reviews scope and utility of Indigenous Pest Management knowledge for the present conditions happening due to uncertainties and detrimental effects of chemical pesticides in farming. A vast collection of traditional practices in pest control have been used by the rural farmers, now it's time to blend these resourceful learning with modern ways of crop protection.

Introduction

With the beginning of agriculture around 8000 B.C., ancient human beings lived with the crop pests without any effort to control them (Abrol and Shankar, 2012), but with the change in time during mid-1960s, there was a challenge to provide increasing supplies of food for a growing population and the repercussive commercialization of agriculture had induced the ascension of agricultural chemicals in India, to date (Kapoor and Sharma, 2020).

The use of these chemical insecticides became increasingly popular with farmers of India, where the crop damage caused by insect pests often at very high levels i.e. 15-20% and unscientific method of application (Atreya, 2007; Devi, 2010; Shetty et al., 2010; Rathee and Dalal, 2018). It is affirmed that indigenous technical practices offer approaches for sustainable insect-pest management (Devanand and Kamala, 2017).

Indigenous Technical Knowledge (ITK) is specifically concerned with actual application of the thinking of the local people in various operations of agriculture and allied sectors. It is the local knowledge - knowledge that is unique to a given culture or society (Prakash et al., 2012).

Local people, including farmers, landless laborers, women, rural artisans and cattle rearers are the upholders of the indigenous knowledge systems (Singh and Sureja, 2008), through accretion of experiences, informal experiences and intimate understanding of the environments in a given culture (Thurston, 1992). The innovative ideas of farmers in solving technical problems by local resource managements are therefore, gaining importance nowadays.

In recent years a growing number of scientists and organizations such as National Innovation Foundation (NIF) and Department of Science & Technology, Govt. of India are recognizing that it offers cheap locally adopted solutions to development problems. Hence, the best results are obtained when the traditional knowledge and IPM strategies intermingled in such ways that improves profitability and lifestyles of local communities in India.

Indigenous Pest Management

India's ancient knowledge in pest control practices dates back to prehistoric, historic, Vedic and Medieval period i.e. Vrikshayurveda (Tree-medicine) and Asura-vaidyaka (treatments of horse and other animals) which are designed to address the process of building harmonious relationship among man, animal and nature (Narayanasamy, 2002). Today, ecologically-based IPM is, above all, based on farmers' skills, abilities and their indigenous knowledge. Here are some examples of traditional knowledge that can be easily accompanied with modern IPM practices in various groups of agricultural crops for better adoption in local communities.

Eco-Friendly Indigenous Practices in Cereals and Pulses

Treatment of paddy seeds in diluted bio gas slurry for 12 hours increases resistance of seedlings to pests and diseases. Rice seedlings raised in nursery beds amply sprinkled with ash grow healthy and tolerate pest attack subsequently in the main field (Patnaik and Dash, 2017). Tribal women of northern Odisha performed the practice of nipping tender leaves of chickpea which they use for culinary purpose, helps to reduce the *Helicoverpa armigera* menace because *Helicoverpa* preferred the 2nd and 3rd leaf for oviposition on chickpea (Patnaik and Senapati, 2002).

Eco-Friendly Indigenous Practices in Vegetables and Fruits

Karthikeyan, et al., 2006 reported that spraying of 10 litres of fermented buttermilk of 2 days in a closed earthen pot on okra after diluting with water in the ratio of 1 litre fermented solution mixed with 9 L water effectively control whiteflies attack. Narayanasamy, 2006 found that a tribal treatment incorporating a mixture of *Calotophis* leaves, garlic, onion and chilli powder was potent against brinjal, *Epilachna* beetle, tomato fruit borer and pumpkin caterpillar infeststations. In Guava, pounding 2 kg of foliage of *Calotropis* sp. with neem cake @ 3 kg, soaking them in 20 litre of water for 4 days and spray by dissolving the extract in 200 litre water/acre to control all the pests (Anonymous, 2018).

Eco-Friendly Indigenous Practices in Cash Crops

To control whiteflies in cotton, about 600 g of tobacco is soaked in water for 2-3 days, filtered and then sprayed (Kanagasabapathy, 1996 and Devanand, 2002). To control the infestation of pest in the cotton field, powdered neem kernels with 'Vasambu' (Sweet flag- *Acorus calamus)* and soaked them in water till night and then spray the filtrate in the next day (Anonymous, 2018). In Sugarcane, trashes are burnt before the next ratoon crop, for killing insects and pathogens and also detrashing (locally known as "sogaiuriththal") the canes to control scales and mealy bugs (Devanand and Kamala, 2017).

Eco-Friendly Indigenous Practices Against Storage Pest

Mixing the dried leaves of notchi (*Vitex negundo)* with seeds/ grains while storing them. Storing the seeds after mixing with pungam *(Pongamia pinnata)* leaves. Pulses and food grains are stored in gunny bags, which are previously wet with 10% salt solution and dried, in order to avoid storage pest attack (Anonymous, 2014).

Conclusion

India is a country populated by a number of indigenous communities, and many of these knowledge and technologies are compatible with the modern knowledge and technology system. Therefore, the main focus of this topic is to understand that indigenous pest management knowledge and traditional ecological knowledge derived through long experiences and perceptions gathered by traditional farmers during the course of their interactions with the nature and natural resources.

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Nano-Fertilizers: Perspectives and Challenges

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Introduction

The increasing demand of food worldwide for growing population is an alarming stage, under such condition, a question arise that how to fulfil the demand with quantitative and qualitative agricultural production through limited resources, especially in India. The widespread deficiency of plant nutrients in soils has resulted in great economic loss for farmers and significant decrease in agriculture production as well as nutritional quality of product. The extensively application of chemical fertilizers to increase the crop productivity is not a suitable option for long run because the chemical fertilizers on one hand increase the crop production but on the other hand disturb the soil mineral balance and decrease soil fertility. Therefore, we need to develop a technology of agriculture that become progressively relevant to the survival of human and environment.

In the recent years, nano-fertilizers have begun to be produced for getting the highest amount and quality of production from the unit area. The earlier research work shows that the nano-fertilizers helps to an increase in nutrient use efficiency, minimize the adverse effects of excessive use of chemical fertilizers and also reduce the frequency of fertilizer application (Tarafdar et al., 2015). These nano-fertilizers contain nutrient elements or compounds in encapsulated nanomaterials and coated with a thin protective film which release nutrients very slowly as compared to conventional fertilizers. The use of nano-fertilizers in agriculture is offering great opportunities to improve plant nutrition and stress tolerance to achieve higher yields in a frame of climate change, not all nanomaterials will be equally safe for all applications. In particular, the extensive release of nanomaterials into the environment and the food chain may pose a risk to human health. The risks of nano-fertilizers should be carefully examined before use, and further biotechnological advances are required for a correct and safe application of nanomaterials in agriculture.

What is Nano-Fertilizer?

A nano-fertilizer refers to a product in nano-meter regime that delivers nutrients to crops. For example, encapsulation inside nanomaterials coated with a thin protective polymer film or in the form of particles or emulsions of nano-scale dimensions (DeRosa et al. 2010). On other words, nano-fertilizers are synthesized or modified form of traditional fertilizers, fertilizers bulk materials or extracted from different vegetative or reproductive parts of the plant by different chemical, physical, mechanical or biological methods with the help of nanotechnology used to improve soil fertility, productivity and quality of agricultural produces.

Advantage of Nano-fertilizers

The use of nano-fertilizers in agriculture have various benefits including:
1. Improving nutrient use efficiency.
2. Improving soil quality by reduction of repeated use or over dosage of fertilizers.
3. Increasing the crop productivity.
4. Improving food security and its quality.
5. Reduction of cost of cultivation.

Conventional Fertilizers v/s Nano-Fertilizers

Conventional fertilizers are commonly applied to the crops by either foliar spray or soil application. However, one of the major factors that decide the mode of application is the final concentration of the fertilizers reaching to the plant. In a realistic set-up, very less quantity reach to the targeted site due to leaching of chemicals, drift, runoff, evaporation, hydrolysis by soil moisture and photolytic and microbial degradation. It has been estimated that around 40 to 70 per cent of nitrogen, 80 to 90 per cent of phosphorus, and 50 to 90 per cent of potassium content of applied fertilizers are lost in the environment and could not reach to the plant which causes sustainable and economic losses (Trenkel, 2010). Towards the enhancement of nutrient use efficiency and overcome the chronic problem of eutrophication, nano-fertilizers might be a best alternative. Nano-fertilizers synthesized in specific intension to regulate the release of nutrients depending on the requirements of the crops while minimizing differential losses, have immense potentiality and they are more efficient than conventional fertilizers.

Comparison of Nano-Technology Based Formulations and Conventional Fertilizers Applications (Cui et al. 2010)

Sr. No.	Nano-Fertilizers-Enabled Technologies	Conventional Technology
1.	Nano-sized formulation of mineral micronutrients may improve solubility and dispersion of insoluble nutrients in soil, reduce soil adsorption and fixation, and increase the bioavailability	Less bioavailability to plants due to large particle size and less solubility
2.	Nano-structured formulation might increase fertilizer efficiency and uptake ratio of the soil nutrients in crop production and save fertilizer resource	Bulk composite is not available for roots and decrease efficiency
3.	Both release rate and release pattern of nutrients for water soluble fertilizers might be precisely controlled through encapsulation in envelope forms of semipermeable membranes coated by resin-polymer, waxes and sulphur	Excess release of fertilizers may produce toxicity and destroy ecological balance of soil
4.	Nanostructured formulation can extend effective duration of nutrient supply of fertilizers into soil	Used by the plants at the time of delivery, the rest is converted into insoluble salts in the soil
5.	Nanostructured formulation can reduce loss rate of fertilizer nutrients into soil by leaching and/or leaking	High loss rate due to leaching, drifting, run-off, evaporation, hydrolysis, microbial degradation, *etc*.

Controlled Release of Nano-Fertilizers and Mode of Application

It has helped to reveal to recent findings that, plant roots and microorganisms can directly take nutrients from solid phase of minerals. Controlled release of nano-fertilizers and nanocomposites are excellent alternatives to soluble fertilizers. Nutrients are released at a slower rate throughout the crop growth; plants are able to take up most of the nutrients without any waste. There are a number of ways, by which the control release is achieved in nano-fertilizers. According to Shaviv (2005) the slow- and controlled-release of fertilizers classified as follows:

1. Organic-N low-solubility compounds: These are biologically decomposing compounds usually based on urea-aldehyde condensation products, viz. urea-formaldehyde and isobutylidene-diurea.

2. Fertilizers in which a physical barrier controls the release: The fertilizer can be as tablets or granules coated by hydrophobic polymers or as matrices in which the soluble active material is dispersed in a continuum that restricts the dissolution of the fertilizer.

3. Inorganic low-solubility compounds: Fertilizers such as metal ammonium phosphates and partially acidulated phosphate rock are typical of this type of slow release fertilizers.

Generally, the main difference between these two types of fertilizer is that for slow release fertilizers the nutrient release pattern is fully dependent on soil and climatic conditions and it cannot be predicted as a very roughly. With controlled-release fertilizers, the release pattern, quantity and time can be predicted within certain limits. The method of application and their controlled release discussed as under.

Soil Application

Soil application is the most common method of nutrient addition by chemical and organic fertilizers. The factors that need attention while choosing this method of fertilizer applications are how long the fertilizer will last in the soil. It is well known that negative soil particles affect the adsorption of mineral nutrients.

Among anions and cations nutrient elements, like nitrate form of nitrogen remains mobile in the soil solution and is susceptible to leaching by water moving through the soil and phosphate form of phosphorus bind to soil particles containing aluminium or iron because the positively charged ions.

As a result, phosphate can be tightly bound, and its mobility and availability in soil can limit plant growth. Under such conditions, the nano-fertilizers are mixed with different materials such as hydrogels, special films or other biopolymers such as chitosan to reduce the uncontrolled release in the soil environment (Kashyap, 2015).

These materials aggregate the fertilizers in complexes with mineral nanoparticles obtained from the clay in soil or other types of ceramic materials, that are used for manufacturing controlled- release blocks, pots, or film. These respond to different environmental stimuli such as temperature or irradiance and modify the release of the nano-fertilizers according to the plants' need.

Foliar Application

In this method, the diluted solution of fertilizers directly applied onto plant leaves through spraying. It is useful method for application of nutrients specially micronutrients to the plants because they adsorbed on soil particles and hence is less available to root system. The foliar application is also reducing the time lag between application and uptake by plant during the rapid growth phase; moreover, it can be avoiding the problem of limited uptake of the nutrients from the soil. The uptake of micronutrients especially iron, zinc, copper and manganese may be more efficient with this method as compared to soil application, for this purpose, the emulsions or encapsulated organic nanoparticles or nano-fertilizers can be more useful.

Challenges of Nano Fertilization

Despite offering numerous benefits pertaining to sustainable crop production, nanofertilizers may have some challenges and drawbacks associated with their use for sustainable crop production (Melanie Kah, 2015 and Elemike et al., 2019); like:

1. The excess use of nano-fertilizers may pose some risks and problem towards the health and also towards environment.

2. The production and availability of nano-fertilizers is inadequate so that face the problem of adoption of nano-fertilizers as a source of plant nutrients.

3. Lack of standard protocols for quantitative and qualitative risk assessment of agri-nanoproducts and there are no separate regulatory guidelines for safe application of agri-nanoproducts with respect to human and environment health.

4. The lack of recognized formulation and standardization of nano-fertilizers which may lead to contrasting effects of the same nanomaterials under various regions.

5. There are many products being claimed to be nano but in fact are submicron and micron in size. This dilemma is feared to remain persistent until and unless uniform size of nanoparticles gets implemented.

Conclusion

Nano-fertilizers are encapsulated by the nano structured material and have slow/controlled release mechanisms that could release their active ingredients in response to environmental triggers and biological demands more precisely. Previous research work showed that the use of nano-fertilizers causes an increase in nutrients use efficiency, reduces soil toxicity, minimizes the potential negative effects associated with over dosage and reduces the frequency of the conventional fertilizer application. Hence, the nano-fertilizers have a high potential for achieving balanced fertilization and sustainable agriculture but they also have adverse effect on crop plant if concentration is more than the optimum which result reduces growth and yield of the crop and may pose some risks and problem towards the health and also towards environment.

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Principles and Methodology of AESA (Agro-Ecosystem Analysis) Based Integrated Pest Management for Citrus

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Citrus (*Citrus* spp.) belongs to family Rutaceae is one of the most important fruit crops which is known for their characteristic fragrance due to flavonoids and limonoides. The genus Citrus is commercially important as many of the species of Citrus are cultivated (Lemons, Limes, Oranges, Mandarin, Grapefruit) for the fruit which can be eaten fresh , pressed for juice purpose or it can be preserved in Marmalades and juices. It is an excellent source of Vitamin C with high antioxidant potential. In India it is grown in an area of 973 ha with production of 12253 mt (NHB 2018). India ranks second next to Mexico in production of limes and lemons (NHB,2018) and it ranks third in production of oranges (NHB,2018). Citrus is prone to the attack of several insects, pest, nematodes and diseases and to overcome the problem which is affecting the yield and fruit quality farmers are using chemicals inordinately and in order to minimize the use of chemicals a revised approach of Integrated Pest Management is evolved which is known as Agro – Ecosystem Analysis.

Introduction

The Agro-Ecosystem Analysis based Integrated Pest Managemeny for Citrus was compiled by the National Institute of Plant Health Management working group under the Chairmanship of Dr. Satyagopal Korlapati , IAS, DG, National Institute of Plant Health Management , and under the guidance of Shri. Utpal Kumar Singh. There is a global rising concern about the adverse effect of chemical on the environment, agro-ecosystem and health of human beings. The deleterious effects can be minimized by promotion sustainable bio-intensive approaches such as Agro-ecosystem Analysis based on Integrated Pest Management. The basic component of Agro-Ecosystem Analysis is based on the past experience and observation of the farmers, the plant health at different stages, soil conditions and the climatic factors.

Principles of AESA Based IPM for Citrus

1. Growing a healthy crop: The variety of citrus that we select should be resistant/tolerant to major pest and the rootstock should be healthy. In order to maintain the soil health mulching along with green manuring practices should be followed and there should be proper spacing at the time of planting. Farmers should apply an adequate amount of dosage of nutrients based on soil test results. If the dosage of nitrogenous fertilizers is high the crop becomes succulent which in turn makes the crop susceptible to disease and insect. There should be proper irrigation in the citrus orchard and farmers should follow the recommended crop rotation.

2. Observing the citrus orchard regularly: Farmers should monitor the situation of the field at least once a week and should make decisions about the field conditions and P: D ratio. Direct action should be taken when needed. If the plants are infested remove them and egg masses are collected from the field in order to prevent infestation.

3. Conserving natural defenders / enemies: Farmers should avoid excessive use of chemical pesticide because natural enemies which are beneficial gets killed by harmful chemicals.

4. Maintaining insect zoo: In an orchard of citrus there are certain insects which are beneficial and some are harmful. Farmers are not having proper knowledge regarding this. In order to increase the knowledge and skills of farmers insect zoo concept is helpful. In this method unknown insect- pest are collected in plastic containers with brush and brought to a place to study them and then they are observed whether the feed on plant or they feed on other insects.

5. Decision making: Based on the observation and analysis farmers have to learn to make decisions keeping in mind their past experience so they can manage their crops. Farmers should be capable to adopt innovative approaches and develop skills and then they should share their knowledge to other farmers.

6. Use of biochemicals and biopesticides: Instead of relying on chemical fertilizers farmers should use biochemical and bio-pesticides so that the ecological balance could be maintained.

Methodology of AESA in Citrus Orchards

Make a group and visit the citrus orchard about 5 farmers in a group can be included .Randomly choose 10 plants/acres across the orchard. Observe keenly each of these plants and record your observations. While walking in the orchard, manually collect insects in plastic bags. Use a sweep net to collect additional insects. Collect plant parts with disease symptoms. Sit in a shad place as a group for drawing and discussions. If insects are there, kill the insects with some chloroform (if available) on a piece of cotton. Each group will identify the pests, defenders and diseases collected and then each group will analyse the field situation in detail. Each drawing will show a plant which shows the field situation. The weather condition, water level, disease symptoms, etc. will be shown in the drawing. Pest insects will be drawn on one side, natural enemies on the other side. Write the number next to each insect. The group should indicate the plant part where the pests and defenders were found. Interaction between pests and defenders should be showed. Each group will discuss the situation and recommend a crop management strategy. The small groups then join each other and a member of each group will now present their analysis in front of all participants. The facilitator will facilitate the discussion by asking guiding questions and makes sure that all participants (also shy or illiterate persons) are actively involved in this process. Formulate a common conclusion. The whole group should support the decision on what orchard management is required in the AESA plot. Make sure that the required activities (based on the decision) will be carried out. Keep the drawing for further comparison purpose.

Data Recording

Farmers should record the data in notebook and analysis should be done to make conclusion. Data that should be recorded is following-

1. Crop situation:

a. Health of plant.
b. Pests, diseases, weeds infesting the crop.
c. Natural enemies present in the orchard.
d. Soil condition of the orchard.
e. Irrigation.
f. Weather conditions of that area.

2. Input cost: Seeds , Fertilizer , Pesticides and Labour cost should be recorded.

3. Harvest: Yield (kg/acre) and Price of produce (Rs./kg) should be calculated.

Evaluation of Agro-Ecosystem Analysis Based on Integrated Pest Management in Different Crops

Tomato crop was maintained in Ecological Engineering field at NIPHM, for the purpose of demonstration and training of organic agriculture. Agro Ecosystem Analysis on biological factors with respect to pests and beneficial insects, to understand the intricate interactions in the ecosystem, revealed that the ecosystem has created favourable conditions for natural enemies and pollinators. Natural enemies were controlling tomato pests in the absence of external forces like chemical pesticides. (SREE LATHA E.,et al 2018).

The findings revealed that minimum brinjal shoot and fruit borer 8.9 per cent with highest abundance of parasitoids (5.82 nos.) in terms of different species occurred with least population of aphid and whitefly 2.16 and 1.19 numbers per three leaves whereas in farmers practices 25 percent incidence of brinjal shoot and fruit borer with minimum parasitoid recorded 1.15 nos and maximum population of aphid and whitefly (16.5, 14.58) respectively. The AESA based IPM practices that consisted of cultural and mechanical components itself proved to be an ideal management strategy against brinjal shoot and fruit borer along with a benefit: cost ratio of 3.03 whereas 2.19 in farmers practices. (Divya S, J Kathiravan and VE Nethaji Mariappan, 2019).

Conclusion

Intensive agricultural practices in citrus relying heavily on chemical pesticides are major cause of widespread ecological imbalances resulting in a serious problem of insecticide resistance, pest resurgence and pesticide residue. Agro-Ecosystem Analysis based Integrated Pest Management approach account ecological principles and relies on maintaining balance in an ecosystem. It has also resulted in reduction in cost of production and increasing the yield of citrus. Quality of fruit is also maintained. Agro-Ecosystem Analysis approach is farmer centric and increases profit of farmers in a sustainable manner.

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In Vivo Identification of Haploid Kernels Using an R1-Nj Marker System

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Rajesh Panchal, Pooja Patel

Introduction

1. The second key to success for large scale application of the DH (Double Haploid) technology in any breeding programs is the ability to identify the seeds with haploid embryo from normal diploid hybrid seed obtained when pollinating plants of the source germplasm.

2. Haploid plant can be distinguished from diploid plant by a characteristic like erect leaves, poor vigour, and sterility R1-nj anthocyanin marker inhibition is highly frequent in tropical maize germplasm considerably affecting efficiency of haploid identification.

3. The R1-Navajo (R1-nj) color marker facilitates easy and quick identification of haploid kernels at the seed stage during in vivo haploid induction process in maize.

4. However, the Navajo phenotype can be completely suppressed or poorly expressed in some germplasm, making it impossible or inefficient to identify haploids at the seed stage.

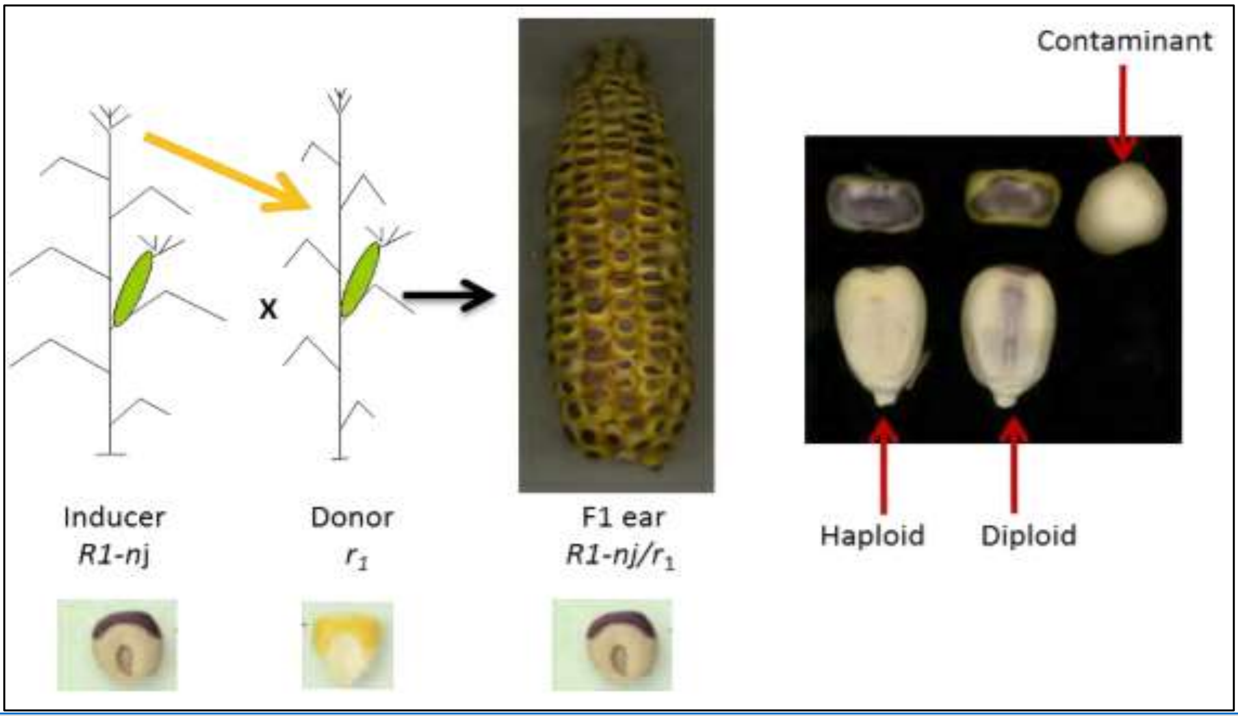
5. The doubled haploid (DH) technology, based on in vivo haploid induction is now central to modern maize genetics and breeding.

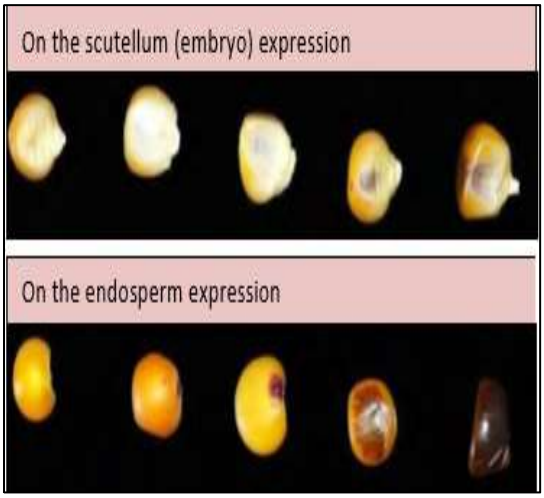
6. Phenotypic marker system based on anthocyanin coloration was identified in the 1960s (Nanda and Chase, 1966).

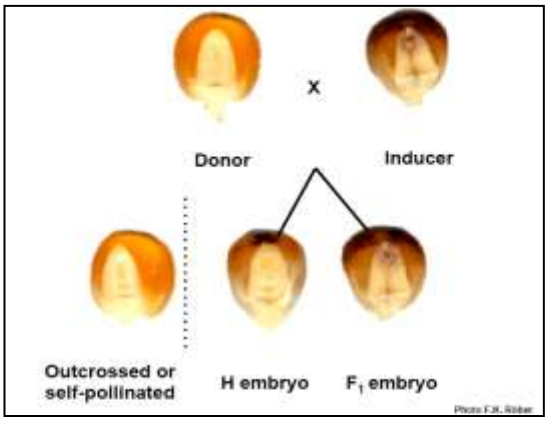
7. R1-nj, a dominant allele of the R1 locus, is now widely used for the screening of haploid in kernels.

8. R1-nj is combination with other dominant gene in the anthocyanin synthesis pathway (A1, A2, Bz1, Bz2, C1 and C2) causes deep pigmentation of the aleurone in the crown region of kernel (Coe, 1994). In addition, it conditions purple pigmentation in the scutellum. This phenotype is called the Navajo kernel phenotype.

Criteria for In Vivo Identification of Haploid and Non-Haploid Seeds







1. Hybrids: The R1-nj gene causes the aleurone layer of the endosperm and the scutellum of the embryo to express a purple pigmentation in these seeds. Endosperm is of the normal triploid type and a normal diploid embryo is present.

2. Haploids: Pigmentation is expressed in the aleurone layer but is absent from the scutellum. These seeds contain normal triploid endosperm and a haploid maternal embryo.

3. Aborted: Seeds express pigmentation in the scutellum of the embryo and the endosperm is non-pigmented. This occurs when the egg cell is fertilized but not the central cell, resulting in a normal diploid embryo and non-normal diploid endosperm. Abortion occurs early in seed development.

4. Outcrossed / Accidental Self: Seeds lack pigmentation in the aleurone layer and the scutellum but develop normally. This type is easily identified and can be discarded.

Classification of Genotypes

Parameter		Score				
		1	**2**	**3**	**4**	**5**
Colour inhibition	Proportion of kernel expressing R1-nj marker	100 %	75 %	50 %	25 %	0 %
Area marked	Extent to which the endosperm expresses *Navajo* phenotype	Entire endosperm	Upper portion of endosperm	Only crown region	Only central portion of crown region	Complete absence of expression
Intensity of pigmentation	Intensity of anthocyanin colour expression on the endosperm	Deep purple/red	Purple/red	Light red/Orange	Light orange	Visually undetectable

Limitation of R1-nj System

1. When a source population contain dominant anthocyanin inhibitor genes such as C_1-I, which are R_1-nj color marker expression is completely suppressed and haploid kernel identification is almost impossible.

2. When F_1 or F_2 populations are used as source materials if only one parent has an inhibitor gene, kernels will be segregating for *Navajo* phenotype. In such cases, one may not be able to identify all haploid kernels efficiently and could loss half to three-fourths of the haploids.

3. The speed and accuracy of haploid identification depend on trained staff with good understanding of haploid detection through the colour expression on endosperm and embryo

4. Automation of haploid identification is difficult.

5. Moisture of kernels at the time of harvest could potentially affect the intensity of colour expression.

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Comparative Evaluation of Different Systems of Fertilizer Application in Soil

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Abstract
This article as a mini review, gives brief information on comparative evaluation of different systems of fertilizer application and their suitability for different soils regarding various growth and yield attributes. Nutrient management is one of the major components influencing the nutrient status in soil system. Soil as a natural source of nutrients, must be protected from all kinds of external factors, especially from the addition of fertilizers in imbalanced ratios. Efficient fertilization is considered as a key factor to sustain the productivity of cropping systems, to prevent nutrient mining and environmental degradation, thereby improves the soil health.

Introduction
Indian economy is based on agriculture and allied sectors where more than 60 % of the total population is dependent on agriculture. The adoption of balanced fertilizers has become a necessity to meet the growing demand of food, feed and fibre from the diminishing arable lands. It has been proved that application of higher doses of fertilizers by farmers in the field without examining the nutrient requirement and soil fertility, causes deterioration in soil quality and crop regarding both nutrient toxicity and deficiency either by over use or inadequate use of fertilizers. Declining soil fertility has raised serious issues about the existing nutrient management practices.

Soil testing helps us to know the nutrient status of soil and apply required amount of nutrients to overcome deficiencies and sustain productivity. But in conventional soil testing, the fertilizer application is usually given for different crops by taking into consideration only the available nutrient status of soil prior to raising crop, by categorizing soil into low, medium and high fertility classes. However, it is necessary to have information on the optimum doses of fertilizers and organic manures based on soil testing, nutrient uptake and efficiency of added nutrients by the crop to develop a prescription for judicious application of fertilizer under integrated nutrient management system. By improving nutrient use efficiency and managing nutrient losses from fertilizers in order to get maximum benefit, they must be applied in the right quantity, sources and combination at the right time using the right methods. (Singh 2016).

Crop response to added nutrients often evaluated in field experiments nevertheless, results are site-specific and not applicable to other locations with different soils or climate. Recognizing the absence of correlation between soil testing and crop responses to fertilizer in multi-location fertilizer rate trials in the past, and the frequent need for site-specific refinements of fertilizer prescriptions, a novel and unique field experimentation methodology was designed for soil test crop response (STCR) correlation studies (Ramamoorthy 1968).

Effect of Different Approaches of Fertilizer Application on Growth & Yield Attributes and Nutrient Uptake
Borkotoki et al. (2016) revealed that combined application of integrated nutrient management (INM) and site-specific nitrogen management using leaf colour chart (LCC) recorded a greater number of effective tillers per plant (15.2) in comparison to integrated nutrient management (INM) alone treatment (13.2) while in control it was 8.6. Similarly, the growth attributes (plant height, panicle length, grains/panicle) were significantly higher in the treatment with combined application of integrated nutrient management (INM) and site-specific nitrogen

management using leaf colour chart (LCC) which might be due the addition of nitrogen, organic manure and other nutrients during critical crop growth stages.

Qureshi et al. (2016) concluded that the pooled data of two years showed comparatively higher grain yield and straw yield under site specific nutrient management (SSNM) treatment followed by STCR and FP (Farmers' practice). Like grain yield, there was significant increase in straw yield of rice crop in all the treatments over control. Lowest grains and straw yield in control plots was due to the continuous removal of fertilizers without addition of any external input.

The STCR treatments showed a remarkable influence on the fruit yield of brinjal as compared to other treatments. The highest achievement of the yield targets was recorded in STCR IPNS - 35 t ha-1 (105.0 %) followed by STCR-IPNS - 30 t ha-1 (102.9 %) and STCR-NPK alone - 35 t ha-1 (102.4 %). This might be due to the better use efficiency of applied NPK fertilisers at low yield target levels (Chand et al. 2006). Increased vegetative growth and balanced C: N ratio due to organic manure might have increased the synthesis of carbohydrates which ultimately promoted the yield of vegetable fruits.

Organic matter plays a significant role in determining the sustainable crop yields which in turn depends upon the soils ability to supply essential nutrients. The yield advantage due to FYM application in INM may be due to addition of secondary and micronutrients in balanced proportion (Banik et al. 2006) along with major nutrients.

Bangar et al. (2001) reported that fertilizer applications as per the yield target equations were superior in terms of nutrient uptake and biomass production which might be due to the judicious application of fertilizer.

Conclusion

From this short review, it can be inferred that the growing concerns about declining productivity, impaired soil health and decreasing nutrient-use efficiency (NUE) are compelling for proper nutrient management in the soil so that the threat to food security, agricultural sustainability, soil and environmental health in the developing world can be tackled. Adoption of site-specific nutrient management, STCR and INM system were found to the best alternative as compared to other systems of fertilizer application involving macro and micro nutrients, organic manures, bio-fertilizers and amendments can improve the production and profitability of farmers.

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Agro-Terrorism

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Agroterrorism, also known as Agriterrorism, is a malicious attempt to disrupt or destroy the agricultural industry and/ or food supply system of a population through "the malicious use of plant or animal pathogens to cause devastating disease in the agricultural sectors". It is closely related to the concepts of biological warfare and entomological warfare, except carried out by non-state parties.

Definitions

A hostile attack, towards an agricultural environment, including infrastructures and processes, in order to significantly damage national and international political interests. It is the use of biological agents as weapons against agricultural and food-supply industries. Terrorist acts intended to disrupt or damage a country's agriculture, especially the use of a biological agent against crops or livestock.

The Origins of Agroterrorism

Of all the acts of 'terrorism', agroterrorism is one of the least studied and till recently little considered by contingency planners. Many nation states including the US, Russia, UK and France had all invested in a variety of biological agents in the 20th century. Deploying these bioweapons against agriculture had though been for most nation-states a theoretical consideration. In the early 1990s the threat from biological attack came to be accepted by many policy makers, (particularly in the US) as the probable form of terrorist attack on the human population. Although there was little physical evidence to support this, beyond some past localised use by radicals. This concern at the threat of biological attack agents grew in the 1990s and included the concern that anti-livestock, anticrop and antisoil agents could fall into the hands of non-state aggressors. Initial concern with agroterrorism began in the US where focus lay firmly with biological agents including crop diseases, pests and animal diseases. The use of the latter raises further issues, as some may be transmittable to humans (Zoonotic). Whilst there are hundreds of potential pathogens, realistically only a few dozen is considered viable. When considering viability of an agent, livestock are considered to be more widely susceptible than crops to pathogens, principally because, livestock in industrialised countries – the UK, US, Australia, etc are generally considered disease free. They therefore make effective vectors of transmission, particularly, during live animal movements.

Agriculture as a Target- Overview of the Threat

About 21 incidents worldwide since 1952 had been considered as acts of terrorism against agriculture. The potential of terrorist attacks against agricultural targets (agroterrorism) is increasingly recognized as a national security threat, especially after the events of September 11, 2001. In this context, agroterrorism is defined as the deliberate introduction of an animal or plant disease with the goal of generating fear, causing economic losses, and/or undermining stability. Agroterrorism is a subset of the more general issues of terrorism and bioterrorism. People more generally associate bioterrorism with outbreaks of human illness (such as from anthrax or sallpox), rather than diseases first affecting animals or plants. Agriculture has several characteristics that pose unique problems for managing the threat:

1. Agricultural production is geographically disbursed in unsecured environments (e.g., open fields and pastures throughout the countryside). While some livestock are housed in secure facilities, agriculture in general requires large expanses of land that are difficult to secure from intruders.

2. Livestock are frequently concentrated in confined locations (e.g., feedlots with thousands of cattle in open-air pens, farms with tens of thousands of pigs, or barns with hundreds of thousands of poultry). Concentration in slaughter, processing, and distribution also makes large scale contamination more likely. Live animals, grain, and processed food products are routinely transported and commingled in the production and processing system. These factors circumvent natural barriers that could slow pathogenic dissemination.

3. The presence (or rumor) of certain pests or diseases in a country can quickly stop all exports of a commodity, and can take months or years to resume.

4. The number of lethal and contagious biological agents is greater for plants and animals than for humans. Most of these diseases are environmentally resilient, endemic in foreign countries, and not harmful to humans – making it easier for terrorists to acquire, handle, and deploy the pathogens.

Thus, the general susceptibility of the agriculture and food industry to bioterrorism is difficult to address in a systematic way due to the highly dispersed, yet concentrated nature of the industry and the inherent biology of growing plants and raising animals. The results of an agroterrorist attack may include major economic crises in the agricultural and food industries, loss of confidence in government, and possibly human casualties. Humans could be at risk in terms of food safety or public health, especially if the chosen disease is transmissible to humans (zoonotic). But an agroterrorist attack need not cause human casualties for it to be effective or to cause large scale economic consequences. The production agriculture sector would suffer economically in terms of plant and animal health, and the supply of food and fiber may be reduced, especially in certain regions. The demand for certain types of food may decline based on which products are targeted in the attack (e.g., dairy, beef, pork, poultry, grains, fruit, or vegetables), while demand for other types of food may rise due to food substitutions.

An agroterrorism event would cause economic losses to individuals, businesses, and governments through costs to contain and eradicate the disease, and to dispose of contaminated products. Economic losses would accumulate throughout the farmto- table continuum as the supply chain is disrupted, especially if domestic markets for food become unstable or if trade sanctions are imposed by other countries on U.S. exports. The economic impact can spread to farmers, input suppliers, food processors, transportation, retailers, and food service providers. Public opinion may be particularly sensitive to a deliberate outbreak of disease affecting the food supply. Public confidence in government could be eroded if authorities appear unable to prevent such an attack or to protect the population's food supply. Because an agroterrorist attack may not necessarily cause human casualties, be immediately detected, or have the "shock factor" of an attack against the more visible public infrastructure or human populations, agriculture may not be a terrorist's first choice of targets. Nonetheless, some types of agroterrorism could be relatively easily achieved and have significant economic impacts. Thus, the possibilities are treated seriously, especially in the post-September 11 world. In addition to concerns that biological weapons could be developed or used by states, recent technological advances increase the likelihood that these weapons could be acquired or produced by non-state actors, including individuals and terrorist organizations. There were also several false accusations of biological weapons use, highlighting the difficulty in differentiating between naturally-occurring disease, accidents, and deliberate use.

Pest-Transmitted Plant Pathogens

Fungi are responsible for 75% of crop diseases, and thus they have the greatest potential for use as an act of aggression against crop plants. Also, the introduction if plant-feeding pest insects or mites had been considered in pat as an act of aggression but is unlikely to be successful in creating significant crop damage in most instances given the complexities of delivery, uncertainty of success and the probable availability of control measures. The arthropod pests require sophisticated mass culture and delivery system if they are to be used as a destructive force. Some vectors are also used to deliver a pathogen with a high infectivity potential from a relatively small number of inoculums. Viruses are the most appropriate pathogens for intentional vector transmission. Major arthropod vectors are: thrips, aphids, whitefly or leafhopper. Other groups include Lepidoptera, Diptera and nematodes capable of transmitting potentially destructive pathogens. The biological attacks to agriculture are simpler to carry out than attacks on humans and may be done with rudimentary knowledge and training without exposing the perpetrators to danger by organisms that are usually no threat to humans.

Strategies for Combating Risks and Costs Associated

In practice, should a suspicious disease event occur, it would be difficult to determine if it was caused by nature, an accident, sabotage, or an act of biological warfare or terrorism. Consequently, the response to a biological event, whether natural, accidental or deliberate, would involve the coordination of actors from many sectors who together possess the capability to determine the cause and attribute it to a specific source. Likewise, the preparedness for and prevention of such an event should also involve multi-sectorial coordination. Because of the wide spectrum of potential biological hazards, efforts to manage the risks should be multi-disciplinary, multi-sectorial, and above all, coordinated. As such, the Biological Weapon Commission relies primarily on a network approach based on coordination with international, regional, and non-governmental organizations and initiatives as well as other non-proliferation regimes in order to address the interconnected nature of biological threats in a holistic manner. Under the framework of the BWC, improved coordination would provide positive externalities for managing disease, whatever the cause. Such an approach ensures that resources are used optimally to provide benefits for many. In this sense, for example, building capacities across sectors to monitor disease would not only strengthen the ability to detect and respond to a biological attack, but it would provide states with the capacity to track and mitigate naturally occurring disease thus vastly improving public health worldwide.

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Principles of Pest Control

Article ID: 31477

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Introduction

A pest is anything that competes with humans, domestic animals, or desirable plants for food or water, injures humans, animals, desirable plants, structures, or possessions, spreads disease to humans, domestic animals, wildlife, or desirable plants, annoys humans or domestic animals.

Types of Pests

1. Insects, such as roaches, termites, mosquitoes, aphids, beetles, fleas, and caterpillars,
2. Insect-like organisms, such as mites, ticks, and spiders,
3. Microbial organisms, such as bacteria, fungi, nematodes, viruses, and mycoplasmas,
4. Weeds, which are any plants growing where they are not wanted,
5. Mollusks, such as snails, slugs, and shipworms, and
6. Vertebrates, such as rats, mice, other rodents, birds, fish, and snakes.

Categories of Pests

1. Continuous pests that are nearly always present and require regular control.
2. Sporadic, migratory, or cyclical pests that require control occasionally or intermittently.
3. Potential pests that do not require control under normal conditions, but may require control in certain circumstances.

Principles of Pest Control

1. Pest Identification: Accurate identification is the first step in an effective pest management program. Never attempt a pest control program until you are sure of what the pest is. The more you know about the pest and the factors that influence its development and spread, the easier, more cost-effective, and more successful your pest control will be. Correct identification of a pest allows you to determine basic information about it, including its life cycle and the time that it is most susceptible to being controlled. As a certified applicator, you must be familiar with the pests you are likely to encounter in the type of work in your certification category. To identify and control pests, we need to know the physical features of the pests likely to be encountered, characteristics of the damage they cause, their development and biology, whether they are continuous, sporadic, or potential pests.

2. Defining the management unit- the Agro ecosystem: The management unit is the agroecosystem and any management action may produce unexpected and undesirable effects-this notion forms the basis of the systems or holistic approach to IPM.

3. Pest Control: Considering whether pest control is necessary, remember control a pest only when it is causing or is expected to cause more harm than is reasonable to accept. Use a control strategy that will reduce the pest numbers to an acceptable level and cause as little harm as possible to everything except the pest. Even though a pest is present, it may not do much harm. It could cost more to control the pest than would be lost because of the pest's damage.

4. Pest Control Goals: Whenever we try to control a pest, we will want to achieve one of these three goals, or some combination of them: Prevention - keeping a pest from becoming a problem. Prevention may be a goal when the pest's presence or abundance can be predicted in advance. Continuous pests, by definition, are usually very predictable. Sporadic and potential pests may be predictable if we know the circumstances or conditions that favour their presence as pests. For example, some pests occur only under certain environmental conditions. If such conditions are present, we can take steps to prevent the plant disease organisms from harming the desirable plants. Suppression- reducing pest numbers or damage to an acceptable level, Suppression is a common goal in many pest situations. The intent is to reduce the number of pests to a level where the harm they cause is acceptable. Once a pest's presence is detected and control is deemed necessary, suppression and prevention often are joint goals. The right combination of control measures can often suppress the pests already present and prevent them from building up again to a level where they are causing unacceptable harm and Eradication- destroying an entire pest population. Eradication is a rare goal in outdoor pest situations because it is difficult to achieve. Usually the goal is prevention and/or suppression. Eradication is occasionally attempted when a foreign pest has been accidentally introduced, but is not yet established in an area. Such eradication strategies often are supported by the government. The Mediterranean fruit fly, gypsy moth, and fire ant control programs are examples. Eradication is a more common goal indoors. Enclosed environments usually are smaller, less complex, and more easily controlled than outdoor areas.

5. Establishment of Economic Threshold Levels: Thresholds are the levels of pest populations at which we should take pest control action if we want to prevent the pests in an area from causing unacceptable injury or harm. Thresholds may be based on aesthetic, health, or economic considerations. These levels, which are known as "action thresholds," have been determined for many pests. A threshold often is set at the level where the economic losses caused by pest damage, if the pest population continued to grow, would be greater than the cost of controlling the pests. These types of action thresholds are called "economic thresholds." For example, when the number of insects on a particular crop exceeds a given quantity, an insecticide application to prevent economic damage could be justified. In some pest control situations, the threshold level is zero: even a single pest in such a situation is unreasonably harmful. For example, the presence of any rodents in food processing facilities forces action. In homes, people generally take action to control some pests, such as rodents or roaches, even if only one or a few have been seen.

6. Pest Monitoring: In most pest control situations, the area to be protected should be checked often. Regular monitoring can answer several important questions: What kinds of pests are present? Are the numbers great enough to warrant control? When is the right time to begin control? Have the control efforts successfully reduced the number of pests? Monitoring of insect, insect-like, molluscs and vertebrate pests usually is done by trapping or by scouting. Monitoring of weed pests usually is done by visual inspection. Monitoring for microbial pests is done by looking for the injury or damage they cause. Monitoring also can include checking environmental conditions in the area. Temperature and moisture levels, especially humidity, are often important clues in predicting when a pest outbreak will occur or will hit threshold levels. Monitoring is not necessary in situations where a pest is continually present and the threshold is zero. Routine pest control measures are taken to eradicate any pests and to prevent pests from entering the area.

7. Avoiding Harmful Effects: Pest control involves more than simply identifying a pest and using a control tactic. The treatment site, whether it is outdoors or indoors usually contains other living organisms (such as people, animals, and plants) and nonliving surroundings (such as air, water, structures and surfaces). All of these could be affected by pest control measures. Unless the possible effects on the entire system within which the pest exists, pest control effort could cause harm or lead to continued or new pest problems. Rely on good judgment and, when pesticides are part of the strategy, on the pesticide labelling. Most treatment sites are disrupted to some degree by pest control strategies. The actions of every type of organism or component sharing the site usually affect the actions and well-being of many others. When the balance is disrupted, certain organisms may be destroyed or reduced in number, and others sometimes the pests may dominate.

8. Integrated Pest Management: Integrated pest management is the combination of appropriate pest control tactics into a single plan to reduce pests and their damage to an acceptable level. Using many different tactics to control a pest problem tends to cause the least disruption to the living organisms and non-living surroundings at the treatment site. Relying only on pesticides can cause pests to develop resistance to pesticides causes outbreaks of other pests, and can harm surfaces or non-target organisms. With some pests, using pesticides alone will not achieve adequate control. To solve pest problems, we must: Identify the pest or pests and determine whether control is warranted for each, determine pest control goals, know what control tactics are available, Evaluate the benefits and risks of each tactic or combination of tactics, choose a strategy that will be most effective and will cause the least harm to people and the environment, use each tactic in the strategy correctly, observe local, state, and federal regulations that apply to the situation. The strategy selected will depend on the pest which have identified and the kind and amount of control required.

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Insect Farming for Biodiesel Production

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The economy of the world is escalating due to increased global population and improvement in the socio-economic standard of man has generated an enormous burden on conventional energy resources and the environment. The worldwide usage of oil and other liquid fuels was predicted to grow from 90 million barrels per day (b/d) to 100 million b/d in the 8years from 2012 to 2020, and to 121millionb/d by 2040. It has also been estimated by experts that the global energy consumption will increase to 48% by 2040. Concerns such as depletion of fossil reserves, higher oil prices, energy security, CO2 emission and global warming have led to a global policy shift toward the use of biomass as renewable and low-cost raw materials for liquid energy generation. Thus, our modern world needs and should prepare for the development of a sustainable, economical, and energy-efficient process.

Biodiesel is an important renewable energy resource for the whole world. In general, oil-bearing plants like rapeseed, soybean, palm, sunflower, jatropha etc, find use as raw materials for the production of biodiesel but the cost of production of biofuels is high from plants and lignocellulose and thus, the cost of feedstock is a major economic factor in the development of biodiesel. Furthermore, this way has many problems because it requires oil seeds plants which occupy limited arable lands. Researches have been done to find alternate ways to reduce the costs of biodiesel by using the cheaper feedstock. In this context, insect fat is emerging as the best alternative to biodiesel rather than from oil bearing plants.

Insect Fat Conversion to Biodiesel

Many insects cannot utilize lignocellulosic substrates as their main food sources, but there are some insects that thrive on lignocellulosic biomass as their only foods. The types of biomass fed upon by cellulolytic insects range from agricultural crops to forest woody substrates, such as in the case of termites (all families), wood-feeding roaches (Blattidae, Cryptoceridae), beetles (Anobiidae, Buprestidae, Cerambycidae, Scarabaeidae), wood wasps (Siricidae), leaf-shredding aquatic insects (Pteronarcidae, Limnephilidae, Tipulidae), silverfish (Lepismatidae), leaf-cutting ants (Formicidae), and so on. Cellulose digestion has been demonstrated in more than 20 insect families representing ten distinct insect orders, for example, Thysanura, Plecoptera, Dictyoptera, Orthoptera, Isoptera, Coleoptera, Trichoptera, Hymenoptera, Phasmida and Diptera. The ability of these insects to feed on wood, foliage and detritus has recently stimulated extensive investigation into the mechanisms of how these insects digest the structural and recalcitrant lignocellulose in their foods, as well as their potential to advance current biofuel technologies and processing. Recent studies using advanced molecular biotechnologies, such as metagenomics, proteomics, transcriptomics, and so on, have brought new insights into the mechanisms of biomass deconstruction within the insect gut systems. Studies conducted on termites reveals that it can digest 74–99% cellulose and 65–87% hemicellulose. Fat content of *Imbrasia belina,* commonly called as emperor moth is 23% while *Rhynchophorus phoenicis* (African palm weevil) have a higher fat content of 66%. At different growth stages, fat content is subject to change. In general, larvae and pupae are rich in fat. The fat content of pupal stage is usually higher than that of adult stage. The Yellow meal worm *Tenebrio molitor* larvae have been reported to contain 23 - 47% fat, and are an important scavenger of decayed milled cereals and grains under humid and poor conditions. They eat storage products and are distributed all over the world. Black Soldier Fly H*ermetia illucens* larvae contain 20 - 40% fat. Yellow Meal Worm and Black Soldier Fly larvae have been utilized for efficiently degrading organic matters and transforming wastes into larval biomass.

Black Soldier Fly *(Hermetia illucens)*

Biodiesel production using black soldier fly larvae fed with animal manure, rice straw, restaurant wastes, and corncob have been reported in various countries. Black soldier fly larvae can convert around 58% of the dry matter into high quality animal feed. The insect opens up for opportunities to utilise it for bio-conversion considering the fact that approximately 1.3 billion tonnes of food is wasted from the food produced each year in world. The larvae convert organic waste material faster than worms used in vermicomposting. For example, a colony of 2,000 larvae can consume about 1kg of house hold food waste per day. They have large and powerful chewing mouthparts which allow the insect to consume organic compounds before they have time to decompose, thereby immediately eliminating odour. For these reasons, black soldier fly has been used to reduce animal manure in commercial swine and poultry facilities in western countries, but in India the practice is not yet common.

Characters of Black Soldier Fly

Hermetia illucens is a dipteran insect belonging to stratiomyidae family. The adult fly is wasp-like and its size varies from 15 - 20 mm.

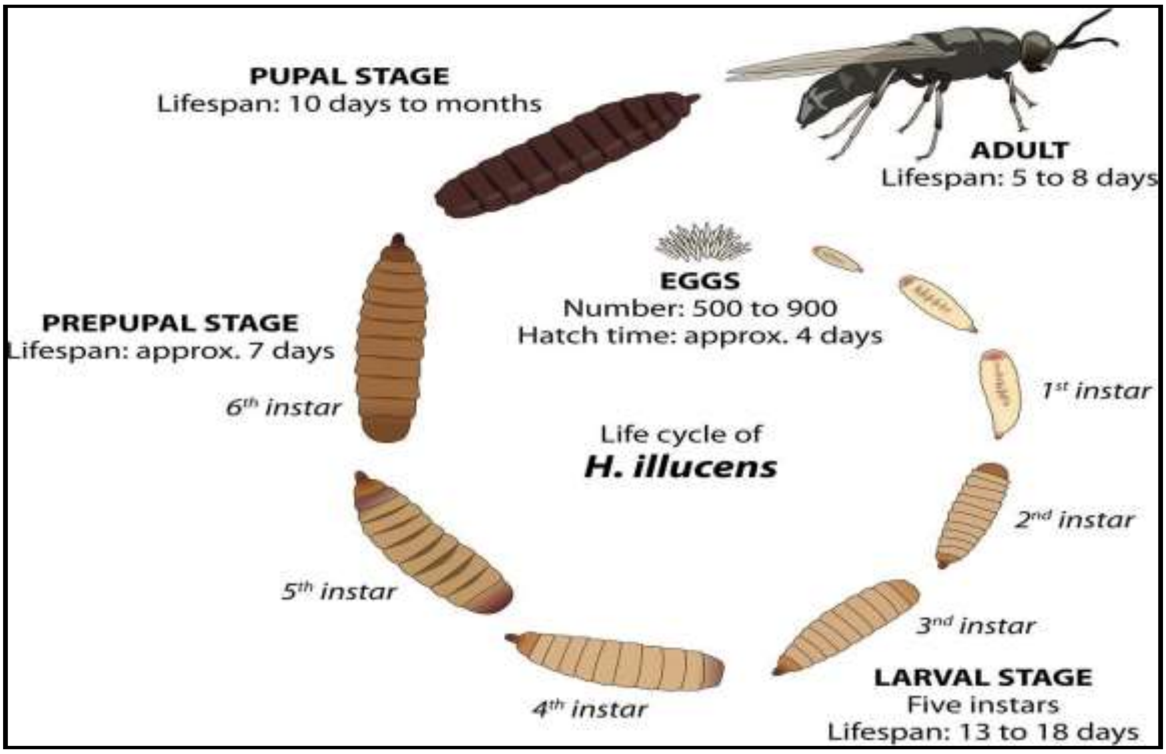
The abdomen of the female is reddish at the apex and has two translucent spots on the second segment. The male's abdomen is somewhat bronze in colour.

H. illucens inhabits tropical, sub- tropical and warm temperate zones of America, Europe, Australia and Asia, including India.

The flies can be seen in bright sunlight areas, resting on nearby structures or vegetation. The adult fly does not feed, feed only as larvae.

They do not bite or sting, and generally not associated with disease transmission. Black solider flies make breeding areas for houseflies less desirable. The fly is often found around decaying organic matter such as animal waste or plant material.

Adult flies are easily distinguished by their long antennae. Black soldier flies are an extremely resistant species capable of dealing with demanding environmental conditions, such as drought, food shortage or oxygen deficiency.



Life cycle of Black Soldier Fly(BSF)

Rearing of Black Soldier Fly (BSF) larvae

Scientists have developed biochemical process to turn organic wastes into biodiesel by black soldier fly larvae (BSF). Researches have shown that BSF is potentially capable of converting most of the nutrients and energy within organic wastes into BSF biomass. They secrete strong digestive enzymes into the organic waste and convert them into soluble organic molecules (sugar, amino acids, and fatty acids). These soluble organic molecules are changed into the grease of BSF, and then the grease is extracted for biodiesel production. The research also emphasis on no creature on the earth is capable of disposing of putrescent waste more quickly and efficiently than BSF. On the surface of the disposal unit, there is a 2 to 4-inch layer of actively feeding larvae in several stages of growth. Over 100,000 active larvae can be found in a typical waste disposal unit. In an experiment conducted in Texas over a period of one year, the results showed that BSF larvae could digest 15 kg/m2 restaurant food waste every day at least. BSF had the ability to eat and digest all kinds of biowaste, including meat and dairy products.

Enviro-Group has developed and patented a unique BSF bioconversion process without energy, electricity, chemicals and even without water. The bioconversion is ideal and simple. Current business investments are marketing efforts on the promises of producing biodiesel from organic wastes. Furthermore, some researches have indicated that the fat from BSF raised on pig manure if converted into biodiesel, would yield as much energy as methane production from the same amount of manure.

The viscosity of biodiesel derived from insect fat is high, due to saturated fatty acid of insect fat and with the increase of saturated fatty acid, the viscosity of biodiesel would be increase. Compared to petro-diesel, biodiesel have a much narrower range of temperatures and the properties of biodiesel are dependent on the feedstock from which they are made.

Besides biofuel extraction the larvae can be utilized as an important feed resource for chicken and fish farmers. Feed trials have confirmed it as being a suitable alternative to fish meal. The larvae consist of ± 35% protein and ± 30% crude fat. This insect protein is of high quality. Feeding waste to larvae has shown to inactivate disease transmitting bacteria, such as Salmonella spp. This implies that the risk of disease transmission between animals and between animals and humans is reduced when using this technology at farm level or when treating waste of animal origin in general (e.g. chicken manure or slaughterhouse waste). Waste reduction of about 80% on wet weight basis has been demonstrated.

Moreover, the residue could be further utilized as a refined protein feed stuff. Insect also provide bio conversion on the treatment processes and the environmental conditions. For instance, BSF can digest organic compounds which contain N and P. BSF can digest manure of pigs, chickens and other livestock within a week. Additionally, insect can mitigate the effects of animal manure and industrial sources of organic wastes thus finding application in organic waste management.

Insects are emerging as potential tools for biodiesel production, protein source for fish and livestock feed and also for bio waste management if proper technologies are used. Researches should be focused in India too for exploiting the potential of these beneficial insects into useful biomass.

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Speed Breeding Techniques: Accelerating Genetic Gains in Crops

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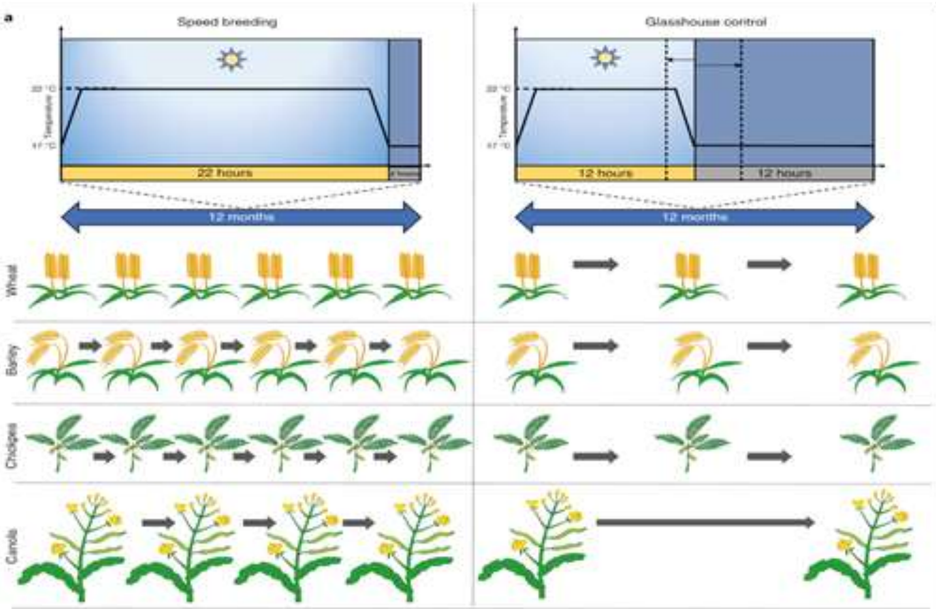
Speed Breeding

A Protocol that uses prolonged photoperiods to accelerate the developmental rate in plants, harvesting them and germination of immature seeds in next generation there by reducing the generation time.

It can be done by:

1. Optimization in photoperiodic conditions.
2. Temperature.
3. Light.
4. Plant Density.
5. Watering regimes.
6. Harvesting immature seed, followed by seed treatment.
7. Rapid phenotyping.

Reduction of Generation Time: Optimizing Photoperiod



Speed Breeding - I: Controlled-Environment Chamber Speed Breeding Conditions

Speed Breeding Protocol: Conviron Chamber Protocol (John Innes Centre, UK):

1. Photoperiod: 22Hrs (light)/ 2Hrs Dark
2. Temperature: 22°C (photoperiod)/ 17°C (Dark)
3. Humidity: 70%
4. Light: White LED, fr LED & Ceramic metal hydragyrum quartz iodide lamp
5. Light Intensity: 360–380 (bench ht) & 490–500 (Adult Plt ht) µ mol m^{-2} s^{-1}

Speed Breeding - II: Glasshouse Speed Breeding Conditions Supplemented with Sodium Vapour Lamps

Speed Breeding Protocol: Glasshouse Protocol (Hickey Lab, Univ. of Queensland, Australia):
1. A temperature-controlled glasshouse fitted with high pressure sodium vapor lamp.
2. Photoperiod : 22Hrs (light)/ 2Hrs Dark.
3. Temperature: 22°C (photoperiod)/ 17°C (Dark).
4. Humidity: 70%
5. Light Intensity: 440-650 (Adult Plt ht) µ mol m^{-2} s^{-1}

Speed Breeding III: Homemade Growth Room Design for Low-Cost Speed Breeding

Speed Breeding Protocol: LED Protocol (Hickey Lab, Univ of Queensland, Australia):
1. Photoperiod: 12Hrs-12Hrs (Light-Dark) for 4 wks then increased to 18 Hrs - 6 Hrs.
2. Temperature: 21°C (photoperiod)/ 18°C (Dark).
3. Light: 7 LB-8 LED light boxes (Grow Candy).
4. Intensity: 210–260 (bench ht) & 340–590 (Adult Plant ht) µ mol m^{-2} s^{-1}

Single Seed Descent (SSD) Method in Speed Breeding

1. Rapid generation advance than normal speed breeding due to high density of plants.
2. Maintenance of an unbiased broad germplasm base.
3. Able to handle large number of samples, and easily modified.
4. Seed sowed in a 96-cell format to conform to a 96-well DNA plate, labour and time efficient.

Conclusion

1. Speed breeding techniques can considerably reduce the breeding cycle in most of the crop.
2. It has little or a few side effects on other morphological or economic traits.
3. Need to "re-design" a breeding program to suit with SBS.
4. Research on SBS protocol can make it available for developing nations using low cost equipment.
5. Speed breeding allows integration with other breeding procedures.
6. Breeding companies in Australia are now using speed breeding.

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Phosphorus Stress Signalling and Homeostasis

Article ID: 31480

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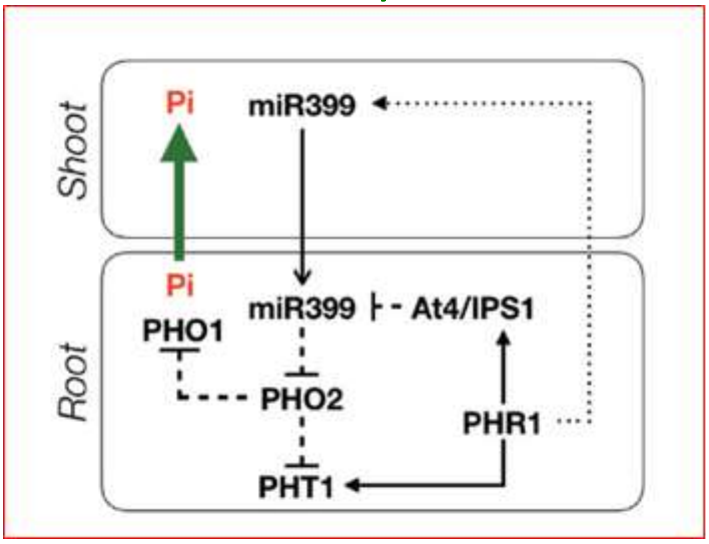
Introduction

Phosphorus is an essential mineral nutrient for plants and they contain approximately 0.1% of P. Phosphorus being a key mineral element necessary for plant growth, plays an important role in energy metabolism, sugar metabolism, enzymatic reaction and photosynthesis. P cannot be substituted by any other element. Phosphorus is also a component of nucleic acid, plant hormone and lecithin, and it determines the yield and quality of crops to a large extent.

Under tropical and subtropical conditions, P is considered as one of the major yields limiting factors in many agriculture production systems. The usable phosphate can be readily combined with some metal ions in soil such as Ca^{2+}, Fe^{3+} and Mn^{2+} to precipitate, resulting in scant available phosphorus in soil to meet the needs of the plant. Larger part of applied phosphorous (more than 80%) is usually fixed in the soil, and remains unavailable to the crops. Non-renewable Global phosphate reserves are depleting and will be exhausted by the end of this century. With around 60 m tons of annual P_2O_5 requirement for agriculture crop production in India, depleting reserve and high mining cost and meagre 10–20% use efficiency of applied P is likely to cause huge burden to Indian economy. The comparatively larger requirement of P for wheat (32 kg/ha), and poor utilization rate (10%) against 14% of rice and 18% of maize (Lu 2004) require immediate attention of wheat researchers.

One of the ways to tackle these issues is thorough understanding in the signalling pathways and their homeostasis mechanism, and its relationship to hormones. Phosphorus starvation responses include alterations in shoot and root morphology, growth and development, exudation of low molecular weight organic acid anions and acid phosphatases enzymes, modifications in lipids and carbohydrate metabolism, association with soil microorganisms, as well as the regulation of expression and activity of high-affinity Pi transport.

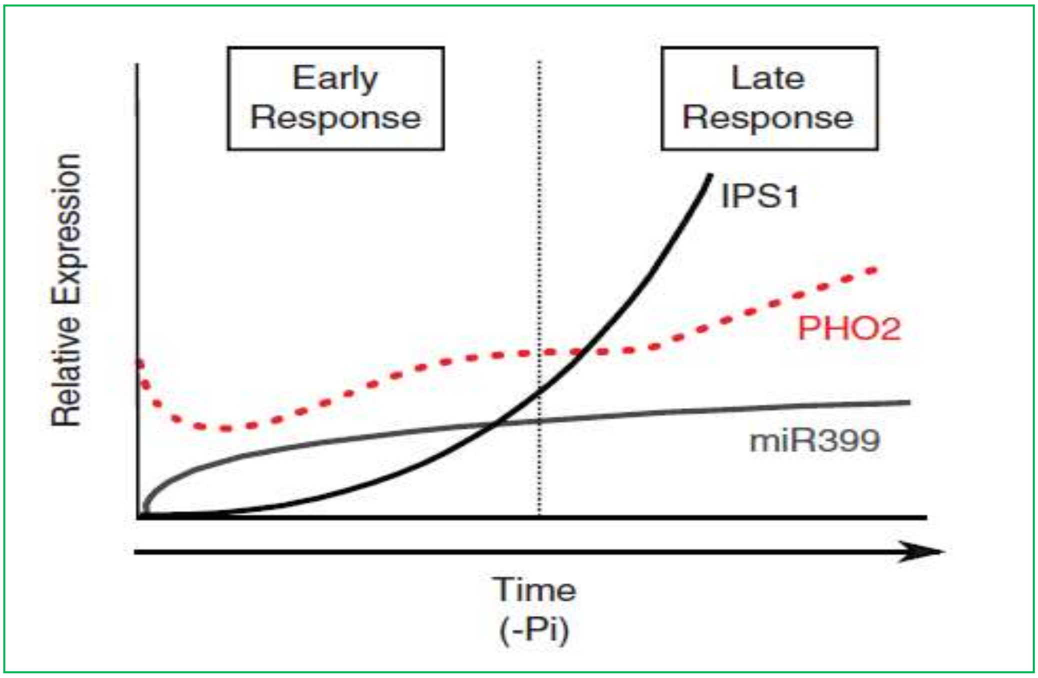
Phosphorus Signalling and Homeostasis Pathway



It is well established that the transcriptional activator PHOSPHATE STARVATION RESPONSE 1 (PHR1) in Arabidopsis and its orthologous OsPHR2 in rice play a key role in regulating the expression of numerous Pi starvation-induced (PSI) genes. Among them, special attention has been paid to the miRNA miR399, whose expression is highly induced by Pi deprivation. This regulator has been shown to be a key systemic cue between plant tissues by modulating the activity of PHO2, which encodes a ubiquitin-conjugating E2 enzyme (UBC24) implicated in protein degradation. Down-regulation of PHO2 prevents the degradation of the Pi transporter PHO1, involved in Pi xylem loading, and some transporters of the PHT1 family, associated with Pi acquisition and translocation within the plant. Another key PSI gene family involved in P signalling and homeostasis is At4/IPS1 in Arabidopsis and rice, respectively. These genes affect the miR399–PHO2 interaction by sequestering free miR399 through a target mimicry mechanism, preventing its binding to PHO2 transcripts and, thus, its degradation. Therefore, Pi acquisition and distribution within the plant are regulated mainly by the interaction of the triad IPS1–miR399–PHO2, which serves to fine-tune PSRs.

Proposed Model for the Regulation of P Signalling and Homeostasis by the Module IPS1–miR399–PHO2

During the first hours of stress, there might be a rapid induction of miR399 levels, which mediates the cleavage of PHO2 transcripts, probably to increase the relative amount of PHT1 members to promote Pi uptake from the soil, with the corresponding translocation to the shoots. In the case where Pi limitation continues over time, transcripts of IPS1 would increase greatly to lock miR399, and probably to exert other regulatory functions as well, with the concomitant increase in PHO2 levels.



This increase will trigger late Pi responses related to the improvement of Pi uptake and modification of root architecture, probably to search for new Pi 'hotspots', among other.

Conclusion

The three levels regulators IPS1–miR399b–PHO2 under Pi limitation which helps to enhance Phosphorus acquition efficiency (PAE), and this enhanced efficiency is due to a better and faster Pi starvation signalling and homeostasis regulation. However, traits associated with PAE are complex and context dependent. This modulation, in the long term, would relatively reduce shoot Pi loading, favouring the development of an enhanced root system and giving rise to an increased soil exploration capacity in search of Pi patches under limiting conditions and to increase Pi acquisition in high Pi-fixing soils.

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Phosphorus Stress and its Relationship to Strigolactones

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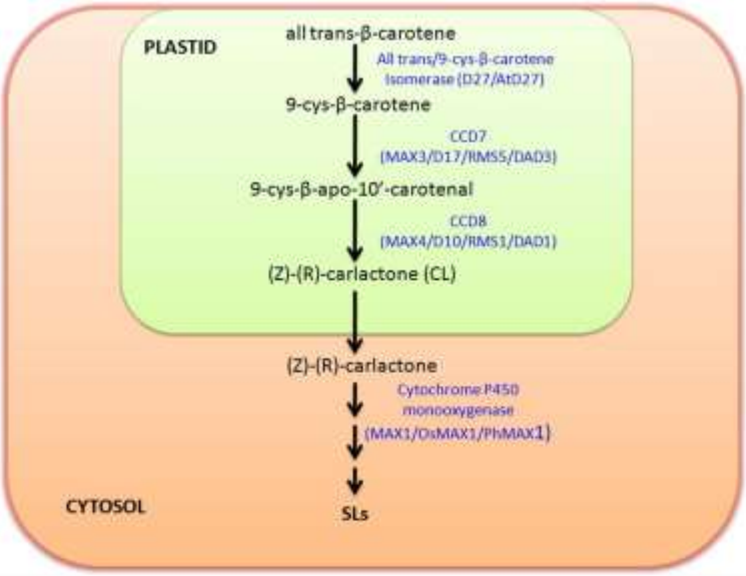
Introduction

Phosphorus (P) is one of the essential nutrients for plants, and is indispensable for plant growth and development. Macronutrients (N, P and K) are required in largest quantities, and deficiency of these nutrients severely limits crop yields. Given the need to food production, the global demand for N and P fertilizer is steadily increasing over the years. Deficiency of Phosphorous leads to stunted growth, high root to shoot ratio, anthocyanin accumulation premature senescence of older leaves.

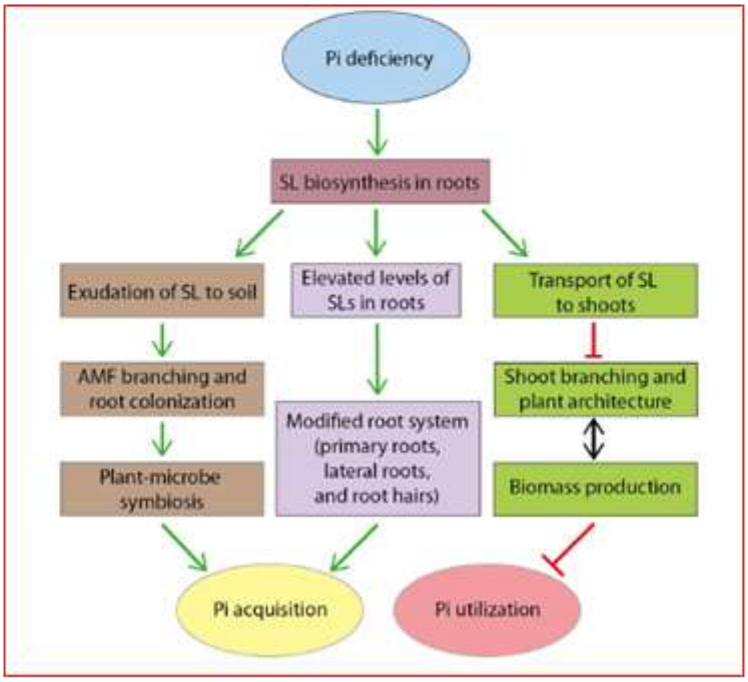
On the other hand, it is well known that phytohormones such as auxin, cytokinin, abscisic acid, ethylene, and in particular strigolactones (SLs) play synergistic roles in the regulation of P homeostasis when plants are subjected to P stress, through modulation of the P signalling- and homeostasis-associated pathways and ultimately root functioning. SLs are the latest class of phytohormones described, and have been shown to function as regulators of plant development/architecture and as signalling molecules in the rhizosphere to recruit arbuscular mycorrhizal fungi under Pi limitation. Indeed, their biosynthesis is highly promoted under this stress condition. Recently, it has been shown that exogenous application of the synthetic SL analogue GR24 induced root hair elongation, anthocyanin accumulation, production of acid phosphatases, and reduced plant weight, which are characteristic PSRs, suggesting a potential overlap between these two signalling and homeostasis pathways in plants.

Strigolactone (SL) Biosynthetic Pathway

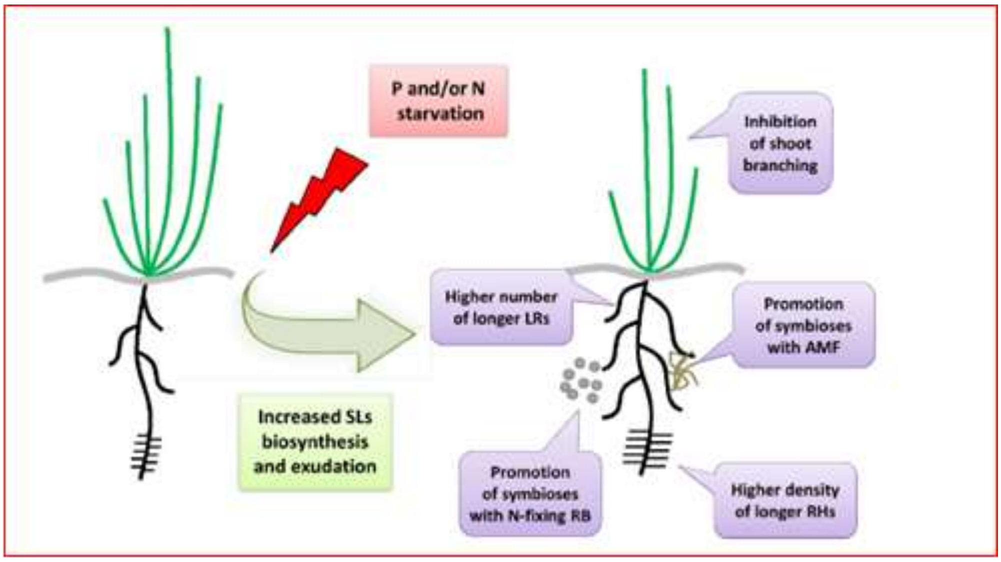


1. These hormones were first identified as stimulants of parasitic plant (Striga and Orobanche) germination.
2. This hormone class got their name after the identification of its first candidate from Striga.
3. Strigolactones (SLs) are a small group of carotenoid derived compounds, exuded from the roots of 80% land plants.
4. The movement of SLs, are in the root-to-shoot direction might confer the observed reduction in shoot branching.
5. Exogenous application of the SLs induced root hair elongation, anthocyanin accumulation, production of acid phosphatases & reduced plant weight.

These are characteristic Phosphorus Starvation Reponses (PSR) suggesting a potential overlap between these two signalling and homeostasis pathways in plants. Many studies revealed P deprivation induced TaD27 and TaCCD8 transcript with an increase in the expression levels. It confirms that response to P starvation through a stronger promotion of SL biosynthesis, it favours a greater & faster development of the root system in response to P-limiting conditions.



Plant Responses to P and N Starvation Stress Mediated by an Increased Production and Exudation of SLs



Recently, examining the role of SLs in plant–microbial interactions, has revealed that SLs encouraging the beneficial symbiosis with arbuscular mycorrhizal (AM) fungi and in the association of legumes with nitrogen-fixing rhizobacteria.

Conclusion

1. Strigolactones, together with other phytohormones, are involved in the regulation of P homeostasis under Pi limitation by modulating P signalling associated pathways and root development.

2. The enhanced phosphorus acquition efficiency (PAE) is associated with an improved P signalling through a fine-tuning modulation of PHO2 activity, which seems to be regulated by strigolactones.

3. Interestingly, increased levels of SLs, suggesting a direct relationship between this phytohormone and plant phosphorus stress responses.

4. Understanding the physiological mechanisms of improved PAE and the genetic basis therein will allow breeders to select more P-efficient cultivars. This knowledge will help to diminish the use of P fertilizers in agriculture, thus reducing costs and alleviating the excessive consumption of this non-renewable resource.

5. Further research is needed to understand the SLs–P signalling relation to develop new strategies for improved performance under P stress conditions.

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Rhizotrons – Tool for Root Research

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Plant roots play a vital role in the overall performance of the plants, being the organ responsible for absorption of water, nutrients and anchorage. Therefore, researchers are interested to study the nature of root system and its functioning.

However, the study of natural root development is a challenge because of the difficulty in observation. Most of the methods used to study root development are extremely time-consuming and tedious. To overcome these constraints rhizotrons have been introduced. Rhizotron is a device for non-destructive observation of plant roots over time.

It is a facility or structure to view and measure underground parts of plants through transparent surfaces (Huck and Taylor, 1982). These facilities allow an investigator for simultaneous access to root and shoot of plants growing in a field-like environment.

Rhizotrons

A rhizotron is a permanent installation that consists either of transparent walls placed against a continuous native soil profile or of compartments isolated from the native profile and separated from each other. It has a drainage system to remove excess soil water from the compartments. Rhizotrons are relatively expensive facility requiring considerable capital investment for the construction. Use large, field-like volumes of soil, access to electricity, water, and other utilities with a protected below-ground environment for sensitive instrumentation, and horizontal access to the root-soil system, as well as visual access through transparent surfaces are some important features of rhizotrons (Klepper and Kaspar, 1994).

Designs

1. East Malling type.
2. Auburn rhizotron.
3. Ames rhizotron.
4. National Soil Tilth Laboratory (NSTL) controlled environment rhizotron.

Uses

1. Root - shoot functional relationships as influenced by phenology.
2. Root growth dynamics as related to soil properties.
3. Uptake of water.
4. Uptake of nutrients.
5. Soil moisture studies.
6. Genotypic responses.
7. Soil born disease.

Advantages

1. Non-destructive method.
2. Successive measurements on the same individual root.
3. Measure soil conditions and recording time-lapse photography.

4. Provides information on speed of root growth and root density.

Limitations

1. Finite number of replications.
2. Immobility of structure.
3. Change in soil environment.
4. Not representative of the roots in bulk soil.
5. Replacement of soil after each experiment.
6. May alter population of soil microbes and insects.
7. Expensive (Auburn rhizotron cost- Rs. 26,83,781.76 in 1969) and labour intensive.
8. Long term commitments and working team.

Conclusion

1. A valuable tool for root studies.
2. Access to individual roots for experimentation and measurement.
3. They are useful for in depth study of roots.
4. Modern non-destructive method - examine the root and soil properties.

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Rhizosphere Management: A Roadmap to Sustainable Production

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The rhizosphere - shining light on the world beneath our foot.

Introduction

The increasing population in the country calls for increased food production and over the years, the revolution in the agricultural sector has transformed from green to grey, with overuse of chemicals. Modern intensive agricultural practices could increase the production but with adverse effects on environment and health. This lightened the dawn of the concept of sustainable agriculture and practices promoting conservation of resources. Soil, the fountain of life had borne the maximum impact of the indiscriminate chemical use, as a result of which the biology that sustained its quality was hampered. The soil physical, chemical and biological properties together assume utmost significance in sustainable agriculture, of which the rhizhospere is crucial. Rhizosphere management is one of the promising approaches to attain sufficiency in food production.

'Rhizosphere' : Rhizosphere is the area adjacent or in close proximity to the roots which provides a favourable environment for the growth of plants through microbial activity (Haichar et al., 2012). It acts as a conduit between plants and the soil. The rhizosphere zone is about 1 mm wide and has no distinct edge. The volume occupied by a single root extends from the root to an ill-defined position in soil which depends on diffusion of exudates, stage of development and biochemistry of roots.

Components of Rhizosphere

The plant roots, microorganisms and soil constitute the rhizosphere. Roots, the hidden half of the plant, secretes exudates, mucilage, ectoenzymses, phenolics, amino acids, polysacchrides and other substances collectively called rhizodeposits, that can modify the soil properties. These increase the availability of mineral nutrients, encourage microbial growth, degrade phytotoxic compounds and suppress soil borne pathogens.

Rhizosphere is regarded as the hotspot of microorganisms. The prominent microbes that colonize in the rhizosphere include *Rhizobia*, mycorrhizal fungi, Plant Growth Promoting Rhizobacteria (PGPR), and root pathogens (Mc. Near Jr., 2013).

Rhizosphere Effects

1. Carbon cycling: Carbon from plants enters soil as root exudates or via decomposition of root or above ground biomass. In soil, carbon exists in the root or microbial biomass and exits as direct emissions via root or microbial respiration. On an average it is estimated that up to 20 % of the carbon fixed by photosynthesis is released in the rhizosphere. It is also lost from the ecosystem as volatile organic compounds.

2. Nutrient acquisition: The efflux of protons and organic acids reduces the soil pH, making the nutrients in plant available form (Yadav. *et al*., 2008). For example, the carbon dioxide released through microbial respiration combines with water present in the soil to form carbonic acid. It solubilizes rock phosphate and helps in acquisition of phosphorus. Similarly, micronutrients like iron becomes available to the plants by siderophore chelation.

3. Microbial root colonisation: Rhizosphere acts as a battle field for soil borne pathogens and beneficial microorganisms and the population is significantly higher than in bulk soil. The beneficial microbes include symbiotic/ associative/ free living nitrogen fixers, AMF, solubilizers, Plant Growth Promoting Rhizobacteria, biocontrol agents and saprophytic organisms. Rhizosphere serves as an infection court where the pathogen encounters the plant and build up a parasitic relationship.

4. Biocontrol of pathogens: The microflora in the rhizospehre include antagonistic microorganisms that can suppress various plant pathogens by producing antibiotics, bacteriocins, siderophores, volatile organic compounds, hydrolytic enzymes etc (Sindhu *et al*., 2016). The *in-situ* mechanism in managing plant diseases and its exploitation opens vistas for minimising the use of plant protection chemicals.

5. Decomposition of organic matter: Organic matter is the key to sustainable agriculture. The rhizodeposits add to the organic reserve in soil and also serve as the primary source of energy for microorganisms. The soil biology (population and activity) that governs nutrient mineralisation, is entirely dependent on the organic matter in soil. The deposits invigorate the metabolic activity of microorganisms, accelerate decomposition of organic matter and releases nutrients to soil. This is called as the rhizosphere priming effect (Fontaine *et al*., 2003).

6. Abiotic stress management: Beneficial and mutualistic plant-microbe interactions attenuate plant acclimation to abiotic stress (Arzanesh *et al.,* 2011). Eg. IAA-producing *Azospirillum* spp. improved drought tolerance in wheat by enhancing root growth and formation of lateral roots.

7. Rhizodegradation: Soil is an abode of contaminants that undermines the soil quality. Microorganisms consume contaminants in the rhizosphere as a source of energy and convert toxic substances to harmless substances. The detoxification is either through their metabolic processes or by enzyme catalysed biodegradation.

8. Allelopathy: Root exudates are the major sources of allelochemicals in soil. The chemical interactions occur among plants by the release of allelochemicals into rhizosphere may be beneficial or harmful to the plants (Bertin *et al.,* 2003). The accumulation of allelochemicals at phytotoxic levels creates a disequilibrium and their persistence in soil determines the phytotoxic interference.

The properties and influences of the rhizosphere thus brings to light the opportunities that lie unnoticed and unexplored in the small volume of soil surrounding the roots. Rhizosphere management involves a strategic management of plant, soil and micro biota and harbors huge potentials to increase nutrient use efficiency, soil health and crop productivity.

How to Manage Rhizosphere?

All crop management practices right from land preparation intended to improve growth invariably results in a higher rhizosphere activity. Some of the specific agronomic strategies that can be recommended include.

Crop Diversification

The soil biodiversity is modified spatially (intercropping and mixed cropping) and temporally (cover cropping and crop rotation) through selection of crops and varieties which have positive effect on the agro ecosystem (Li et al., 2007). The root hairs increased the radial rhizosphere extension three-fold times. Studies have documented that wild types allocated more carbon to the roots than the mutants. Intercropping helped to increase the acquisition of nutrients and crop rotation with legumes intensified the microbial population in the soil. The high species diversity intensifies the root activities in soil adding to rhizospheric activities and benefits.

Conservation Tillage

Conservation tillage contributes significantly to soil organic carbon and microbial biomass carbon. It ensures a residue mulch on the soil surface, promotes maintenance of a permanent soil cover, minimum soil disturbance and overcomes sustainability weakness. Conservation tillage practice such as zero and chisel plough, as a moderate disturbance practice, can preserve the soil structure and enhance the soil nutrient status, thereby contributing to a stable rhizosphere phylogenetic diversity and selection for favourable plant growth-promoting rhizobacteria.

Mulches provide an ecological niche for soil microorganisms. It helps to improve the organic carbon status of the soil, facilitates rhizopriming, release allelochemicals and other leachates that suppress harmful micro-organisms.

Planting Geometry and Methods

The accurate method of planting and optimum spacing reduces the competition for the inputs and thus provides better above ground and below ground interactions. Root biomass is better and uniformly developed for row crops compared to broadcasted crop as there is less competition for space. Ridge and furrow film mulching in potato planting were found to harbour higher soil microbial communities and enzymatic activities compared to flat plot methods revealing the significance of the method of planting.

Soil Management

Addition of soil amendments like lime, gypsum and biochar alters the soil pH, increasing the population of beneficial microbial biomass and amount of dehydrogenase in the soil. Acidification of the rhizosphere can solubilize several hardly soluble macronutrients and micronutrients Root excretion of H^+ in the rhizosphere is an effective mechanism for improving uptake of micronutrients except molybdenum. Legumes have the ability to acidify the Organic manure application improves the physico-chemical properties of rhizosphere, root growth, soil biological activity, nutrient mobilization, colonization of mycorrhiza, soil water retention and buffering capacity of soil against alkalinity and acidity.

Nutrient Management

Application of biofertilizers like N fixers, P solubilizers and mobilizers, K solubilizers, and consortium biofertilizers like PGPR Mix I, augments the microbiome in rhizosphere and enhances nutrient availability. (Zhang et al., 2010). Site specific and precise application of nutrients based on soil test data and crop demand help to improve the root growth and rhizosphere efficiency. This results in increased nutrient use efficiency and reduced environmental risk. Renewed interest on integrated nutrient management results in better rhizospheric environment.

Water and Biotic Stress Management

Water is an inevitable factor that determines biological activity of rhizosphere. Water management practices that ensures adequate moisture at the right time in right quantity should be emphasized upon. Further any biotic or abiotic stress that hinders the growth of the crop can negatively affect the root growth and rhizhophere activities. Organic methods of pest and disease management practices are more promising than the use of chemical inputs.

Bioaugmentation

The inoculation with allochthonous microorganisms augments the biological functions in soil and aids in waste water management, bioremediation of polluted soil etc. Bioaugmentation facilitates significant shift in microbial communities in the soil.

Rhizosphere Engineering

Rhizopshere engineering, the approach of engineering organisms that can complement the naturally occurring plant- soil- microbe interaction near the roots is the recent upcoming strategy for the exploitation of rhizosphere effects.

These include technique for engineering:

1. Plants with favourable root traits and enhanced carbon storage.
2. Development of transgenic microorganisms that exude exogenous compounds which can improve plant nutrition, repress pathogenic microbes and minimize the consequences of biotic and abiotic stresses.

Constraints

The complexity of the below ground interactions, rhizosphere chemistry and biology, multiple plant- microbe, microbe –microbe interactions, occurrence of harmful and phytotoxic associations between organisms and roots, inability to reliably and predictably engineer the rhizosphere and the economic issues limit the scope for rhizosphere management.

Conclusion

However, rhizosphere being the core of all the physiochemical and biological activities essential for plant growth and development, research explorations on the root microbe interactions will help to improve productivity of food crops under stress conditions and allows for the increased drawdown of atmospheric carbon dioxide to stabilize carbon pools in soil. **'Manage the rhizosphere for a better future'**

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Health Benefits of Honey

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Since ancient times, honey has been used for its medicinal properties to treat a wide variety of ailments. It may be used alone or in conjunction with other substances and administered orally or topically for the eradication of certain ailments. However, misuse of antibiotics, the emergence of resistant bacteria, high cost and unavailability of some conventional drugs and increasing interest in therapeutic honey have provided an opportunity for honey to be used as a broad-spectrum antibacterial agent. The beneficial actions of honey have been established in the following.

Honey in the Treatment of Wounds

A broad spectrum of wounds is being treated all over the world with natural unprocessed honeys from different sources (Al-Waili, 2003, 2004). At present Medihoney TM (a blend of manuka and jelly bush honey) has been one of the first medically certified honeys licensed as medical product for professional wound care in Europe, America and Australia (Molan and Betts, 2004; and Molan, 2006). In addition, dressings impregnated with honey under controlled conditions and sterilized by gamma irradiation are available in Australia and New Zealand. Honey is equally found as an active ingredient in products such as ointments for the treatment of minor burns and cuts in Nigeria (Williamset al.2009).

Cross Contamination

The viscous nature of honey is believed to provide a moist wound environment that allows skin cells to re-grow across the wound as well as it provides a protective barrier that helps safeguard patients by preventing cross contamination (Lusby et al.2002). Bacterial colonization or infection of wound may occur with micro-organisms that originate from the patient's endogenous skin, gastrointestinal and respiratory flora through contact with contaminated external environmental surfaces, water, air and soiled hands of health care workers (Tan et al.2009).

Stimulation of Tissue Growth

The re-growth of tissue is very important in the wound healing process. Honey stimulates the formation of new blood capillaries (angiogenesis), the growth of fibroblasts that replace connective tissue of the deeper layer of the skin and produce the collagen fibres that give the strength to the repair. In addition, it stimulates the regrowth of epithelial cells that form the new skin cover over a healed wound (Rozainiet al.2004). Thus, prevents scarring and keloid formation, and removes the need for skin grafting even with quite large wounds (Subrahmanyamet al.2003).

Anti-Inflammatory Action

The anti-inflammatory activity of honey has been documented in clinical studies of human burn wounds and in in vitro studies (Subrahmanyamet al.2003). The potential consequences of effectively managing inflammation include rapid reduction of pain, edema, and exudates, additionally hypertrophic scarring is minimized by avoiding protracted inflammation that may result in fibrosis (Dunfordet al.2000).

Subsequently, reducing inflammation lessens exudates production and dressing change frequently, which may conserve resources in terms of dressings used, staff time, and unnecessary disturbance of the patient and the wound bed (Williams et al. 2009).

Gastritis, Gastric and Duodenal Ulcers

Gastritis, gastric and duodenal ulcers are complications resulting from infection with Helicobacter pylori. Conventional treatment for the eradication of H. pylori is far from satisfactory; thus, there is search for alternative treatment. Honey-derived remedies constitute a potential source of new compounds that may be useful in the management of H. pylori infections (Manyi-Lohet al.2010a). In vitro studies suggested that honey possesses bactericidal activity against H. pylori and could be used in combination with the antibiotics in the triple therapy in a bid to help eradication. Even isolates that exhibited resistance to other antimicrobial agents were susceptible to honey.

Conclusion

There is an ever-increasing demand for the consumer based diversified honey products, which leads to a value addition to honey. Processing honey at proper time and temperature was effective in increasing the shelf life of honey for one year with the minimum changes in the quality characteristics. Thermal treatment would degrade biochemical components in honey to certain extent depending upon its initial biochemical composition. Microwave heating can be effectively used, as it provides rapid heating to achieve the desired results for long term storage.

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Genetics for Bitterness in Cucurbit Crops

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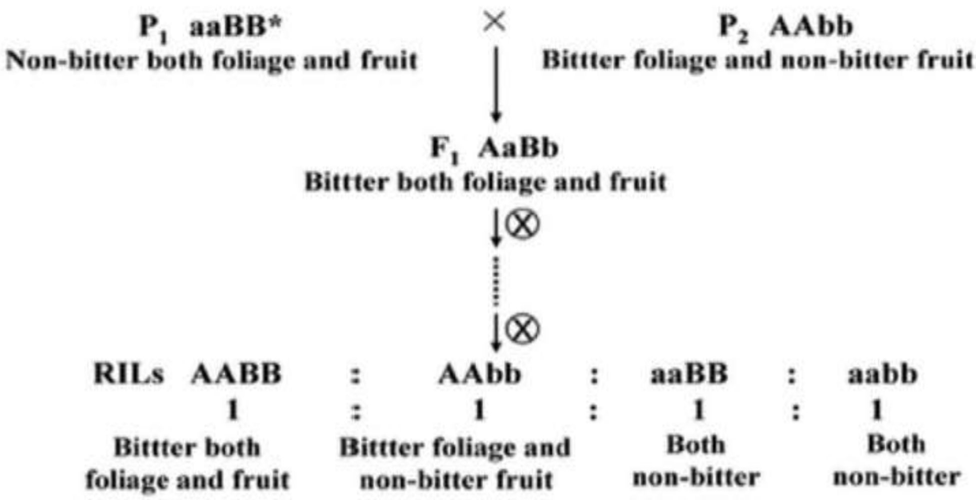
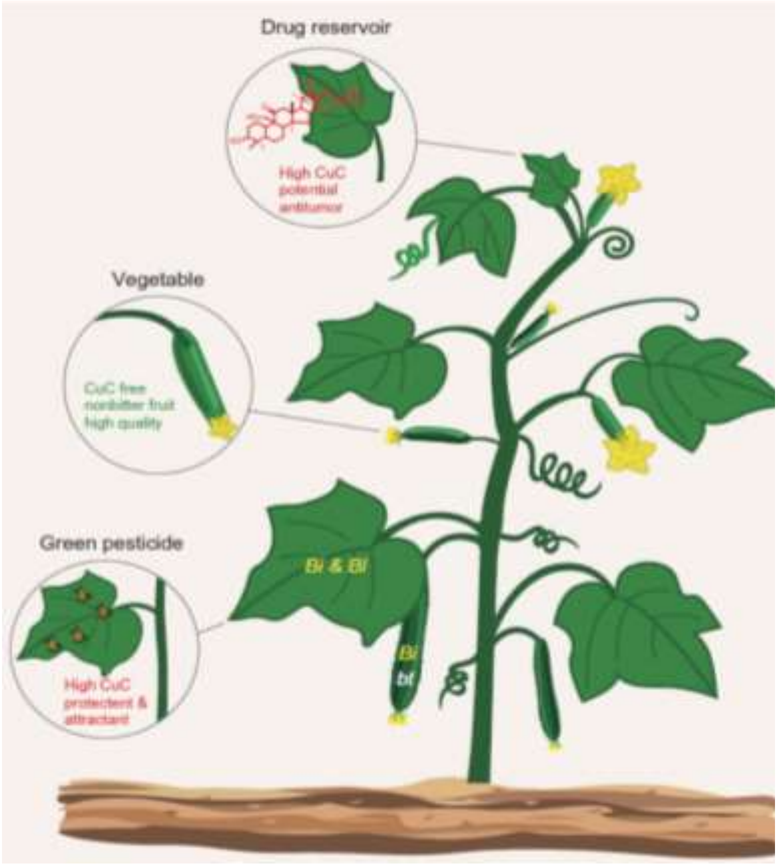
Bitterness is known to be controlled by two genetic traits, "Bi" which confers bitterness on the whole plant and "Bt" which leads to bitter fruit. Plant natural products consisting mainly of phenolic compounds, alkaloids and terpenoids are valuable for both plants and humans. Recently a breakthrough has been made in explanation of biosynthesis of cucurbitacins. Class of highly oxygenated tetracyclic tri-terpenoids present in the family *Cucurbitaceae*, which confer unpleasant bitter taste to help the plant to wade off herbivores and are exploited by humans in form of traditional herbal medicines for their anti-inflammatory, hepatoprotective and potential antitumor properties. Widely consumed as vegetables and fruits, the cultivated non-bitter cucurbits, e.g. cucumber, melon and watermelon, are domesticated from their extremely bitter ancestors thousands of years ago. However, some of domesticated cultivars would turn bitter when they were grown under stress, e.g. drought or low temperature, seriously affecting their quality and marketability. The underlying mechanism remains largely unknown.



Bitterness in cucumber fruit and foliage is due to the presence of cucubitacins. Several genes have been described that control the trait, with bi (bi-1) making fruit and foliage bitter free and Bt (Bt-1) making the fruit highly bitter. Previous studies have reported the inheritance and molecular markers linked to bi-1 or Bt-1, but we were interested in studying the inheritance of fruit bitterness in the progeny of 2 non-bitter fruit inbred lines. The objective was to determine the inheritance of cucumber fruit and foliage bitterness and to locate them on a current linkage map using a recombinant inbred lines (RILs) population derived by crossing 9110 Gt and 9930. It was concluded from the inheritance analysis that there were 2 loci controlling fruit bitterness in the population. One locus was in the same position as the location previously identified for bi-1 and another locus was for bi-3. Using a simple sequence repeat (SSR) inkage map, 2 loci for fruit bitterness in this RILs population were mapped. The locus of bi-1 was located at the region between SSR0004 and SSR02309 within the genetic distance of 5.2 cM on chromosome 6. The locus of bi-3 was placed in the region of SSR00116-SSR05321 within the genetic distance of 6.3 cM on chromosome 5. The physical distances for the regions of bi-1 and bi-3 were 11430.94 Kb with 160 predicted genes and 1528.23 Kb with 198 predicted genes, respectively. Among 160 predicted genes for bi-1, there is a terpene synthase gene named Csa008595, which was speculated as the candidate gene of bi-1.



Differentiation of secondary metabolite profiles in closely related plant species provides clues for unravelling biosynthetic pathways and regulatory circuits, an area that is still under investigated. Cucurbitacins, a group of bitter and highly oxygenated tetracyclic triterpenes are mainly produced by the plant family *cucurbitaceae*. These compounds have similar structures, but differ in their antitumor activities and Eco physiological roles. By comparative analysis of the genomes of cucumber and melon, we uncovered conserved syntenic loci encoding metabolic genes for distinct cucurbitacins. Characterization of the cytochrome P450s (CYPs) identified from these loci enabled us to unveil a novel multi-oxidation CYP for the tailoring of the cucurbitacin core skeleton as well as two other CYPs responsible for the key structural variations among cucurbitacins C, B and E. We also discovered a syntenic gene cluster of transcription factor that regulates the tissue-specific biosynthesis of cucurbitacins and may confer the loss of bitterness phenotypes associated with convergent domestication of wild cucurbits. This study illustrates the potential to exploit comparative genomics to identify enzymes and transcription factors that control the biosynthesis of structurally related yet unique natural products.

The structural diversity of plant secondary metabolites in phylogenetically related species is likely to be associated with adaptation to different ecological niches. In the plant family Cucurbitaceae, bitter compounds known as cucurbitacins can serve as protectants against generalists and also as feeding attractants for specialists in mediating the co-evolutionary association between herbivores and cucurbits including cucumber and melon. 12 categories of cucurbitacins have been discovered, most of these form cucurbit plants. Although cucurbitacin C (CuC) biosynthetic module consisting of 9 genes have been identified.

The non-bitter cucurbit cultivars that are used for production of vegetables and fruits for human consumption have been domesticated from their extremely bitter progenitors. In cucumber, expression of the CuC biosynthetic genes is controlled by two tissue-specific basic helix–loop–helix (bHLH) transcription factors (TFs) in the leaves (Bl, bitter leaf) and fruit (Bt, bitter fruit)5. Mutations within the promoter of Bt effectively remove fruit bitterness, and this trait of non-bitterness has been selected and fixed during the domestication process5. However, it is unclear whether the mechanisms underlying CuC regulation and domestication in cucumber also prevail in other cucurbits. Since genome mining has become a powerful strategy for metabolic studies in both microbes and plants12–20, we envisioned that investigation of the genome sequences of three cucurbit plants (cucumber21, melon22 and watermelon23) would provide a unique opportunity to understand the regulatory and biochemical principles dictating cucurbitacin diversity in cucurbits.

Here, by applying a comparative genomic study, we report that independent mutations within syntenic transcription factor genes in the three cucurbits may result in marked decreases in fruit bitterness, in turn giving rise to converged domestication of bitter wild cucurbits. Furthermore, dynamic genomic variations in the biosynthetic loci explain the observed chemical diversity of cucurbitacins, opening up the possibility to produce novel cucurbitacins or derivatives there of through metabolic engineering.

Sanwen Huang and colleagues have de novo sequenced the genome of cucumber and draw the first cucumber variation map. By integrating these big genomic data and multiple research tools, they cloned the cucumber bitterness gene (Bi), which participates the first committed step of cucurbitacin C (Cuc C) biosynthesis. Identification of two non-bitter mutants and analysis of cucumber variation map lead to the discovery of Bl (bitter leaf) and Bt (bitter fruit), two bHLH transcription factors that directly regulate the expression of Bi in cucumber leaf and fruit, respectively. Through co-expression and co regulation studies, a 9-gene module responsible for Cuc C biosynthesis in cucumber was uncovered and functions of four enzymes, including Bi, two P450s and one ACT, have been characterized. Bl and Bt are two master regulators, directly controlling the expressions of the 9-gene module in leaf and fruit, respectively, which is the first example of how the gene cluster is regulated in plant. Mutations occurred within Bt promoter region decreased its expression in the fruit tissue, and may be selected and fixed during the cucumber domestication. Among these mutations, a single-nucleotide polymorphism (SNP, G/A) is essential for cucumber to response to cold stress. Once mutated from ‘G’ to ‘A’, non-bitter cucumber would not turn bitter even grown under cold stress while otherwise would. The discovery of bitterness biosynthesis, regulation and domestication in cucumber provides possibility to develop a new non-bitter cucumber by accurately tuning the bitterness biosynthesis in different plant tissues, which protect plants from herbivores with their own weapon systems but avoid the unpleasant bitter taste in the fruit. This study also opens a door to metabolic engineering cucurbitacins as potential antitumor drugs. However, we must notice that there are five enzymes whose biochemical functions are still unclear. It’s a big challenge to elucidate the whole pathway of cucurbitacin biosynthesis in future.

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To Study the Methods of Collection and Preservation of Insects Including Immature Stages

Article ID: 31486

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Introduction

Insect collection is a source of recreation for many people and may be a hobby for those who are interested in studying insects. Methods of collection and preservation of insects are the pre-requisite to study the insects and their various internal and external organs. After collection, it becomes imperative to keep and preserve the insect specimens intact and safe for longer time to further study the characters or to develop the insect collection museum. Let 's has a look and do the different types methods of collection, devices used for collection and preservation of insects including immature stages in this practical session.

Why Make an Insect Collection?

1. An insect collection helps develop personal identification skills.
2. An insect collection can be used to display insects or insect features so that others may learn about them.
3. An insect collection can allow you to better observe details of insect structures and how they function.
4. An insect collection can provide a record of when and where various insects occur.

Places of Insect Collection

They can be collected from- Air (flying insects), Water (dragonflies, mayflies and stone flies that hover over water, aquatic insects and sea shore insects), Home (from furniture, boxes, bookshelves (fleas, bugs, flies, and mosquitoes), flower, fruits and vegetables brought in), Debris and animal dung (which acts as food source for many insects), and from domestic animals and birds (ecto and endo- parasites).

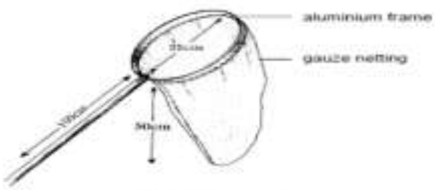
Collecting Kit

An old, soft-sided leather or canvas purse or a diaper bag with long shoulder straps makes an excellent collecting kit. The kit must be large enough to hold the kill jars (usually 2) and a couple of alcohol vials. Other useful items include paper, a pencil, lots of plastic bags, forceps, and a pry tool. The bag must leave both hands free, but have the equipment readily accessible to the collector. Every collector needs a bag, but bags can come in many variations – from backpacks to saddlebags.

The Insect Net

1. Hand picking: This method is suitable for catching the large insects like beetles and grasshoppers. It is very tedious (hard working) method and not suitable for catching the biting and stinging natured insects.

2. Aerial net or Butterfly net: It is light in weight, useful for catching active fliers like butterflies, moths, dragonflies, wasp, flies etc. The net consists of three parts viz., loop or frame; handle and porous muslin clothe bags. The diameter of hoop and the depth of the bag should be in the proportion of 1:2.



Aerial/Butterfly net

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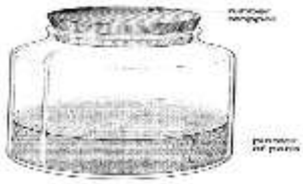
3. Sweep net: It is heavier than the aerial net. It consists of short handle, a large loop and dense cloth bag. This is suitable for collecting leaf hoppers, grasshoppers and other small insects. The net is swept over vegetation.

Sweep net

4. Aquatic nets: Special aquatic nets are constructed more heavily than sweep nets, with a strong mesh that allows water to drain.

Killing Jar

Killing should be immediately after capture. Potassium cyanide (KCN), ethyl acetate, carbon tetrachloride and chloroform are commonly used for killing insects. KCN kills the insects quickly but deadly poisonous and must be handled with extreme care. Ethyl acetate kills the insects slowly and does not last long. But the dead insects remain in relaxed condition for a longer time without becoming brittle and stiff.



Insect Collection Box

Storage of insects is done in the insect boxes, which is made up of wood (top and bottom could be of plywood) and lined on one(bottom) or both (roof also) sides with cork sheets covered with white paper. It is light in weight, moisture proof and airtight. General(common) size of insect collection box is45x30x15 cm.

Labelling

Specimen collected should be uniform in size and labelled properly on stiff paper or reference card. Labelling consists of following notes i.e., Host, Date, collector and Location.

Setting or stretching boards Setting is the method that wings antennae and Occasionally (Hymenopterans) spread legs in full display of their features. This method needs a setting or stretching board which have two side‘s boards separated by groove. Both board and grooves are lined with thin sheet of cork. The width of groove varies according to the width of insect body.

Methods of Preservation

Protection of Insect specimens: Collected Insects can be protected for longer time in insect collection box by putting the naphthalene balls on the corner side of box.

Preservation of Insects

1. Temporary preservation.

2. Permanent preservation: Insects can be permanently preserved either dry, in fluid, or on microscope slides. Arachnids are always preserved in liquid or on microscope slides. The method of preservation depends on the type of arthropods. It can be done by the following methods:

a. Dry preservation: Insects that are to be preserved dry are best mounted in ways that facilitate study and permanent storage. Specimens should be mounted soon after killing, if possible while still soft.

b. Liquid preservation: It is done in 70 % ethyl alcohol + 4 % formalin solution. Soft scale insects and mealybugs can be preserved in mixture of 4 parts 90 % ethanol and 1part glacial acetic acid whereas, thrips can be preserved in a mixture of 9 parts 60 %ethanol and 1-part glacial acetic acid. It is very important to periodically check and top up containers of a liquid collection.

c. Mounting on a microscopic slide: Small specimens have to be mounted on microscope slides so that they can be studied under a compound microscope. These include group such as thrips, aphids, parasitic wasps, scale insects, booklice, lice and mites. Insect and spider body parts (e.g. mouthparts and genitalia), and larvae often have to be slide mounted. Microscope slide mounts may be temporary or permanent, but specimens maintained in collections require permanent mounts.

Bringing the Specimen Home or the Laboratory

1. Materials required: Butterflies and other large-winged insects can be stored in folded protective paper envelopes. Most arthropod specimens can be conveniently stored between layers of absorbent paper. Paper envelops(Newspaper, wax paper) can be used to keep the specimen and brought it to home or laboratory (having good absorbent quality)Cellophane and transparent plastics can also be used for this purpose.

2. Relaxing container / Jar: Relaxing is the method / process of re-softening the insects. Relaxing container/Jar –contains a layer of sand (5 cm thick) or any other absorbent materials (basal wood, pith, synthetic sponge) and few drops of formalin or carbolic acid is added to prevent mould/fungal growth and then covered with filter paper. Cleaning- Dust, pollens and dirt can be removed with a camel hairbrush dipped in water mixed with detergent.

Preparing Insects for the Insect Collection Box

Insects longer than about 8 mm are usually mounted on pins pushed through the thorax. Insect pins are longer than ordinary pins, and are made of stainless steel that does not rust. A No. 2 or No. 3 entomological pin is suitable for most insects, although those with delicate bodies may require a size No. 0 or No. 1.

Entomological Pins

There are three general series of pins viz:

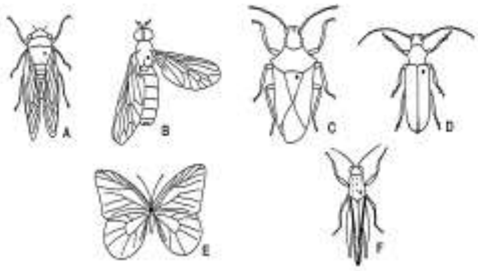
1. English pins: Sold by weight, range of 18-30 mm in length and stout, used to pin lepidopteran insects, which lies or kept low in the box.

2. Continental pins: Sold by 100s, Range 35 mm in length,(000,00,0 & 1-7 Nos.), No. 2 & 3 are useful for general purpose, 38 mm(No. 8-10), 50 mm(No. 11-12), 000 is the thinnest pin and No. 12 is the thickest pin.

3. Minute pin: Minutest and finest pins, used for pinning the insects meant to stage, for minute, softest and fragile insects.

Pinning

It is the best and common method to preserve hard bodied insects. They will dry and remain in perfect condition on the pins for long time without any further treatment. They are pinned vertically through the body. Depending upon the size of insect's pins has to be selected accordingly. Exact place of insertion of the pin varies among different groups of insects.



Proper location of pinning for : (A) cicada, (B) horsefly, (C) true bug, (D) beetle, (E) butterfly, and (F) grasshopper.

Double Mounting

Pinning is troublesome in smaller insects. Very small insects cannot be pinned because most of the body parts of the insects are lost during pinning. For such insects double mounting can be followed.

Staging

The stage is narrow rectangular piece of cork or pith. The small insect is pinned correctly with a micro pin to the stage. Later the stage is pinned in the insect store box with a bigger pin.

Carding

A rectangular white card (5x8 or 5x12mm) may be used as stage. On stage instead of pinning, the insect specimen is stuck on it by using glue or adhesive. After mounting the insect, card is pinned in the box with a large pin.

Pointing / Gumming

The insect specimen is glued to a card cut into a triangle of 10 mm height and 5 mm base. Bend down the tip of card to form as mall surface to which the insect is stuck. Apply a drop of glue or adhesive by touching the point to the glue and to the thorax of the insects to be mounted.

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Pandemic Followed by Epidemic: Locust

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Introduction

Emerging pandemic show that humans or not infallible and communities need to be prepared. Corona virus was first reported at the end of 2019 and now it has been reported as pandemic by World Health Organization. Worldwide countries are responding differently to this virus outbreak which led to an overburdening of local health systems. On other hand some other nations have put in place effective strategies to contain the infection and have recorded a very low numbers of cases since the beginning this pandemic. As of now there is meagre hope in getting recovered fully from this Covid-19, another natural disaster phenomenon called "Swarming of Locust".

Some insects are useful and some are highly harmful to mankind, one of which is Desert locust, the notorious insect in the world. Locust crisis has affected so far 23 countries. They are highly migratory in habit, marked as polymorphism and great devastative polyphagous by nature. Ten important species of locust were reported in the World out of which only four species *viz*. Desert locust (*Schistocerca gregaria*), Migratory locust (*Locusta migratoria*), Bombay Locust (*Nomadacris succincta*) and Tree locust (*Anacridium sp.*) were reported in India. An average small locust swarm eats as much food in one day as about 10 elephants, 25 camels or 2500 people. With such aggressive growth, one square kilometer of land could hold up to 40-80 million of these insects. They also travel great distances, covering up to 150 kilometers daily depending on the wind direction and speed. Desert locust covers about 30 million sq. km this includes countries like North West and East African countries, Arabian Peninsula, the Southern Republic of USSR, Iran, Afghanistan, the Indian sub-continent. The last locusts-cycles damage was estimated at Rs. 7.18 lakh in India in 1993.

Biology of Locust

The life cycle of locust is complete usually 3 to 6 months. A female laid 20 to 200 eggs in group in soil at a time, which hatches within 10 to 20 days. Locust has solitary phase and gregarious phase in which gregarious phase is most active and exterminator in nature. They always fed and swarm in group. Adults rosy pink on fledging, darkens with age to greyish or brownish red then to yellow on sexual maturation. Males are brighter. Adults of solitary phase are pale greyish brown, buffer peach coloured. Males change to pale yellow on sexual maturation whereas female show no colour change on maturation at low density. Locusts breed in three seasons' viz., winter breeding from November to December, spring breeding from January to June and summer breeding from July to October. India has only summer breeding season but in Pakistan has both spring and summer breeding.

In India, Locust Control and Research (LC&R) is responsible for control of Desert Locust and is being implemented through Organization known as "Locust Warning Organisation (LWO)" established in 1939 at Jodhpur and later amalgamated with the Directorate of Plant Protection Quarantine and Storage in 1946. Locust Warning organization (LWO) is responsible to monitor and control the locust situation in Scheduled Desert Area (SDA) mainly in the States of Rajasthan and Gujarat while partly in the States of Punjab and Haryana by way of intensive survey , surveillance, monitoring and control operations where required. In India, a total of desert area is 2,05,785.45 square kilometres out of which under Rajasthan possess the maximum area (1,79,250.64 sq.km) followed by Gujarat (23,077.58) and Haryana (3,457.20).

During the first fortnight of January, 2020, Immature/maturing adults/swarms were observed in the Jaisalmer, Barmer, Bikaner, Jalore, Jodhpur, Pali, Sirohi, Sriganganagar of Rajasthan and Banaskantha and Bhuj-Kutch of

Gujarat. According to FAO update on 13th May, 2020 the current situation remains extremely alarming in East Africa. At this time, there is a risk that swarms will migrate to the summer breeding areas along both sides of the Indo-Pakistan border as well as to Sudan and perhaps West Africa. According to the Global Committee, some adult teams were expected to come to India for spring breeding. Hence, vigilance was issued against the expected attack of locust in the upcoming days.

According to figures estimated form the most horrific attack of locust parties after 26 years, in the six states of the country since December last year, about 10 to 15 million acres of crop has been damaged, while according to the government figures so far the yield of one lakh acres of cotton, pulses, oilseeds and vegetables and fruits produced in summer has been affected by the locust attack. The April attack did not have much impact on the crops because most places had been harvested and there was no sowing in the fields.

The locust invasions join hands with the COVID-19 pandemic, creating a much burden to the farmers who were waiting for the harvest. Local agri-food supply chains are already experiencing disruptions, including reduced access to inputs and services, labour movement, transport and roadblocks, and credit or liquidity due to COVID-19. Particularly, the pandemic is disrupting the supply chains for pesticides and other equipment necessary to control the spread of locusts is again a new challenge for the farming communities.

Conclusion

Addressing the locust crisis there is significant constrains in all aspects of farming. Border closures and delays posed by quarantine measures are imposing restrictions on the movement of personnel and equipment to aid in the locust response. Even in those countries where the government is making locust response an essential activity and allowing teams to move, special care needs to be taken to reduce the threats that hinder workers and control officers spread the two remote rural locations where locust control operations are required. In this scenario, these two crises have the potential to generate the conditions for famine, disease and increased poverty unless and until proper quarantine measures is ensured. India will also use drones and specialist equipment to monitor the movement of locusts and spray insecticides to ward off a new outbreak. This comes even as officials and experts noticed a change in the locusts' attack strategy.

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Mycotoxins and their Effects

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Introduction

The term mycotoxin was coined in 1962 in the aftermath of an unusual veterinary crisis near London, England, during which approximately 100,000 turkey poults died. *F.moniliforme* associated with maize seeds caused human toxicosis in humans. When this mysterious turkey X disease was linked to a peanut (groundnut) meal contaminated with secondary metabolites from *Aspergillus flavus*(aflatoxins), its sensitized scientists to the possibility that other mould metabolites might be deadly. The period between 1960 and 1975 has been termed the mycotoxin gold rush because so many scientists joined the well-funded search for these toxigenic agents. The sale of yellow rice was banned in Japan due to *Pencillium* puberulum (pencillic acid) in 1910. Some 300 to 400 compounds are now recognized as mycotoxins, of which approximately a dozen groups regularly receive attention as threats to human and animal health (Rocha *et al*., 2014).

What is a Mycotoxin?

1. Mycotoxin is derived from the Greek word-mykes, meaning fungus and Latin word toxicum meaning poison.
2. Mycotoxin are Secondary metabolites (chemicals) of a fungus that produce toxic results in another organism, that cause pathological or undesirable physiological responses in humans and other animals.
3. Toxins can remain in the organism after fungus has been removed.
4. Can be heat stable, not destroyed by canning or other processes.
5. Mycotoxicoses are diseases caused by the ingestion of food or feeds contaminated by mycotoxins.

Field Mycotoxins

In the field, infection of ears by *Fusarium* species can result in mycotoxin development when the weather is warm and wet at flowering. Fusarium mycotoxin occurrence may be greater when wet weather delays harvest. Crops infected at flowering may have individual bleached spikelets, or partially bleached ears, resulting at harvest in pink or chalky-white shrivelled grains. However, there is little correlation between fusarium-damaged grains and mycotoxin occurrence.

Storage Mycotoxins

Storage fungi can grow on cereals from about 14.5% moisture content (7.5-8% in oilseed rape) upwards. They can cause heating and loss of germinative capacity and some produce mycotoxins. Ochratoxin A (OTA) may be produced by the storage mould *Penicillium verrucosum* if grain exceeds 18% moisture content. The greatest risk occurs during harvest backlogs and during ambient air drying when grain may take weeks to dry. OTA incidence can be unpredictable. In the UK only some strains of*Penicillium verrucosum* produce OTA. Even when present, those strains do not always produce toxins. The three major mycotoxin-producing storage fungi are *Aspergillus, Fusarium and Penicillium.* Four key mycotoxins that are generally recognized as dangerous are aflatoxin B-1, Fusarium Tricinctum (T-2), Zearalenone and Vomitoxin (Don). The field fungi are, *Claviceps purpurea,Dipodia maydis Sclerotinia sclerotiorum.*

Modes of Spore Transmission

1. Airborne, wind or indoor ventilation systems.
2. Attachment to insects of birds, thus transmitted from plant to plant, or animal to animal, etc.
3. Via transportation mechanisms such as trucks, crop machinery, etc.

Effects of Mycotoxins

1. Aflatoxins: Aflatoxins are produced primarily by the fungi *Aspergillus flavus* and *Aspergillus parasiticus*. There are four main types of aflatoxins: B1, B2, G1, and G2. Aflatoxin B1 is the major toxin produced. The clinical effects of aflatoxins may include death, liver cancer, reproductive problems, anemia, immune system suppression, and jaundice. Aflatoxin contamination is economically important in crops such as maize, peanuts, cottonseed, and tree nuts. *Aspergillus flavus* is commonly associated with a disease of maize known as Aspergillus ear rot. Powdery, grey-green spores may develop on the surface of maize ears, and aflatoxins may be produced by the fungus until the kernel moisture reaches about 15 percent. *Aspergillus flavus* and *A. parasiticus* may cause a disease of peanuts known as yellow mold. Tree nuts such as pistachios and almonds may become contaminated with aflatoxins during injury, such as the splitting of hulls.

2. Fumonisins: The fumonisins are a group of mycotoxins produced primarily by *Fusarium verticillioides* and *Fusarium proliferatum*, although a few other Fusarium species also may produce them. There are at least 28 different forms of fumonisins, most designated as A-series, B-series, C-series, and P-series. Fumonisin B_1 is the most common and economically important form, followed by B_2 and B_3. Maize is the most commonly contaminated crop. Fumonisin-producing *Fusarium* fungi cause a disease in maize known as Fusarium ear rot. Horses that are poisoned with fumonisins may develop a fatal disease known as equine leukoencephalomalacia. Symptoms of this disease include drowsiness, blindness, staggering, and liquefaction of brain tissue. Swine that are poisoned with fumonisins may experience reduced feed intake and weight gain, liver damage, and can develop a fatal disease known as pulmonary edema, in which the animals' lungs are filled with fluid and they are suspected to influence the formation of oesophageal cancer in humans.

3. Ochratoxin: It is produced by *A.melleus,A.ochraceous & P.chrysogenum,P.verrucosum.* The major source of *P.verrucosum* and its toxin is barley in temperate zones. Ochratoxin A is the most economically important form of ochratoxin; ochratoxins B and C are less toxic and less common. Ochtratoxin poisoning is thought to be the cause of a chronic kidney disease in humans known as Balkan endemic nephropathy. Grapes, raisins, and even wines may become contaminated with ochratoxins produced by *Aspergillus carbonarius*, the principal causal agent of grape black mold.

3. Trichothecenes: The trichothecenes are the largest group of mycotoxins known to date, consisting of more than 150 chemically-related toxic compounds. These mycotoxins are produced by several species of *Fusarium*, *Stachybotrys*, *Trichoderma*, and *Trichothecium*. The most important trichothecene mycotoxin in the United States is deoxynivalenol (DON), a common contaminant of wheat, barley, and maize. DON is sometimes called vomitoxin because of its deleterious effects on the digestive system of monogastric animals. Humans consuming flour made from wheat contaminated with DON often demonstrate symptoms of nausea, fever, headaches, and vomiting.

4. Zearalenone: Zearalenone is a mycotoxin that mimics the reproductive hormone estrogen. This mycotoxin is produced primarily by the fungus *Fusarium graminearum*, the same fungus that produces deoxynivalenol in maize and small grains. Swine are the most commonly affected domestic animals, but cattle and poultry may also be affected. The clinical effects of zearalenone may include an enlarged uterus, swelling of the vulva and vagina (known as vulvovaginitis) ,enlarged mammary glands, anestrus (periods of infertility), and abortion. Zearalenone may be passed to nursing piglets through the mother's milk. A commercially available derivative of zearalenone (zeranol) has been used as a growth hormone to increase weight gain in beef cattle. High humidity and low temperatures favor the production of zearalenone by *F. graminearum* in maize.

5. Ergot alkaloids: It is produced by *Claviceps* and are associated with rye & Triticale. The name *ergot* means 'spur' in French, since grains colonized with *Claviceps* spp. often resemble the spurs on the legs of a rooster. Ergot poisoning in humans and domestic animals is known as ergotism. Ergotism is one of the oldest known human diseases caused by mycotoxins. In the Middle Ages, humans suffering from a disease called St. Anthony's fire reportedly experienced symptoms that suggested ergot poisoning such as burning skin, insects crawling under their skin, and the loss of hands and feet.

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Conclusion

Fungi cause human illness in different ways. Mycoses are the best-known diseases of fungal etiology, but toxic secondary metabolites produced by saprophytic species are also an important health hazard. The term mycotoxin is an artificial rubric used to describe pharmacologically active mould metabolites characterized by vertebrate toxicity. They fall into several chemically unrelated classes, are produced in a strain specific way, and elicit some complicated and overlapping toxigenic activities in sensitive species that include carcinogenicity, inhibition of protein synthesis, immunosuppression, dermal irritation, and other metabolic perturbations. Mycotoxins usually enter the body via ingestion of contaminated foods, but inhalation of toxigenic spores and direct dermal contact are also important routes. It is difficult to prove that a disease is a mycotoxicosis. Only with continued research on understanding the effects and modes of mycotoxin action in various species, have regulations and control strategies been forthcoming.

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Harnessing the Beneficial Effect of Microbes Through Seed Coating

Article ID: 31489

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Introduction

Currently, more than 1/3 of the Earth's land surface is occupied by agriculture, with a total net production value estimated in 2.6 × 109 US dollar (FAOSTAT, 2016). It is a sector of great importance, providing employment for about 50% of the labour force in low income countries (Cheong et al., 2013) and being the basis of human dietary composition. Nonetheless, the unsustainability of the current conventional agricultural practices along with future climate scenario urges for alternatives that can not only increase agricultural production but also bring environmental and economic sustainability, thus ultimately improving human well-being.

Plant beneficial microbes (PBMs) are considered to be a natural alternative path to ease the pressure on the environment resulting from conventional farming. These microbes can help plants maintain or increase productivity while reducing the input of agrochemicals, restoring soil fertility, and/or overcoming problems caused by abiotic and biotic stresses. In the last decades, the interest in the use of PBM for increasing yields and resilience of agricultural crops has been growing steadily Yet, agricultural practices such as intensive fertilization, soil tillage and abusive application of pesticides can severely affect the soil microbes and their beneficial interaction with the target plants. Thus, hampering a wider use of PBM. Moreover, currently, the large-scale application of PBM, particularly in broad-acre crops, might not be practicable or economically feasible considering the amount of microbial inoculum needed per plant. Therefore, there is an urgent necessity of efficient and effective inoculation methods to apply PBM.

Seed inoculation has been considered as a precise and cost-effective method to deliver microbial inoculants, with the potential for large-scale application. Seed coating is a technique in which an active ingredient (e.g., microbial inoculant) is applied to the surface of the seed with the help of a binder and in some cases a filler that can act as a carrier. Seed coating has been proposed as a promising tool for inoculation of different crop seeds, since it is able to use minor amounts of inoculation in a precise application (Rocha et al., 2019).

What is Seed Coating?

Seed coating is a technique in which an active ingredient is applied to the surface of the seed with help of a binder and in some cases a filler that can act as a carrier.

Need of Seed Coating

Seed is coated when grows need a precision sown crop and the non-coated seed is too small, light, variable in size or shape to be sown accurately with existing equipment. Precision sowing is desirable when growers need singulation for cell try plant production in a greenhouse or strict control of spacing or depth of placement. Singulation and controlled spacing also are vital for crops that are direct sown and then thinned back to the desired plant population. The field thinning operation is faster, cheaper, and more accurate when coated seeds are used (Rouphael et al., 2017).

How is Seed Coated?

Seed coating can vary from simple on-farm applications to sophisticated and industrialized procedures. Although the processes used by farmers and industrial companies may, the principle is basically same. Overall, it includes, seeds inside a container (rotating drum, cement mixer), where a binder (e.g., adhesive compound), a filler (bulking agent) if needed, and active ingredients (e.g., nutrients, protectants, and PBM) are mixed.

1. Fillers – (Bulking material): Fillers can be single or mixed components. These components can function as microbial carriers and modify seed size, shape, and weight. Some ingredients like alginate can be used both as filler and binder. Ex: Peat, Talc, Lime, Biochar, Chitosan, Alginate.

2. Binder: Natural or synthetic polymers, generally added during or toward the end of the coating process in order to bind the exogenous materials and reduce the amount of dust in the final product. Ex: Methyl cellulose, Carboxymethyl cellulose, Gum arabic, Polysaccharide pelgel, Xanthan gum.

Seed Coating Method is Used for Applying

1. Colours and tracers (e.g., fluorescent dyes).
2. Protectants (e.g., pesticides).
3. Soil adjuvants (e.g. soil hydrophilic materials and hydro-absorbers).
4. Compounds that stimulate germination, growth, and stress resistance (e.g., salicylic acid, gibberellic acid and abscisic acid).
5. Macronutrients and micronutrients.
6. PBM inoculants.

Plant Beneficial Microbes

Microorganisms that benefit plant establishment, growth, and development by direct or indirect mechanisms are generally known as PBM. This article mostly focuses on two main groups of soil microorganisms, bacteria and fungi, particularly on plant growth-promoting bacteria (PGPB), arbuscular mycorrhizal (AM) fungi, and Trichoderma, due to their importance as microbial inoculants in agroecosystems.

Bacteria

Bacteria are, by far, the most abundant microorganisms present in the rhizosphere. Various genera of bacteria (e.g., Azospirillum, Azotobacter, Pseudomonas, Bacillus and Burkholderia) contain species that have positive effects on plant growth and development. These beneficial bacteria, also designated as PGPB(Plant growth promoting bacteria), are responsible for protecting plants from biotic and abiotic stresses, enhancing plant growth and performance through direct and indirect mechanisms.

Fungi

Arbuscular mycorrhizal fungi (AM fungi): AM fungi associate with the roots of almost 80% of terrestrial plants to form arbuscular mycorrhizas. These symbiotic associations are of great relevance for agricultural systems especially under low input of agrochemicals, due to their role in increasing nutrient uptake and acquisition, improve soil aggregation, provide a protective barrier against pathogens, increase water acquisition. Besides the structural and nutritional benefits, AM fungi can help crops cope with environmental stresses, therefore enhancing plant growth by producing metabolites (e.g., amino acids, vitamins, phytohormones, and antioxidant enzymes) and adjusting plant physiological status (e.g., proline content, carbon dioxide exchange rate, and stomatal conductance).

Trichoderma Spp.

As common free-living fungi in the rhizosphere and soil, Trichoderma spp. are well known for their ability to produce a wide range of antibiotics and to parasitize other fungi. Metabolites released during plant–Trichoderma interaction can influence several aspects of plant development such as plant growth and root morphology and nutritional status (increase in nutrient uptake, N use efficiency, and nutrient solubilization), and trigger induced systemic resistance, biocontrol of pathogens, and inactivation of toxic compounds in the root zone.

Agricultural Applications

In general, the application of microbial seed coating in agriculture is aimed at improving crop productivity. Seed coating with PBM has been successfully applied to a wide range of seeds with many different sizes, shapes, textures, and germination types. The most explored agricultural crops regarding inoculation via seed coating are cereals like wheat and maize, and fruit/vegetable crops such as tomato, cucumber, and sugar beet. Soybean, chickpea, and pea are some of most commonly reported oil and seed pulses crops. In addition, fibre crops like cotton or forage crops like alfalfa have also been addressed in PBM seed coating research.

In most reported studies, application of PBM via seed coating is able to promote

1. Crop production, productivity and nutrition of crop.
2. It act as a Biocontrol agent.
3. It reduces Plant disease.
4. Improve Seed quality.
5. Reduce the Abiotic stress tolerance.
6. It can also be used as Bio-priming.

Conclusion

Driven by the need for sustainable and environmentally friendly farming practices and safer and healthier food, the demand for microbial inoculants is rising. Nevertheless, despite the well-known and proven benefits of PBM in improving yield, quality, and stress resistance of agricultural crops, Seed coating has the potential to be a cost-competitive and time-saving approach for crop production and protection, reducing application efforts and providing extra and desirable characteristics to the seeds. Therefore, seed coating with PBM may be regarded as an innovative ecotechnological approach for sustainable agriculture.

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Turf Making Techniques

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Lawn

It is a ground cover of perennial grass, which persists in close mowing and requires proper management practices.

Purpose of Lawn

1. It is an important element in the garden.
2. It leads to utility in garden design.
3. It is a natural green carpet and is the carpeted floor of outdoor room.
4. It is the heart of the garden and centre for social life.
5. It is the centre piece around which all other garden elements are placed in sub-ordinate order like the royal court, where king occupies the central position and is surrounded by his courtiers.
6. It gives restful appearance to the eyes through its green outlook all the time.
7. A lush green lawn is refreshing especially during summer.
8. Lawn is best foreground to enjoy the charm and beauty of the ornamental plants and feature.
9. Prevent soil erosion.

Important Characteristic of Lawn Grasses

1. Look fresh and green throughout the year.
2. Not patchy.
3. Cold or drought resistant.
4. Free from insects and diseases.
5. Quick growing.
6. Soft to tough.
7. Not giving foul or bad odour.

Plains

1. Bermuda grass / dhoob grass / Hariali:

a. *Cynodon dactylon* (Calcuttia, Hariyali, Selection1 and Selection 8).
b. *Cynodon bradeyi.*
c. *Cynodon magnannissi*.
d. *Cynodon travalensis.*

2. Fine leaved grass:

a. *Osterdamia materella (Syn) Zoysia marelella (Syn).*
b. *Loysia japonica.*

3. Meadow grass:

a. *Poa annua*.
b. *Poa trivialis*
c. *Poa compressa.*
d. *Poa notatum*
e. *Poa pratensis*

4. Uparagu: *Sporobolus termulua*
5. Dichondra: *Dichondra repens*

Shade Loving Grass

St. Augustine grass	*Stenotaphrum secundatum*
WET Soil: Joint grass	*Paspalum distichum*
Hills: Kikiyu grass	*Pennisetum cladestinum*

Practices in Different Methods of Lawn Making

Ideal site for lawn: South, south east or south west open and sunny place for the day with adequate water availability.

After the preparation of land, lawn is laid out by adopting one of the following methods.

1. Seed sowing: In India lawn is made by sowing seeds. A lawn from seed is thought of only when grass roots are not available. About 3 g of good seed may be necessary for one sq.m. There will be 3000 to 6000 seeds in each gram of seed. The soil should be made to a fine tilth and a light rolling is given before sowing. Seeds should be sown on a windless day evenly, thinly and covered with fine light soil. The land should be rolled again and watered liberally with rose-can.

2. Turfing or sod: Turfs (pieces of earth with compact grass on them) should be cut uniformly thick in square, rectangular or round form, from a place where the grass is short, compact and free from weeds. They should be spread upon the prepared land side by side and beaten down flat with a turf-beater. Any cavity in between should be filled with fine soil. Then the entire turfed area should be rolled and watered liberally.

3. Turf plastering: Fresh grass stems and roots should be cut into pieces of 2 to 4 cm long. In a pit a mixture consisting of two parts of these grass pits and one part each of fresh cow dung and red earth should be made into a paste by stirring it with required quantity of water. The paste is spread evenly over the prepared land which has been watered previously if necessary. Sometime grass pieces are soaked in cow-dung water and stored for 24 hours by covering them with gunnies. After spreading it is covered with litter or silt to minimize evaporation and to prevent drying. Watering should be done with rose-can.

4. Dibbling roots: This is the cheapest and the slowest method. Grass roots should be dibbled 15 cm apart in the prepared land when it is wet after rain. The roots spread and grow underground in the course of six months.

Problems in a Lawn

	Problem	Symptoms	Control
1.	Chlorosis	Grass turns yellow with the deficiency of magnesium and iron	Iron: Spray Ferrous sulphate 25 gms dissolved in 10 liters of water per 100 sq. meter. Magnesium: Spray magnesium sulphate 100 gms in 10 litres of water per 100 wq. Metre.
2.	Dog urine	Dead grass in the lawn roughly circular	Re-plant grass
3.	Fertilizer burn	Grass browns especially in hot weather	Drench the lawn in injured areas to leach excess fertilizers deep into the soil
4.	Improper mowing	Lawns cut too closely torn yellowish and often look diseased or dried	Mow enough to remove not more 1/3 of the grass height at a time. Keep mower blades sharp.

5.	Improper watering	Light sprinkling encourages shallow roots. Over watering causes diseases	Water the lawn to wet the soil about 10 to 15 cm depth.

Plant Protection

	Pest	Symptoms	Control
1.	White ants	Form small mounds around the entrance to their nests	Apply BHC 10% dust
2.	Cut worms	Eat away grass stems near the surface of the soil causing dead spots	Apply BHC 10% dust
3.	Grubs	Eat away the roots of grasses creating brownish dead patches	Apply BHC 10% dust
4.	Leafhoppers	Suck the juice from grass blased causing stripped white, then yellow and finally brown leaves	Spray Rogor 1 ml in litre of water
5.	Nematodes	Affect the roots, lawn take a bleached-out appearance	Apply nematicide Furadan at 40 g sq. metre.

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Indigenous Technological Knowledge (ITK) for Soil and Water Conservation in Madhya Pradesh, India

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Introduction

Apart from modern technology tried earlier in black soil regions of the state of M.P. (Gupta and Sharma, 1990, Sharma and Ranade, 2004; Sharma R. A. (2020), a blending and utilization of Indigenous Technical Knowledge (ITK) with modern technology and its utilization would trigger people's participation for maximizing agricultural production per unit of land. There are a lot of indigenous technologies which are utilized in rural areas for the conservation of natural resources particularly rain water, soil and efficiently utilizing them for enhancing the productivity of crops. Attempts have been made to review and summarize these prevalent indigenous techniques in rural areas of the state of Madhya Pradesh.

Indigenous Rural Technologies

There is a lot of indigenous technological knowledge (ITK) which are being practiced in rural areas for the conservation of natural resources particularly rain water, soil and efficiently utilizing them for enhancing the productivity of crops. Some of these have been summarized here.

1. Bunding / Bandhan Making / Pal making / Bori Bandhan: This ITK is adopted by all types of farmers on individual and on community basis. This is an age-old practice and has been evolved from experience of controlling floods. This practice consists of earthen bunds which are constructed manually to check runoff and impound runoff water in kharif fallow lands. The bunds are covered with grasses like *Dicanthium annulatum, Chrysopogen fulvus, Sehima nervosum* etc. Now farmers are using empty cement bas filled with soil to make bunds which they call Bori Bandhan. It is cost effective, technically feasible apart from socially acceptable and can be adopted in a big way. Advantages of this ITK are making field boundaries, use of surface area of the bund for production of grasses to account for the loss of land area due to bunding.

2. Deep ploughing in summer: This practice has been evolved from experience and ploughing in cotton growing areas since ancient time. About 1-2% of the farmers are practicing this in the villages. In this practice farmers are ploughing the land up to depth of 20-30 cm M.B. plough during summer season; it controls perennial weeds like Saccharum, Ziziphus and others. This practice is very common in Malwa plateau of M.P. It is technically suitable apart from providing comparative yield advantage of 12 to 15%. This practice is socially acceptable. This can be done in 3 years. This can be adoptable in big way.

3. Application of tank silt: This ITK is adopted by medium and big farmers on individual basis. This is an age-old practice. In this practice, during summer season tanks and ponds are de-silted and silt is transported and spread on cultivated fields. This is done by bullock carts, dumpers, trolleys and even manually. This practice should be adopted in a big way. This helps improved water storage capacity of tank and improvement in soil fertility and soil health.

4. Crop stubbles / Residue Management: This practice is most common and prevalent practice in wheat growing tracts. After harvest of wheat crop residues are put to firing or burning in fields itself. But some farmers practice incorporation of crop residue on individual basis. This has been evolved from the experience in preparation of seedbed by cultivators and is being practiced since ancient time. The incorporation of residue is done after harvest of crops by plough / bakher. This practice helps to increase moisture holding capacity along with improving organic matter content in the soil. This practice can be simplified by using implements like rotavator. This is socially acceptable and technically feasible. This practice should be adopted in a big way. This ITK improves organic matter content and water holding capacity in soil.

5. Intercultural operations: This ITK practice is followed by all categories of farmers on individual basis since ancient time. A mini blade harrow namely 'Dora' is adopted by 100 % farmers in all the villages in Malwa and Nimar regions of M.P. In this practice, after 10 to 30 DAS of kharif crops 'Dora' is operated in between the rows by one bullock pair and 2 to 4 labourers. Two or three Dora operations within a month time after sowing are most common in soybean and more so in widely spaced crops like maize, cotton etc. The cost of adoption is Rs. 350/ per hectare. This practice can be improved by tractor drawn inter-culture Dora to cover large area per unit time. This costs Rs. 7000-800/ha and comparative yield advantage is 15-20%. This practice is adoptable in a big way. It controls weeds, helps in aeration of root system, makes soil friable for better interception of rainfall; breaks capillarity to reduce evaporation and helps in earthing up of crops.

6. Strip Cropping: This ITK is adopted in erodible and sloppy areas. In this practice, sowing of soybean and maize is done with 10:10 row ratio in broad strips. Rows of soybean act like erosion resisting crop. This improves the soil and moisture conservation in the fields and is cost effective and technically feasible. It is known to reduce runoff and soil erosion.

7. Inter row Cropping: This ITK is practiced by small and medium farmers on individual basis. This is practiced for the last 25 years. Less than 5% of the problematic area is under this practice. This practice is soybean based with maize / pigeon-pea / sorghum in Kharif season in 4:2 ratios and wheat based with chickpea / linseed in rabi is sown as intercrop by Dufan / Tifan (bullock drawn) implement. The Cost of adoption is Rs. 800/ha for one pair of bullocks and 3 labourers. This helps in mitigating the aberrant weather conditions, better moisture conservation and soil fertility improvement.

8. Green capping: This ITK is adopted by all categories of farmers on individual basis. This practice is evolved from growing of vegetation on the hillocks to reduce the runoff and is in practice since ancient time. This practice covers a considerable area in the villages. In this practice, planting of grasses like *Dichanthium, Cenchrus, Chrysopogan fulvus* etc. shrubs on the hillocks, trees on slopes. There is restricted grazing on permanent pastures and grass lands. No recurring cost is involved in this practice. The pasture is regenerated automatically. This practice helps in reducing soil loss, water loss and nutrient loss. Sowing across the slope will help in increasing the time of concentration. It reduces the soil, water and nutrient losses and Increase in biomass.

9. Green manuring: This ITK is adopted by big category farmers since ancient times. Very few farmers are practicing this. In this practice, growing of green manure crops like sun hemp, sesbania and cowpea and turning at maximum vegetative growth after 1 to 1 ½ months of sowing. Turning ensures proper incorporation of green manure and adequate rainwater conservation in the field. This practice is, technically suitable apart from getting 10-15% more yield. Advantages of this practice are improvement in organic matter content soil, about 25-30 % N requirement of crop is met through N-fixation by green manure crops and also increased organic matter enhances the release of fixed nutrients form soil pool, and improvement in water holding capacity.

10. Talab / Pond: This ITK is practiced by all categories of farmers on individual basis. This is an age-old practice. About 3% of the cultivated area is covered under this practice. In this practice, pond is constructed by hiring machinery and labour on community basis to store runoff water. They can be made by putting along obstruction across the flow of water or by making dug outs. This has to be maintained every year. Due to electric power supply problem, the well water is pumped in to the tank at night and pond water is used during day time for irrigating the nearby crops by gravity. Water is used by gravity or by pumping. This practice can be adopted in a big way on community basis. This practice helps meet our domestic needs, improves water level in nearby wells, avoids water-logging of lower reaches of the fields.

11. Earthen bunds supported by vegetation: About 2 to 5% of the farmers are practicing this ITK in the problematic areas. In this method, farmers grow pigeon-pea on bunds of sloppy lands. Some farmers raise bamboo on the bunds. Few farmers grow vetiver grass for stabilizing the bunds. The cost of adoption of this practice may vary from Rs. 1000 to 3000/ha. This practice can be adopted in a big way. This practice helps in erosion control, stabilization of bunds, stabilization of banks of rivers, and water ways etc.

12. Dug Wells: This is practiced by all categories of farmers on individual basis. It is an age-old practice. In this system 2- 6 m diameter well is dug manually. The depth of the well varies from 5-12 m depending on the availability of groundwater in the shallow aquifer. The wall of the well is pitched by setting foundation stones up to a height of 1 m above the ground level. The water lifting system is installed in the well. The cost involved in this practice is Rs. 20,000 to 50,000 depending on the size of the well. This practice requires improvement as the adoptability is very good and the users take water from the wells with manually, mechanically or electric pumps or motors for domestic use and irrigation. This is socially acceptable. Dug well water is used for drinking, domestic and irrigation purpose. Dug wells ensure the use of shallow aquifers.

13. Haveli / Bharel system: This ITK is practiced by all categories of farmers on individual basis. This practice is most common in central M.P. as15-20% of the farmers of the villages follow this. In this practice, the haveli field is surrounded by earthen bunds all around and the rain water is collected in the haveli up to the month of September. This is adopted on slope up to 3%. The bund height is about 1-2 m and width 1-3. The size of the bund is increases with the increase in land slope. Before the onset of monsoon during summer season ploughing (MB plough once in 3 years) is done have lies. Harrowing is done after first showers to kill weeds. The average size of haveli is 2-6 ha. Then the water is drained off in October when the field preparation condition is achieved; sowing of Wheat, Chickpea, lentil, pulses, coriander, mustard, peas etc. is done in the receding moisture. The cost involved for making the surrounding bunds is Rs. 20000-25000 per ha. Besides, the bunds have to be maintained manually every year. This practice is the best device for reducing soil loss. Water loss and loss of nutrients, besides controlling weeds in Kharif season. Haveli system is an age-old practice. This practice controls weeds and increases yield of crops through rainwater conservation.

14. Bandh system of cultivation: This ITK is practiced by big and medium farmers on individual/community basis. This covers about 20-30% of cultivated area having low lying areas. This is an age-old practice. The construction of Bandh is usually done by manual labourer. The cost of construction of Bandh ranges from Rs. 50, 000 to 2, 50,000 (1 ha to 5 ha). The cost depends on size of Bandh and its maintenance needs of Rs. 3000 to 5000/- in alternative years. This Bandh area may be utilized to kharif crops by way of making water harvesting pond in 10% pond in 10% of area. This practice is cost effective and technically feasible apart from 10% higher yield in kharif crop by providing lifesaving irrigation during kharif season. Besides, Rabi crops are also assured. This practice is socially acceptable for adoption.

15. Tank (Talab): This Practice is adopted by large category farmers on individual and community basis. This is an age-old practice. About 1 to 3% of farmers make Talab. In this practice, 2 to 3 m deep low-lying field is excavated using bulldozer or excavators. Then the whole tank is surrounded by excavated earth. The cost of construction is 1 to 5 lakhs rupees depending on size of the tank. This tank is to be de-silted and cleaning of vegetation, garbage is to be done once in 3 to 4 years. Water lifting devices for irrigation system, fish growing, Singhara (water nut) cultivation and green capping surrounding bund may be improved for greater adoption of this practice. The tank needs bund strengthening and repairing once in 3-4 years. Advantages of the ITK are availability of water for use throughout the year, Fish and water nut cultivation possible, recharge of water table, water is available for irrigation, livestock and recreation purposes.

16. Earthen check dams: In this practice, farmer make earthen bund for creating water reservoir after recession of rains to collect lean season flow. A dam waterway is used to irrigate the fields, which are situated near the bank of waterway. Any type of water lifting device can be used for water supply. The cost of construction in Rs. 3,000- 6,000 per bund/ check dam. This structure collapses every year. This structure can be made stronger using stones and RCC. Pucca check dam is suggested at minimum cross-section of the waterway. Such check dams may be built-in series after every 100 to 200-meter length of water-way; this costs Rs. 10,000 to 35,000 per dam. This helps to supply the water to both sides of the fields. Water may be stored for a longer period, fields located on either side of the waterway get at two irrigation.

Awareness About Resource Conservation Practices

Education plays a vital role in enhancing and stabilizing the productivity in agricultural produce on a sustainable basis. It is only the agricultural education which has resulted in rapid strides in Indian agriculture since independence. It has contributed significantly in boosting up food grains production from 51 million tonnes in early fifties to 206 million tonnes at the turn of the century and achieving self-sufficiency in food and avoiding food shortages in our country. The greatest challenge in Indian agriculture in coming decades lies in the fact that the production environments are unstable and degrading and the balance between intensive and extensive agriculture is precarious. The greatest challenge would be to increase the production with ecological sustainability. This challenge can be met through proper formal as well as informal education at different levels.

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Supply / Value Chain Management

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Introduction

The term 'Value Chain' was used by Michael Porter in his book "Competitive Advantage: Creating and Sustaining superior Performance" (1985). A value chain "disaggregates a firm into its strategically relevant activities in order to understand the behaviour of costs and the existing and potential sources of differentiation". Porter's value chain consists of a "set of activities that are performed to design, produce and market, deliver and support its product".

Basic Model of Porter's Value Chain

1. The term 'Margin' implies that organizations realize a profit margin that depends on their ability to manage the linkages between all activities in the value chain.

2. In other words, the organization is able to deliver a product / service for which the customer is willing to pay more than the sum of the costs of all activities in the value chain.

Inbound logistics	Operations	Outbound logistics	Marketing and sales	Service activities
Receiving, warehousing and inventory control	Value-creating activities that transform inputs into products	Activities required to get a finished product to a customer	Activities associated with getting a buyer to purchase a product	Activities that maintain and enhance a product's value, such as customer support.

3. The linkages are flows of information, goods and services, as well as systems and processes for adjusting activities.

4. They are about seamless cooperation and information flow between the value chain activities.

Steps in Value Chain Analysis

1. Analysis of own value chain – which costs are related to every single activity.
2. Analysis of customers value chains – how does our product fit into their value chain.
3. Identification of potential cost advantages in comparison with competitors.
4. Identification of potential value added for the customer – how can our product add value to the customers value chain (e.g. lower costs or higher performance) – where does the customer see such potential.

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Supply Chain

1. The term supply chain was created by consultant Keith Oliver in 1982.

2. A supply chain is a network of organizations that are involved through upstream and downstream linkages in different processes and activities that product value in the form of products and services in the hand of the ultimate consumer.

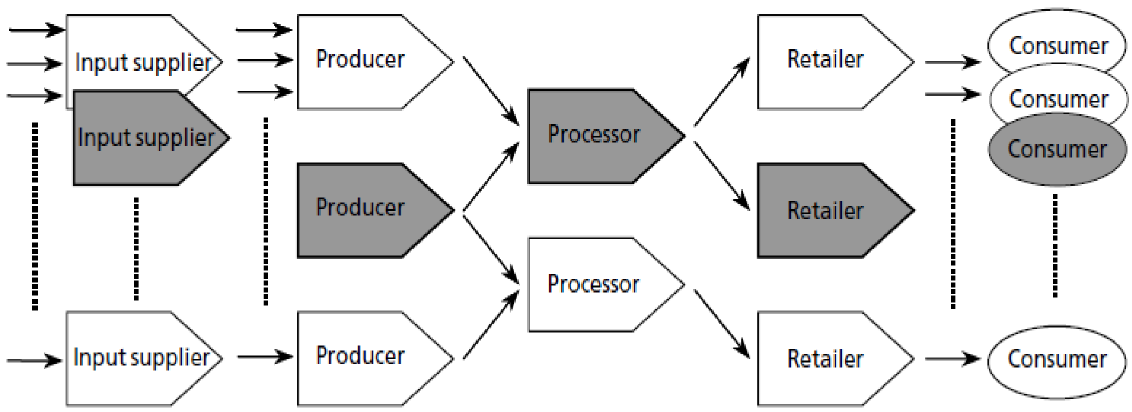
Bull-whip effect (Forrester effect):

1. The beer distribution game (Massachusetts Sloan School of Management in the USA)
2. It is not caused by external factors, e.g. consumer demand, but created by the independent actors of the supply chains themselves.
3. The main causes are the perceived demand, the quality of information and the inherent delays that may be found within the supply chain.
    a. Eliminate time delays by better planning and better use of ICT.
    b. Exchange information through ICT and collaboration among chain partners.
    c. Vertical integration.
    d. Improve the 'decision rules' at each stage of the supply chain.

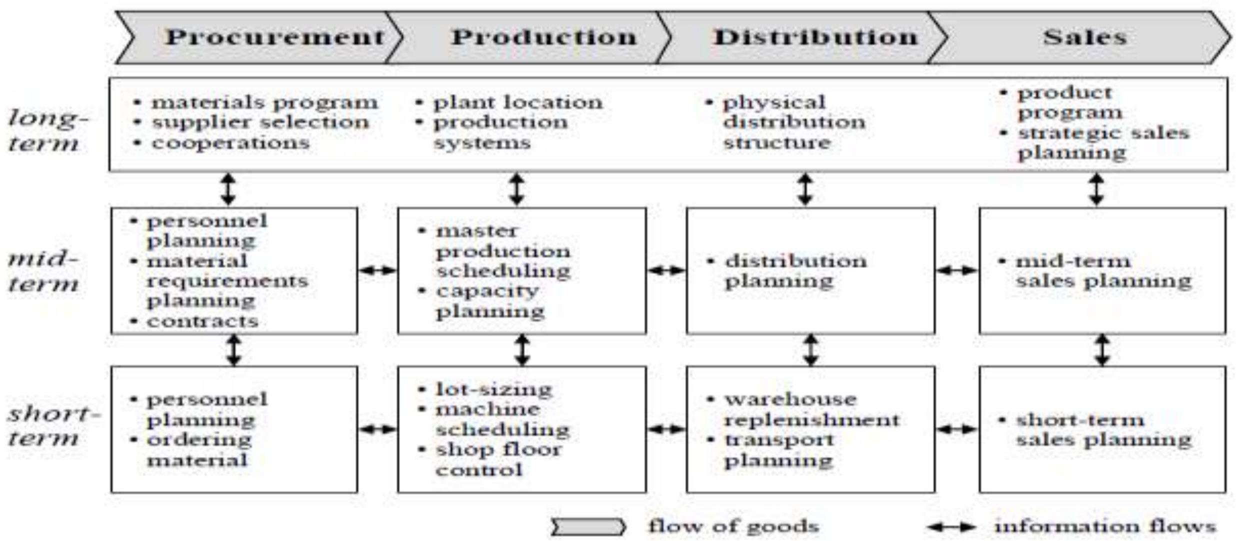
Supply Chain Management

1. Supply chain management is the "flow of material, information and fund across the entire supply chain, from procurement to production to final distribution to the consumer" (Silver et al).
2. SCM is all about effective integration of Right Product, Right Quantity, Right Quality, Right place, Right time, Right value.

Schematic diagram of a supply chain (shaded) within a total supply chain network:



Supply chain planning matrix:



1. The supply chain planning matrix provides an integrated management framework by planning horizon (strategic, tactical and operative) and supply chain process.
2. Short-term decisions are related to short-term planning and scheduling of production.
3. This operative and transactional level is related to the traditional focus of logistics and/or MRP I and MRP II concepts.

Supply Chain Analysis

1. Supply chain analysis is a process that involves evaluating each link in the chain, both separately and together, with the end goal of making the supply chain as cost-effective and efficient as possible, while also attempting to shorten the total time it takes to get a product from its earliest formative stage to completion.

2. Building a supply chain analysis requires to spend time in the following tasks:
   a. Mapping the chain (through a flowchart) to obtain an overview of the chain, the product flows, the position of the chain actors and type of interaction between the actors.
   b. Developing the economic accounts corresponding to the activities of the agents involved in the chain. This consists in quantifying the activities observed and their flow of material both in physical and in monetary terms. This allows the analyst to assess the relative importance of the different segments or sub-chains of the chain, which in turn will allow an appropriate use of time and resources.

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Nutraceuticals: Categories and Therapeutic Benefits

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Summary

The customers are deeply involved approximately how their fitness care is controlled administered and priced. Located at the interface between meals and capsules, a growing body of merchandise is assuming importance; the customer is now searching out complementary or opportunity beneficial products and that's why these days they may be the use of Nutraceuticals. Useful ingredients and Nutraceuticals products represent a price-added boom opportunity both regionally and across the world. Improvement of better characterized and research-verified products will assist decorate client confidence in Nutraceuticals and useful food merchandise within the world.

Introduction

In 1989 Dr. Stephen coined the period "Nutraceuticals" which is a mixture of vitamins and pharmaceuticals. Nutraceuticals has a come lengthy manner because a new trend inside the care of partner animals emerged inside the 1990's and comparable trends in the human area as well. The term Nutraceuticals isn't well commonplace on global, regulatory structures at the same moment as nutritional supplements are taken into consideration to be greater outstanding. Currently, over 470 Nutraceuticals and useful food merchandise is available with documented fitness benefits.

Plants are one of the most vital assets of human meals and medicines. Hastily growing expertise on nutrition, medicine, and plant biotechnology has dramatically modified the ideas about food, fitness, and agriculture, and brought in a revolution on them. New concepts have seemed with this trend, inclusive of Nutraceuticals, nutritional therapeutics, phytonutrients, and phototherapy. Those purposeful or medicinal meals and phytonutrients or phytomedicines play fantastic roles in enhancing fitness and improving immune function to save you unique sicknesses and additionally hold outstanding promise to lessen facet results and fitness care prices. The latest examine reviews that 70% of sufferers generally seek advice from a clinical practitioner before or at some point of traditional therapy, shows the disapproval of natural remedy. But the sufferers are a good deal aware of the side effects; contraindications prompted due to the chemical marketers in quick and long-time therapy. Hence, the interest to prevent a medicinal drug from each small sickness came into the trend and therefore caused new studies on alternative treatment plans preferably with the assist of dietary strategies. This evaluates provides highlights of unusual essential information concerning the remedial use of Nutraceuticals as the economic and conventional remedies.

Concept of Nutraceuticals

Nutraceutical a combination of the word's "nourishment" and "pharmaceutical," is a food or food item that purportedly gives wellbeing and health advantages, including the avoidance and treatment of illness. But in the case of nutrition, there was no verification method for foods in preventing diseases in the past. In current years but, as food composition has been scientifically tested to motive existence style-related sicknesses, and has come to be a social issue. The Nutraceuticals products are diagnosed and bring fitness advantages like alleviating the danger of most cancers and heart disorder and additionally to prevent or deal with hypertension, high cholesterol, immoderate weight, osteoporosis, diabetes, arthritis, macular degeneration (leading to irreversible blindness), cataracts, menopausal symptoms, insomnia, dwindled reminiscence and attention, digestive upsets and constipation, other products are touted as healing procedures for thinning hair, lack of confidence, poor complexion, varicose veins, alcoholism, depression, and lethargy. The concept of Nutraceuticals has started to be acknowledged as one of the measures for preventing such diseases. India is the house of a big quantity of medicinal herbs, spices, and tree species that have a significantly large domestic market. The useful foods and Nutraceuticals are available as conventional Indian Ayurveda drug treatments in India and advertised in special logo names. But no strict pharmaceutical policies are to be had for the Ayurveda and Nutraceuticals health merchandise in India; they are available to the general public as over the counter without any medical prescription. India holds a substantial share of the global practical food and Nutraceuticals market and trading's products to numerous countries.

Categories of Nutraceuticals

1. Dietary Supplements including botanicals:

a. Vitamins, minerals, co-enzyme Q, carnitine.
b. Gingsing, Gingko Biloba, Saint John's Wort, Saw Palmetto.

2. Functional Foods: A food product that is part of usual diet but has beneficial effects that go beyond the traditional nutritional effects. Examples:

a. Yogurts - Probiotics for intestinal health.
b. Foods/cereals/snacks enriched with soluble fibres, vitamins and minerals.
c. Omega-3 milk in prevention of heart disease.

3. Medicinal Foods:

a. Health bars with added medications.
b. Transgenic cows and lacto-ferrin for immune enhancement.
c. Transgenic plants for oral vaccination against infectious diseases.

Therapeutic Applications

Nutraceuticals Ingredients	Therapeutic Applications
Probiotics, Prebiotics	Bone and Joint Health
Vitamins, Antioxidants	Cancer Risk Reduction
Soya based ingredient	Cardiovascular Health
Minerals	Maternal and Infant Health
Nutritional lipids and oil	Immune system
Fibres and carbohydrates	Energy and Eye Health
Dairy base ingredients	Skin Health, Respiratory Health Weight Management Cognitive and Mental function

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	Cholesterol Reduction

Conclusion

The guideline presents noteworthy difficulties to the globalization of Nutraceuticals from multiple points of view. Chiefly, the administrative variety between nations impedes worldwide exchange and promoting. For example, a large portion of the nations talked about adopting a casual strategy to the guideline, yet China's procedure for dietary enhancement endorsement includes an exacting testing convention, under the US procedure for pharmaceutical endorsement. Not at all like DSHEA, the guidelines of certain countries don't appear to give sufficient qualification between food, medicate and Nutraceuticals. Additionally, tragically, Nutraceuticals now and then end up in a similar administrative classification as regular nourishments: normalization of portion and strategy for conveyance to improve the adequacy and medical advantages could beat this. In this way, there is an unequivocal need to examine Nutraceuticals portion related issues. It is basic to test and manage the utilization of Nutraceuticals practically and effectively as to livestock. This can offer superior wellbeing, not exclusively to those refined creatures, yet to people who devour them.

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Mycotoxins - Their Impact on Health Issue and its Management

Article ID: 31494

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Introduction About Mycotoxin

The term mycotoxin is derived from the greek word 'mykes' meaning fungus and Latin word 'toxicum' meaning poison. Mycotoxins are secondary fungal metabolites that cause pathological or undesirable physiological responses in human and other animals. *Fusarium moniliformae* associated with maize seeds caused human toxicosis in 1881. First record of toxicosis in animal caused by aflatoxin producing Aspergillus was occurred in 1891. Sakaki (Japan) demonstrated that ethanol extract from moldy, unpolished yellow rice feed to doges, gunea pigs and rabbits, caused paralysis of nervous system. In 1940, Miyake et al., reported production of highly toxic metabolite named *Citreovirdin* by *Penicillium toxicarium* infecting yellow rice. First reliable account of toxin production by a fungus *(Penicillium puberulum)* was given by Pitt (1991). Udagava (1988) reported red mold poisoning in many parts of rural Japan in the 1950, which was due to Deoxynivalenol (DON) contamination. Thousands of people were affected by DON toxicosis in the Kashmir valley in 1987. In 1960, turkey X disease caused by an aflatoxin produced by Aspergillus flavus, resulted in the death of 10,000 turkey birds in England.

Mycotoxicoses

Mycotoxicoses are diseases caused by the ingestion of foods or feeds contaminated by mycotoxins.

Major Groups of Fungus That Producing Mycotoxins

Aspergillus, Penicillium, Alternaria and Fusarium are amongst the most common mycotoxin-producing fungal species associated with growth in and damage to food crops in the field and in store.

1. Aspergillus: About 30 species of Aspergillus or their teleomorphs are associated with food spoilage. Mycotoxins produced by Aspergillus flavus include aflatoxins and cyclopiazonic acid. Other important mycotoxins from Aspergilli include ochratoxin A and patulin. Aspergillus species tend to be associated more with tropical and warm temperate crops, since they prefer to grow at relatively high temperatures.

2. Penicillium: Penicillium is a large genus containing 150 recognized species, of which 50 or more occur commonly. Many species of Penicillium are isolated from foods causing spoilage; in addition, some may produce bioactive compounds. Important mycotoxins produced by Penicillium include ochratoxin A, patulin, citrinin and penitrem A. Some of the most important toxigenic species in foods are *Penicillium expansum, P. citrinum, P. crustosum* and *P. verrucosum*. Penicillium species are associated more with cool temperate and temperate crops, mainly cereals, since most species do not grow very well above 25-30ºC.

3. Alternaria: Alternaria species are plant pathogens that can produce toxins in both pre- and post-harvest commodities. They are characterized by very large brown conidia with a characteristic "beak" at the tip. The species *A. alternata* and *A. tenuissima* are pathogenic to a wide range of crops.

4. Fusarium: Fusarium species are mainly plant pathogens and normally occur in association with plants and cultivated soils. Typically, able to grow only at higher water activities, damage is usually confined to pre-harvest, for cereals, or immediately post-harvest.

Kinds of Mycotoxins

1. Aflatoxins: Afltoxins are mycotoxins produced by *Aspergillus flavus* and *A. parasiticus*. *A. flavus* produce aflatoxin B_1 and B_2 and *A. parasiticus*, Aflatoxin G_1, G_2, M_1 and M_2 as well as B_1 and B_2. Afltoxin B_1 is the most potent and carcinogenic naturally occurring substance known, causing liver damage to most domestic and experimental animals and humans. The most common aflatoxins are B_1 and B_2 found in agricultural commodities and M_1 secreted in milk by dairy cattle consuming aflatoxin contaminated food or fodder. In most cases, aflatoxins are formed after harvest. Aflatoxin cause diseases such as hepatitis, hepatocarcinoma and Reye's syndrome due to consumption of aflatoxin contaminated food.

2. Ochratoxin A (OTA): Octratoxin A is produced by *Aspergillus alliaceus, A. melleus, A.ochraceus, A.ostianus, A. petracii, A.sclerotioum* and *penicillium chrysogenum, P. puberulum, P. variabile, P. verrucosum and P. viridicatum*. It is an acute nephrotoxin with an oral LD-50 of 20 mg/kg in young rats and 3.6 mg/kg. in day old chicks. It can act as a carcinogen, nephrotoxin, hepatotoxin, mutagen, teratogen and immunosuppressive agent.

3. Trichothecens: Trichothecens are produced by several fungal genera viz., *Cephalosporium, Cylindrocarpon, Fusarium, Myrothecium, Phomopsis, Trichothecium*. However, most of the trichothecens are isolated and characterized from *Fusarium*. Toxicoses caused by trichothecens include vomiting, food refual, skin irritation, hemorrhagic lesions in gut, necrosis of esophageal mucosa, teratogenicity and carcinogenicity.

4. Ergot alkaloids: Ergot alkaloids produced by *Claviceps* are associated with rye and triticale. Alkaloids consumption may result in gangrene, leading to necrosis of extremities; central nervous system effects include anaxia, convulsions, paralysis and gastrointestinal disorders. Ergotism is the mycotoxicoses caused due to consumption of food and feed containing mycotoxins produced by the fungus *Claviceps purpurea.*

5. Patulin: Patulin is produced by many species of *Aspergillius* (*A. clavatus*) and *Penicillium* (*P. patulum* and *P. expansum*). Patulin is produced by *P. expansum* in rotten apples and apple juice. The toxicity by oral intake is low, so is poses little threate to humans.

6. Zearalenone: It is produced by *F. roseum* and *F. tricinctum*. It results in estrogenic and anabolic activity in animals and is associated with reddening and swelling of the vulva, uterine enlargement and carcinogenic. It occurs in cereals and in animal feed.

7. Deoxynivalenol (DON): It is produced by *F. graminearum* and *F. culmorum* found in maize, wheat and other grains. It causes livestock toxicoses, feedrefusal, inhibites protein synthesis, suppress immune system.

8. Fumonisins: These are highly water soluble. It produced by *F. verticilloides*. Fumonisin B_1, B_2, B_3 and A_1 and A_2 are produce, of which B_1 and B_2 are highly toxic and common. Fumonisins are carcinogenic a human.

9. Penicillic acid: It is produced by ***P. aurantiogriseum*** and ***P. puberulum*** and occurs in maize and poultry diets. It produces carcinogenic, cardiotoxin and cytotoxin effects. It has not been reported to cause animal or human mycotoxicoses.

10. Sterigmatocyctin: It is produced by species of ***Aspergillus, Bipolaris*** and ***Penicillium***. It is one of the precursors in aflatoxin biosynthesis pathway. It is mutagenic and carcinogenic.

11. Citreoviridin: It is produced by ***P. ochrosanmoneum*** and ***T. citreonigrum*.** It is aneurotoxin. The disease beriberi, known in Japan as acute cardiac beriberi has been associated with consumption of moldy yellow rice.

12. Citrinin: It was discovered as an antibiotic during the 1940, but proved too toxic for therapeutic use. It is considered a hazardous mycotoxin. It is produced by ***P. citrinum, P. verrucosun*** and ***Aspergillus ferreus***. It is anephrotoxin that occurs in apple juice, barley, oats, peanuts, rye and wheat. It causes kidney degeneration and watery diarrhoea.

Management of Mycotoxin Production

Mycotoxin production in seed can be reduced by one or combination of the following method.

1. Storage condition: Seed should be stored under conditions that retard of prevent growth of storage fungi. Most toxicogenic *Aspergillus* does not grow at 4˚C or blow. With small seeds, RH of less than 75% (13-15% moisture) inhibited growth of storage fungi. Concentration of CO_2 between 20 and 60% prevent significantly and reduce mycotoxin production by *Aspergillus, Penicillium* and *Fusarium*.

2. Cultural operations:

a. Irrigation: Avoid water stress condition in maize to reduce aflatoxin production.

b. Harvest stage: In maize reduction in aflatoxin B_1 is associated with early planting and low harvest moisture. Ginning of harvested cotton by the third day after harvest, minimized aflatoxin production by *A. flavus*.

3. Sorting of grains: Sclerotia of ***C. purpurea*** can be separated from healthy seeds by immersing contaminated seed lots in water. Air screen cleaners are used to remove broken and infected seeds.

4. Chemical treatment: Prevention of mould growth by chemical, especially propionic acid limit mycotoxin production. Use of ammonium and sodium bicarbonate reduced the growth of ***A. parasiticus*** on maize seeds. **Draughon** (1983) reported that the insecticides bux, carbaryl and diphonate reduced the aflatoxin levels in naturally infected maize by more than 85%. Mineral oil and highly saturated soybean oil reduced pea seed infection by ***A. flavus*** by 50%; when applied to seeds at 5ml/kg.

5. Biological control: Amicroorganisms are potential biological control agents for reducing aflatoxin contamination. Treatment of maize with mycocurb, a mould inhibitor inhibited ***A. flavus*** growth and aflatoxin levels.

6. Detoxification: Detoxification becomes a second line of defence. More than 75% degradation of aflatoxin B_1 occurred in copra meal and peanut after treatment with 16 and 35 mg chlorine gas per gram of substrate, respectively. The most effective and suitable chemical for aflatoxin detoxification is ammonium bicarbonate (3%), which reduces aflatoxin B_1 by 80% in maize and peanut.

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White Angel in a Dark Moon

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Abstract

Mushrooms are large reproductive structures of edible fungi belonging to either Basidiomycota or Ascomycota. Majority of the edible mushrooms belong to Basidiomycota. Their sexual fruiting body (basidiocarp/sporocarps) is otherwise called Mushrooms. A mushroom is the macroscopic, fleshy, spore-bearing fruiting body of a fungus, typically produced above ground, on soil, or on its food source.

They can be defined as achlorophyllous, eukaryotic, filamentous structures which are bound by a cell wall, made up of cellulose or chitin or both. The mushrooms comprise a large heterogeneous group having various shapes, size, colour, appearance and edibility.

Mushrooms are low in calories, fat free, cholesterol free, gluten free, very low in sodium and vitamins like B, C, vitamin D, riboflavin, thiamine nicotinic acid. Minerals such as potassium, iron, copper, zinc and manganese are high in fruit bodies. However, the common term, mushroom often refers to the fruiting body of gill fungi (Basidiomycota) of the 2000 edible species known, only 20 are commercially cultivated.

Keywords: Oyster mushroom, *Pleurotus ostreatu* and Paddy straw.

Introduction

Pleurotus ostreatus (Oyster Mushroom) is a common edible mushroom. It was first cultivated in Germany as a subsistence measure during World War I and species of *Pleurotus* may be called **oyster** or **tree mushrooms**, and they are one of the most widely consumed mushrooms in the world.

Pleurotus fungi are found in both tropical and temperate climates throughout the world. Oyster mushroom (*Pleurotus* sp.) belonging to Class: Basidiomycetes and Family: Agaricaceae is popularly known as **'Dhingri'** in India. It is rich in Vitamin C and B complex and the protein content varies between 1.6 to 2.5 percent and mineral salts required for the human body.

The niacin content is about ten times higher than any other vegetables. The folic acid present in oyster mushrooms helps to cure anaemia. Mushrooms have antioxidant properties due to the presence of compounds like Ergothioneine.

Production Technology of White Angel (Oyster Mushroom)

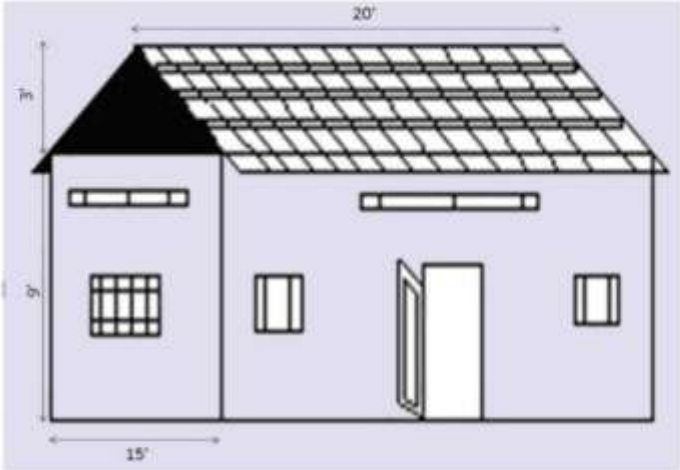
Mushroom shed: Thatched shed is preferred for mushroom growing. Sheds are built in east west direction to avoid direct effect of sun and to reduce the temperature inside the house. The floor of the shed is filled with sand to a uniform height of 15-30 cm. Inner walls of the shed are lined with jute gunny bags. Water is sprinkled twice in a day on the floor and gunny bags to maintain the required relative humidity and temperature.

Spawn (Mushroom Seedling):

1. Suitable substrate: White sorghum, Maize or, Wheat grains

2. Preparation of spawn: Half cooked grains, air dried, mixed with calcium carbonate powder at 20g/kg, fill the grains in empty glucose drip bottles or polyphone bag (28x12.5cm in size) plug with non-absorbent cotton and sterilize in the cooker for 2 hours or autoclave for 15 psi (121.1°C) for 20-30 minutes.

3. Put the pure culture of the fungus and incubate at room temperature for 15 days (Use 15-18 days old spawn for spawning).



Select the Substrate and Sterilization

1. Suitable substrate: Paddy/wheat straw, sugarcane bagasse and hulled maize cobs.
2. Cooking of substrate (Pasteurization): Cut into 5cm bits, soak in potable water for 5 hrs, boil water for one hour, drain the water, air dry to 65% moisture (no water drips when squeezed between hands).

Polypropylene Bags

Use 60x30 cm polythene bags of 80-100-gauge thickness.

Preparation of Mushroom Bed - Poly Bag Method (Spawning)

Twist the processed straw into a rope of 10cm thickness and coil it to the diameter of the polybag. Place the coiled straw in the bottom of the bag to a height of 5 cm, sprinkle 25 g of spawn. Place another coil of 10 cm thickness. Repeat the process to get four layers of spawn and 5 layers of straw. The last layer of straw is of 5 cm height.

Make the bag compact and tie the mouth with a twine. Punch around 8-10 holes in the bag at random with a sterilized rod for good aeration. Arrange beds in tiers in the spawn running room (Temp. 20-30°C and Relative humidity 80-85%). After the 13-15th day of spawn running period, transfer the beds to the cropping room. Maintain cropping conditions. After the mushroom sprouts from the bag spray a fine mist of water on the fruiting to maintain the moisture.

Harvest and Yield

Mushroom pinheads appear on 5-7 days after spawn running stage on the punched holes. Matured mushrooms can be seen 3-4 days after pinhead formation. Harvest matured mushrooms by pulling them along with the rhizoids (Self life: 1-3days), before spraying water. New holes may be provided after the first harvest. Second and third harvest can be obtained after weekly intervals (Yield: 400-600g/500g bed). The entire crop cycle will be over in 40-45 days.

Calculation

The edible fungi (Oyster mushroom) cultivation is a regulated bio-conservation of agricultural waste and residues. Mushroom cultivation suits very well with sustainable agriculture and has many benefits. Mushroom growing suits very well with sustainable agriculture and has many economic benefits. It uses agricultural waste products. High production per surface area can be obtained, and a good soil conditioner is still after picking the spent substrate. The Mushrooms are excellent cash crops. Hence, oyster mushroom fruiting bodies can be used frequently in their diet as a protein supplement or as an alternative protein supplement. The oyster mushroom's low lipid and high fiber content makes it beneficial food items for health, particularly against heart disease and diabetes.

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White Angel (Oyster Mushroom) Cultivation Process

Sterilized paddy straw

Shade dry

Bed preparation

Spawn running stage

Initial budding

Initial fruiting body

Ready for harvesting
(White Angel in a Dark Moon)

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The Overview of Government Subsidies to Agriculture Sector in India

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Introduction

Government of India performs a significantly diverse responsibility in development of our agrarian economy which primarily includes self-sufficiency, employment generation, sustenance to small-scale cultivators for endorsement of advanced technologies and modernised inputs, decline in price fickleness and improvement of the net returns of farm households taking a variety of forms like import export policies and domestic policies such as price support programmes, direct payments, and input subsidies to influence the cost and availability of farm inputs viz. credit, fertilizers, seeds, irrigation water, etc. In practice, stepping up agricultural productivity has been a powerful mechanism especially in larger economies (Gollin, 2010). Furthermore, it has also been noted that the structure within agriculture also changes – away from staples and towards income-elastic foods such as fruits, vegetables, milk, meat and eggs (Timmer, 1988). Among all the domestic support mechanisms related to production, input subsidies and product price backing are the most familiar. Numerous advantages are mentioned in extenuating commodity subsidies such as economic, environmental as well as social. Input subsidies chiefly on fertilizers, irrigation water and electricity contribute a remarkable proportion in agricultural subsidies in our country that can provide economical welfare to the society, moreover, fertilizer subsidy has captivated abundant attentiveness of policymakers, and researchers in the recent past. An agricultural subsidy, many a time considered as the antithesis of tax, is an implement of fiscal policy and a governmental budgetary assistance remunerative to the peasants and agribusinesses to complement their monetary income, administer the supply of different products, and impact the cost and supply of such inputs. Derived from the Latin word "subsidium", a subsidy literally connotes coming to assistance from behind. The major recognizable ambition of various forms of subsidies, cash payment to the producers or consumers by the medium of constituting a wedge between consumer prices and producer costs, lead to changes in demand or supply decisions. Notwithstanding, it also possess certain imperceptible forms, additionally, it may be concealed in reduced tax liability, low interest government loans or government equity participation. If the government procures goods, such as food grains, at higher than market prices or if it sells as lower than market prices, subsidies are generally implied.

Different Types of Agricultural Subsidies Given to Farmers in India

1. Fertilizer subsidy: Fertilizer subsidy measures the difference between prices paid to the manufacturer of fertilizer and price received from farmers and rest of the burden is borne by the government, additionally, it disburses inexpensive inorganic and organic fertilisers among the farmers.

This subsidy assures:

a. Cheap inputs to farmers,
b. Reasonable returns to manufacturer,
c. Stability in fertilizer prices, and
d. Availability of fertilisers to farmers in adequate quantity at the time of requirement.

2. Power subsidy: The power or electricity subsidies imply that the government charges low rates for the electricity supplied to the farmers mainly utilized for irrigation purposes and it acts as an incentive to farmers to invest in pumping sets, bore-wells, tube wells etc. It is the difference between the cost of generating and distributing electricity to farmers and price received from them.

3. Irrigation subsidy: It is the difference between operation and maintenance expenditure of irrigation infrastructure and irrigation charges recovered from farmers that may work through provisions of public goods viz. canals, dams, tube wells etc. which the government constructs and charges low prices compared to the markets rates or no prices at all in exceptional cases from the farmers.

4. Seed subsidy: Seeds of high yielding varieties can be contributed by the government at minimum expenses and also at future payment alternatives. The research and developmental happenings required to yield such type of productive seeds are also attempted by the government, additionally, the expenditure on these is a sort of subsidy granted to the cultivators.

5. Export subsidy: It is given to the peasants to confront the international achievements; moreover, agricultural exports are especially encouraged as long as these do not create hazard to the domestic economy and subsides provided to promote exports are designated as export subsidies. When a farmer or exporter sells products in foreign markets, he can earn money for himself including foreign exchange for our nation.

6. Credit subsidy: It is the difference between interest charged from farmers and actual cost of providing credit, plus other costs such as write-offs bad loans. Availability of credit is one of the greatest miseries for poor farmers and they do not have adequate cash to purchase agricultural implements and cannot approach the credit market due to dearth of collateral required for loans. For carrying out production, they generally reach the local money lenders and taking advantages of the helplessness of poor peasants, the lenders charge very high rates of interest. Many a times even the farmers possessing some collateral cannot avail loans because banking institutions are chiefly urban based and they do not indulge in agricultural credit operations, which is considered to be quite risky.

With the objective to tackle those problems, the government have given following provisions:

a. More banking operations in rural areas which can advance agricultural loans,
b. The interest rates can be maintained low through subsidization schemes, and
c. The terms of credit like collateral requirements can be given relaxation to the poor.

7. Infrastructure subsidy: Private attempts in several regions do not prove to be enough to recuperate crop productivity. Better transport and storage facilities, electricity, information regarding market, transportation to the ports, etc. are important for production and sales and no individual farmer can come forward to furnish those facilities due to their bulkiness and inherent constraints related to revenue collections. Hence, the government takes the charge of contributing this proficiency and considering the situation of farmers, a lower price can be charged from the poorer cultivators.

8. Input subsidy: These can be accepted through the distribution of inputs at prices less than the standard market price for the inputs. The magnitude of subsidy is accordingly equal to the difference between two prices for per unit of input distributed.

9. Price subsidy: It is the difference between the price of food grains at which Food Corporation of India procures them from farmers, and the price at which PCI sells either to traders or to the Public Distribution System. In some cases, market price falls too low that the farmers will have to bear losses instead of making profits, and then the government may promise to buy the crop from the farmers at a price which is higher than the market price. The price at which government purchases crops from the farmers is called procurement price which encourages them to cultivate crops which are regularly procured.

Policy Instruments of Farm Subsidy

1. Price and income support policy: Government of India has numerous policies to defend the interest of farmers and the main price and income support instruments are:

a. Minimum Support Price (MSP): While calculating the cost of cultivation, the CACP considers the cost of paid out inputs, imputed value of family labour, and rented land. MSP are announced before commencement of sowing operations of a crop and are generally remunerative and higher than the production cost.

b. Minimum Export Price (MEP): The government disallows the export of particular commodity such as onion, pulses, rice, edible oils etc. below specific price using MEP to check domestic price rise, augment the supply within domestic market, and help the farmers and exporters to realize better and remunerative prices.

c. Market Intervention Price (MIP): It is a price support mechanism implemented by central government on request of state governments for procurement of perishable and horticultural commodities in the event of a fall in market prices. The scheme is implemented when there is at least 10% increase in production or 10% decrease in the ruling rates over the previous normal year.

d. Buffer Stocks Operations: The government maintains buffer stocks of food grains (rice/ wheat) and other commodities (pulses) procured by its agencies via MSP or other procurement schemes to check sudden price rise of commodities and any such other contingencies.

e. Public Distribution System: Distribution of subsidized food to poor Indian is at the core of India's food security system. It is operated through the TPDS and managed by the FCI, which is also responsible for procurement and buffer stocks of grains.

2. Research and development support: The government implements schemes to amplify the public investment in R & D with concentration on enhancing crop production and productivity.

3. Input subsidies: Central and state governments afford input subsidies through fertilizers, power, irrigation and seeds. Co-operative societies and regional rural banks including commercial banks are needed to provide credit to producers below the market interest rates.

4. Import measures: Government imposes tariffs, quota, state trading and monitoring agencies as import measures to provide indirect subsidies.

5. Export measures: This involves means to accelerate exports and the key factors include agri-export zones, incentives and price support on farm exports, and establishment of various promotional councils.

Conclusion

India occupies an enormous amount of arable lands and consumes lot of investments in agricultural sector but a considerable abatement was noticed in provision of fund towards this area in five years plan and annual budgets in accordance with subsidies. The quantity and prevalence of agricultural subsidies is increasing day by day along with the enhancement in total cultivated land & investment which is ultimately taking the responsibility of slow growth of agrarian economy in our country and less contribution in gross domestic product. The government of India conveyed momentous measures for improvement of agricultural section and subsidies are one of the remarkable tools for assisting vigorous crop production in India. In conclusion, efforts are dominating at the complete fledge from the government to make the lives of farmers comfortable and easy. Subsequently, ranging from the raw material procurement to the complex marketing and infrastructure, the centre is aiding all along the way. Furthermore, all the schemes are effortless to attain, thereby facilitating their lives uncomplicated. As a result, the bigger picture would be the improvement of Indian economy.

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GIS and its Application in Agriculture

Article ID: 31497

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Introduction

Geographic Information Systems (GIS), Software systems with capability for input, storage, manipulation / analysis and output / display of geographic (spatial) information. A system of integrated computer-based tools for Processing (capture, storage, retrieval, analysis, display) of data using location on the earth's surface for interrelation in support of operations management, decision making, and science, set of integrated tools for spatial analysis, encompasses end-to-end processing of data, capture, storage, retrieval, analysis/modification, display, uses explicit location on earth's surface to relate data.

Significance of GIS

1. 80% of local government activities estimated to be geographically based.

2. Military and defence:

a. Battlefield management.
b. Satellite imagery interpretation.

3. Scientific research employs: Agriculture, veterinary, fisheries, environmental etc.

4. Local Government:

a. Public works/infrastructure management (roads, water, sewer).
b. Planning and environmental management.
c. Property records and appraisal.

5. Real Estate and Marketing: Retail site selection, site evaluation.

6. Public safety: Crime analysis, fire prevention, emergency management.

7. Natural resource exploration/extraction: Petroleum, minerals.

8. Transportation: Airline route planning, transportation planning / modelling.

GIS – Integrating Technology

1. Data in GIS: GIS holds spatial information in independent layers, integrates layers by registering them to a common locational reference. Thematic layers can all be made visible at the same time or selectively and linked by common location. Allows overlaying to get homogenous land units and other types of information allows collating data from several layers for any location.

2. The GIS Data Model: Allows the geographic features in real world locations to be digitally represented and stored in a database so that they can be abstractly presented in map (analog) form, and can also be worked with and manipulated to address some problem.

3. Spatial and Attribute Data: Spatial data (where):

a. Specifies location.
b. Stored in a shape file, geo-database or similar geographic file.

4. Attribute (descriptive) data (what, how much, when):

a. Specifies characteristics at that location, natural or human-created.
b. stored in a data base table.

5. Representing Data with Raster Models:

a. Area is covered by grid with equal- sized, square cells.
b. Attributes are recorded by assigning each cell a single value based on the majority feature in the cell, such as land use type.
c. Image data is a special case of raster data in which the "attribute" is a reflectance value.

6. Representing Data with Vector Models:
The fundamental concept of vector GIS is that all geographic features in the real work can be represented either as:

Points or dots (nodes)	Trees, poles, fire plugs, airports
Lines (arcs)	streams, streets, sewers
areas (polygons)	cities, districts

Building a GIS

1. Data Base Design:
    a. Area boundaries.
    b. Co-ordinate system data layers.
    c. Features for each layer.
    d. Attributes for each feature type.
    e. Coding and organizing attribute data.
2. Entering spatial data from maps for each layer.
3. Creating topology.
4. Entering attribute data.
5. Managing the data base.
6. Presenting maps in customized form.

Sampling Methods

1. Grid Sampling: It is an intensive sampling of entire field. Data is collected for each cell or point and multiple samples are combined into each cell or point sample.
2. Direct Sampling: It is an intensive sampling of particular target areas. Sampling zones are established based on knowledge on field GPS used to locate sample points and areas of interest intensively sampled while the others are lightly sampled.

Application of GIS In Agriculture

In agriculture, there is an urgent need to generate and disseminate a specific system for the management of crops, soils, input and natural resources to sustain high productivity and maximum profit as conventional systems have several problems.

Conventional systems of crop production forecasting have several problems like variations in statistical figures, lack of availability of data, difficult in storing and retrieval, lack of timely information.

The solution for providing food security to all people of the world without affecting the Agro- ecological balance lies in the adaptation of new research tools, particularly from Aaerospace Remote Sensing, and combining them with conventional as well as frontier technologies like Geographic Information Systems (GIS). Remote Sensing, GPS and GIS are becoming fast and effective tools for extracting information of complex and dynamic agricultural system.

GIS technology are being effectively utilized in India in several areas of Agriculture and Soils. The major areas of Remote Sensing and GIS applications in Agriculture include Crop/land use inventory (crop acreage - and yield estimation; crop condition assessment; cropping system analysis), Soils resource inventory, Land degradation study, Soil erosion hazard assessment, Soil conservation planning of watershed and Land evaluation for land use planning.

Crop inventory related applications comprise of:

1. Identification of crop covers.
2. Acreage estimation.
3. Predicting crop yield per unit land area.
4. Cropping system analysis.

Crop yield modelling, Crop yield is influenced by several factors such as:

1. Crop genotype.
2. Soil characteristics.
3. Agronomic practices.
4. Weather conditions.
5. Biotic stresses.
6. The spectral data of crop.

Methodological Aspects of Various Modelling Approaches

1. Spectral yield models: There are two types:

a. Integrated yield models.

b. Agromet-spectral yield models.

2. Agro-Ecological Zone based Land Use Planning: AEZ encompasses the delineation of landscapes into regions or zones that are broadly homogeneous with respect to Agro-climate, soils, terrain characteristics, Agro-climate, soils and terrain characteristics are also relatively uniform with respect to crop production possibilities. GIS Technology is very useful for automated logical integration of bioclimatic, terrain and soil resource information which are required for delineating AEZ in a region.

3. Yield Maps: It is a record of spatial yield variability within a field or farm. GPS Data is coupled with yield data to produce map which shows whether it is mechanically harvested/hand harvested. It also shows total yield of a specific area.

4. Field Scouting: Field can be scouted for a variety of pests and pest populations can be recorded on maps which can be applied on a site-specific basis as required.

5. Soil Erosion Inventory: GIS techniques are being effectively used in India for preparation of soil erosion inventories by integration of physiography, soils, land use/ land cover, slope map layers and use of ancillary data of Agro-met and soil physio-chemical properties. DEM generated slope and slope length and ancillary Agromet and soil characteristic data were used to assess erosional soil loss according to Universal Soil Loss Equation (USLE) in a GIS environment. The basic equation of the USLE model is –

A = R.K.LS.C. P

Where, A is estimated soil loss (t/ha/year); R is rainfall erosivity factor; K is Soil erodibility factor; LS is slope and slope length factor; C is landcover factor and P is conservation practice factor.

Conclusion

1. GIS is a computer-based tool for geographic analysis.
2. It is not a map, nor does is store maps. IT STORES DATA.
3. Central concept:
   a. Separation of spatial and attribute data for entry.
   b. Their linkage for analysis.
4. Database management concepts are central to GIS.
5. Spatial data in two formats: Vector & Raster.
6. Keep note of map projections / scale to transform information to real-world terms.

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Deficit Irrigation: A Vista to Allay Agricultural Water Use

Article ID: 31498

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Introduction

Water, the fuel that sustains life has been over exploited and over used for past few decades, driving it into the status of a limited or rare resource. Incredibly agriculture turns out to be the largest consumer of freshwater. In India, 71 per cent of water withdrawal accounts to agriculture and livestock sector (FAO, 2010). The prime aim of irrigation focuses on maximum profit, maximum yield per unit land and maximum yield per unit water (Vaux and Pruitt, 1983). Under the present era of climate change and water scarcity, it is important to increase the efficiency of irrigation systems as well as the water productivity i.e. 'per drop more crop'. Therefore, each drop of water is determinant to meet the food demands of the increasing population. Deficit irrigation is one of the promising methods to ensure the optimal use of allocated water.

The concept of deficit irrigation (DI) born on 1970s refers to the application of water below full crop water requirement. The objectives of deficit irrigation are to increase the water use efficiency of a crop by eliminating irrigation that have little impact on yield, reduce the amount of water used for irrigating crops and acclimatize plants to certain degree of water deficit. In this optimizing strategy the crops are deliberately permitted to sustain some degree of water deficit and yield reduction.

Main Approaches in Deficit Irrigation

1. Regulated / reduced deficit irrigation (RDI): It is growth stage-based deficit irrigation approach. This method is based on the basic principle that the plant's demand to water stress, may not be equal in all the growth stages. Irrigation is limited to the critical stages of plant growth, undermining the water requirement of non-critical stages of the plant that does not have a significant impact crop yield rather than reduced crop growth. Water saving up to 62.4 per cent was observed through deficit irrigation treatments at different stages of growth in sunflower (Mila et al., 2016).

2. Partial root zone drying (PRD): PRD emphasizes on irrigating only one part of the root zone in each irrigation event, leaving the other part remain dry for a certain degree. Two approaches of PRD are alternate partial root zone irrigation and fixed partial root zone irrigation. In alternate partial root zone irrigation, the frequency of watering and drying of root zone are alternated in a manner that allows the well-watered side of the root zone to dry down while fully irrigating the previously dried root zones. However, in fixed partial root zone irrigation, approximately half of the root system is irrigated with adequate quantity of water each time and the remaining half is always exposed to drying soil during the entire growth frame. Kang et al. (1998) observed the sufficiency of 60-65 per cent irrigation in maize using alternate partial root zone irrigation except for a yield reduction of 6-10 per cent.

3. Sustained deficit irrigation (SDI): Sustained deficit irrigation is application of a certain degree of constant water stress throughout crop growth, without considering its phenological period.

4. Sub surface irrigation: Subsurface irrigation is considered as one of the DI practices which is used mainly in nursery systems and to a lesser extent, in the commercial production of field crops. In contrary to the traditional practice of watering overhead in the root zone- air interspace, irrigation water is applied to plants by capillary movement from the bottom of the root zone.

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Essentialities for Deficit Irrigation

The essential features for implementing deficit irrigation methods include practicing DI on relatively deep soils, usage of drought resistant cultivars, increasing the contribution of precipitation, application of water to the most sensitive growth stages, satisfying pre plant irrigation requirement, reducing probable losses incurred in irrigation and accordingly modifying the cultural practices.

Deficit Irrigation Scheduling

Deficit irrigation is scheduled based on the yield response factor of each crop with seasons and specific growth stages. The yield response factor Ky is given by the formula:

$$[1 - Ya/Yx] = Ky\,[1 - ETa/ETx]$$

(Yx and Ya are the maximum and actual yields, ETx and ETa are the maximum and actual evapotranspiration rates. Ky, the yield response factor is specific to crop and varies over the growing season with respect to the growth stages).

Ky>1: crop is highly susceptible to water deficit. Larger yield reductions under water deficit situations.

Ky<1: crop is more tolerant and exhibits minimal yield reductions under water stress.

Ky =1: yield reduction and water use are directly proportional.

Deficit Irrigation-Benefits

Increased water use efficiency, enhanced root activity, improved nutrient use efficiency, improved product quality and increased plant yield calls for the importance of deficit irrigation in the intensive agriculture system.

The cost of cultivation incurred by irrigation often seems to be more than the economic returns. The reduction in irrigation frequency permits the allocation of the given supply of irrigation water to a proportionally larger area.

Although yield per hectare is reduced under deficit irrigation strategy compared to full irrigation, the reduction in cost of irrigation compromises the lower yield.

Challenges

Assurance of unrestricted water availability during sensitive stages which may not be possible in periods of extreme shortages, reluctance from farmers to adopt an innovative technology and difficulty to implement in closely spaced crops, limits flourishing of DI.

Future Prospects

Research on morphological, physiological and biochemical responses of crops to DI must be evaluated. Influence of cultivars, rootstocks, soil and climate on DI and studies to examine long-term effect of DI on plant performance are the areas which needs further explorations.

Conclusion

Irrigation has achieved the status of the largest single consumer of water globally. But the competition among various other sectors for water resource, has now forced irrigation to operate under the condition of water scarcity.

Deficit irrigation lessens the irrigation water use and thereby aids in handling the situations where the supply of water is confined. In many field crops, a well outlined deficit irrigation regime can revamp water productivity in areas where full irrigation is not completely feasible.

Thus, DI can be deployed as a tactical measure to counteract the problems incurred due to water deficit. In this context it is indispensable to probe the suitability and feasibility of DI via experiments to emerge it as a solution for the water scarcity.

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Organic Inputs for Soil Health and Crop Productivity

Article ID: 31499

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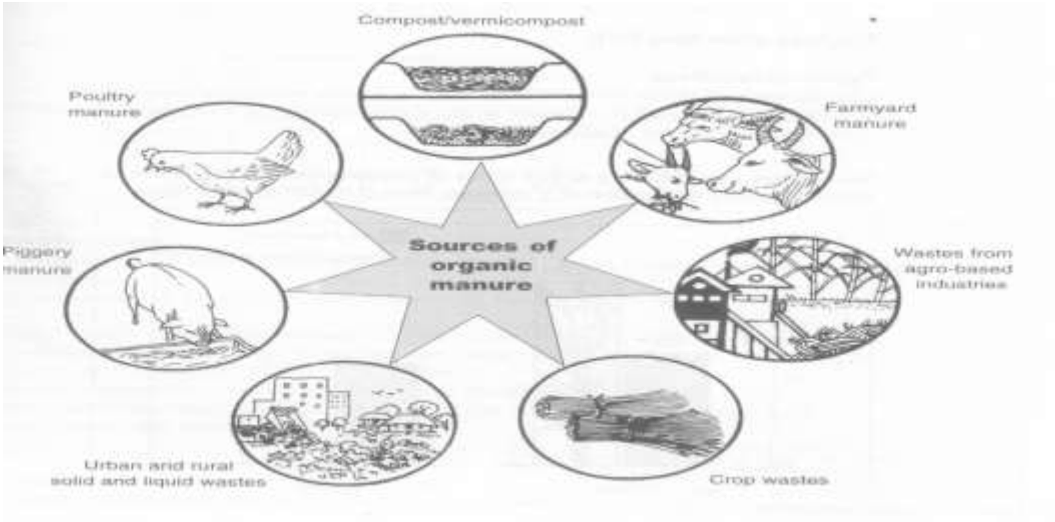
Introduction

1. The use of chemical fertilizer is increasing day-by day for the sake of increasing production. By excess use of it, the fertility of soil and health also deteriorate.
2. The use of organic inputs is one of the alternative ways for enhancing production and improves the soil health.
3. Soil organic inputs consists of decomposing plant and animal residues.
4. It protects soils against erosion a help to forms good soil structure.
5. Most dominant microorganisms are involved in the decomposition of organic inputs viz. bacteria, actinomycetes and fungi.

Sources of Organic Manure



Nutrient Status of Organic Manures

Sr. No.	Sources	Percent Nutrient		
		N	P	K
1.	Cattle dung	0.3-0.4	0.10-0.15	0.15-0.20
2.	Cattle urine	0.80	0.01-0.02	0.5-0.7
3.	Sheep dung	0.65	0.50	0.03
4.	Night soil	1.2-1.5	0.80	0.50
5.	Human urine	1.0-1.2	0.1-0.2	0.2-0.3
6.	FYM	0.5-1.0	0.15-0.20	0.5-0.6
7.	Poultry manure	2.87	2.00	2.35
8.	Vermicompost	1.20-1.16	1.8-2.0	0.5-0.75
9.	Rural compost	0.5-1.0	0.20	0.30
10.	Castor cake	5.5-5.8	1.80	1.00
11.	Groundnut cake	4.50	1.70	1.50
12.	Rapeseed cake	5.10	1.80	1.00
13.	Linseed cake	5.50	1.40	1.20

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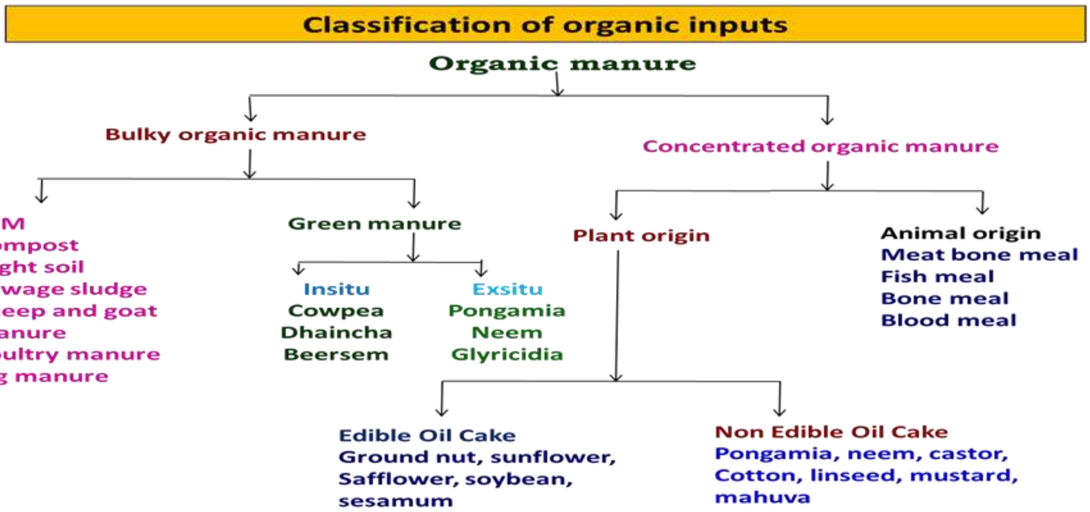
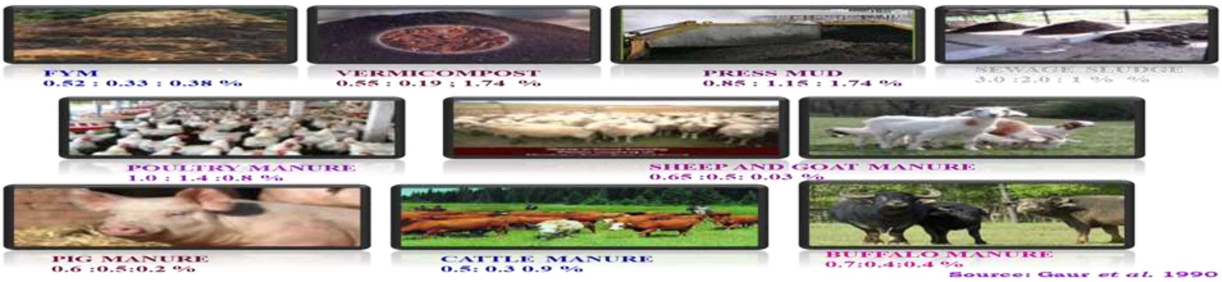
14.	Safflower cake	4.80	1.40	1.20
15.	Blood meal	1.12	1.20	1.00
16.	Horn and hoofs meal	1.30	0.30-1.5	-
17.	Fish meal	1-10	3-9	1.5



Classification of Organic Inputs

1. Bulky organic manure (NPK %):



Green manures (nutrient contribution %)

2. Concentrated organic manures:

Bone meal
3-4 :20-25:0 %

Fish meal
4-10:3-9: 0.3-1.5 %

Cattle urine
1.2 : traces : 0.75 %

Buffalo urine
1.8 :0.3 :0.2 %

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Castor cake
4.3 : 1.8 : 1.3 %

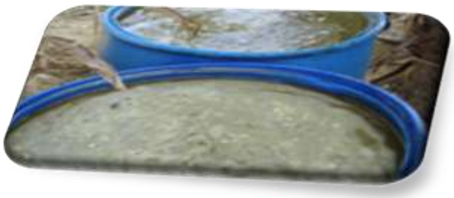
Neem cake
5.2 : 1.0 :1.4 %

Linseed cake
4.9 : 1.4 :1.3 %

3. Liquid manures:

Panchayagvya
0.24 : 0.032 : 0.056 %

Jeevmrutha
2.13 :0.20 : 0.39 %



Beejamrutha
1.75 : 0.26 : 0.38 %

Advantages of Organic Inputs for Sustaining Soil Health

1. The decomposition of organic matter, evolution of CO_2 and certain organic acids.

2. Lowering of pH and the release of cations by solubilization of $CaCO_3$ and other soil minerals.

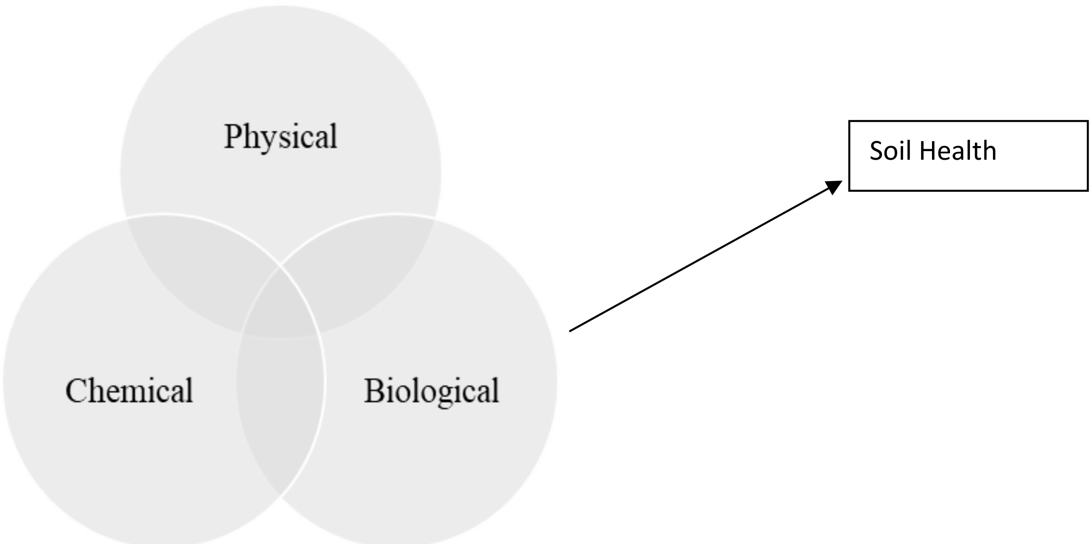
3. Replacement of exchangeable Na by Ca and Mg and thereby lowering the ESP.

4. Physical properties like bulk density, porosity, void ratio, water permeability and hydraulic conductivity are significantly improved.

5. Increases soil aggregation and aggregate stability; increases the CEC (the ability to attract and retain nutrients); and contributes N, P and other nutrients.

Soil Health

The capacity of a soil to function within land use and ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant, animal and human health.



Soil health deals with integration of Physical, chemical and biological components of the soil.

Conclusion

1. Application of organic inputs improve the physical, chemical and biological properties of soil.
2. Application of organic manures significantly reduced the soil pH and increased the soil organic carbon contents.
3. Available N, P and K, exchangeable Ca, Mg, Na total Fe, Mn, Zn and Cu of soil after harvest of crop were significantly higher in organic manures applied field as compared to recommended NPK through fertilizers.
4. Organic inputs supply all the essential nutrients for plants growth.
5. This indicated that the application of organic inputs improves the soil quality, plant growth and yield of crop.

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Effect of Foliar Application of Macro and Micronutrients on Fruit Drop, Growth, Yield and Quality of Kinnow Mandarin *(Citrus Reticulata)* on Five-Year-Old Plants

Article ID: 31500

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Abstract

A field experiment was conducted during March to November, 2019-2020 at the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj to study the "Effect of Foliar Application of Macro and Micronutrients on Fruit drop ,Growth and quality of Kinnow Mandarin(Citrus Reticulata) on Five year old plants. under Prayagraj Agro climatic conditions". The experiment was conducted in Randomized Block Design on Kinnow Mandarin(Citrus Reticulata) on fruit drop ,Growth and quality with 5 various treatments combinations (Control ,Urea - 1%,Pottasium – 1%,Zinc sulphate – 0.5%, Iron Sulphate – 1%,Boric acid – 0.2%)in three replications. The Maximum plant height ranged from 199.46 cm to 239.64 cm. The minimum plant height (176.68 cm) was recorded in Control (Water spray) which was significantly over all other treatments. Based on the results obtained, the most number of flowers obtain in Treatment combination of (Urea1%+Zinc sulphate 0.5%+Iron sulfate1%) , maximum number of fruits per plant (171.45), maximum fruit weight per plant (110.42gm) and maximum fruit length per plant (6.30cm) was found superior at Treatment combination of Urea 1%+Zinc sulphate 0.5% +Boric acid 0.2%) foliar spray. Among these treatment combinations, the most effective combination of foliar spray for Plant height(cm), number of flowers, fruits per plant, fruit weight, fruit length is (Urea1%+Zinc sulphate 0.5%+Boric acid 0.2%).

Keywords: Kinnow Mandarin (Citrus Reticulata), Macro and Micronutrients, Fruitdrop, Growth, Quality.

Introduction

Kinnow Mandarin (Citrus Reticulata) fruits act as an important constituent of daily nutrition. They are also nutritionally crucial and commercially predominant. Citrus are rich in vitamin-c vitamins (A and B complex) and minerals (calcium, iron, and phosphorus) in diet to keep human health in good state. In India Citrus is grown in 0.62 million ha. area with the total production of 4.79 million tonnes Kinnow occupies 54.9% of the area under citrus. It is a hybrid of two citrus cultivers-King (Citrus Nobilis) x willow leaf (Citrus deliciosa). The genus Citus L. belongs to subfamily Aurantioideae of the family Rutaceae. It was first developed by Howard B. Frost in 1915 and released in 1953 at the university of California, Citrus experiment station.

Materials and Methods

The experiment was carried out using Kinnow plants at the Cenral Research field of Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the year 2019-2020. The experiment was conducted in Randomized Block Design with 5 various treatments (Control, Urea -1%,Pottasium – 1%,Zinc sulphate – 0.5%, Iron Sulphate – 1%,Boric acid – 0.2%) in three replications. The experimental site is situated at of a latitude of 20o and 15o North and longitude of 60o 3" East and at an altitude of 98 meters above mean sea level (MSL).

Fig.1. Field Visit with my Advisor Dr. V. M. Prasad Sir.

Results and Discussion

Among all the different treatment combination shown in Table -1, the maximum height of the plant was observed in treatment combination foliar spray of Urea -1%, Zinc sulphate – 0.5%,Boric acid – 0.2% (239.64 cm),the minimum height of the plant was observed in Control (176.68). Maximum number of flowers per plant were observed in Treatment combination foliar spray of Urea -1%, Zinc sulphate – 0.5%, Boric acid – 0.2% (181.51), and minimum number of flowers were observed in Control (110.30).The maximum number of fruits were observed in treatment combination foliar spray of Urea -1%, Zinc sulphate – 0.5%, Boric acid – 0.2% (171.45), and the minimum number of fruits were observed in control (95.58). The maximum fruit weight was observed in treatment combination foliar spray of Urea -1%, Zinc sulphate – 0.5%, Iron sulphate 1% (110.42gm) and a minimum fruit weight was observed in control (96.47gm).The maximum fruit length was observed in treatment combination foliar spray of Urea -1%, Zinc sulphate – 0.5%, Boric acid – 0.2% (6.30cm), minimum fruit length observed in control (4.83cm).The maximum fruit yield per plant was observed in treatment combination foliar spray of Urea -1%, Zinc sulphate – 0.5%,Iron sulphate 1% (18.32 kg). Among all the treatments combinations, maximum total soluble solids (50.74) was observed in foliar spray of Urea -1%, Zinc sulphate – 0.5%,Boric acid – 0.2%.The maximum Vitamin-c (24.42) was observed in foliar spray of Urea -1%, Zinc sulphate – 0.5%,Boric acid – 0.2%.

Table 1 Treatment combination data of Foliar application of Macro and micronutrients used for Kinnow mandarin (Citrus reticulata). Here Urea (U), Pottassium Sulphate (K_2SO_4), Zinc sulphate ($ZnSO_4$), Iron Sulphate ($FeSO_4$), Boric Acid (H_3BO_3).

Treatments symbols	Treatment combination	Plant height Maximum	Number of flowers per plant	Number of fruits per plant	Fruit weight(gm)	Fruit length(cm)
T0	Control (Water spray)	216.56	110.30	95.58	96.47	4.83
T1	U 1% +K2SO4 1%	221.80	130.26	118.47	98.43	5.54
T2	U 1% + ZnSO4 0.5%%	229.80	138.57	123.68	97.38	5.41
T3	U 1% + FeSO4 1 %	228.94	132.53	119.55	101.43	5.32
T4	U 1% +H3BO3 0.2%	228.26	144.31	111.51	105.46	5.76
T5	U 1% + ZnSO4 0.5%+FeSO4 1 %	222.43	163.72	148.59	110.42	5.21
T6	U 1% + ZnSO4 0.5% + H3BO3 0.2%	239.64	181.51	171.45	108.69	6.30

T7	U1% +H3BO3 0.2%+FeSO4 1 %	225.14	169.51	155.37	109.57	6.26
T8	K2SO4 1% + ZnSO4 0.5%	233.82	170.43	162.6	105.70	6.16
T9	K2SO4 1% +FeSO4 1 %	232.06	180.49	169.61	107.37	5.85
T10	K2SO41% + H3BO3 0.2%	228.57	162.53	149.47	106.84	5.94
T11	K2SO41 % + ZnSO4 0.5%+FeSO4 1 %	233.85	155.74	138.56	99.49	5.64
T12	K2SO4 1 % + ZnSO4 0.5%+ H3BO3 0.2%	230.73	166.72	140.35	101.33	6.21
T13	K2SO4 1% + H3BO3 0.2% + %+ FeSO4 1 %	227.88	167.38	142.54	106.48	6.24
	F-test	S	S	S	S	S
	C. D. at 0.5%	1.426	0.223	0.279	23.315	0.295
	S.Ed.(+)	1.928	0.302	0.377	31.518	0.399

Conclusion

Based on the result obtained, the most effective Treatment combination of foliar spray for optimum Plant height, number of flowers, fruit per plant, fruit weight, fruit length, Yield is found to be T6, having the proportions (Urea -1%, Zinc sulphate – 0.5%,Boric acid – 0.2%.) as shown in Table 1.

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A Brief Overview of Integrated Fish Farming Systems

Article ID: 31501

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Introduction

When two interlinking farming practices are done through the utilization of waste material from one farming system to another farming system, known as integrated farming system. The main objective of the integrated farming system, is to increase production through sustainable manners at the expenses of small amount of money. When fish farming is done along with other farming practices like duck, chicken, pig, dairy etc., called as integrated fish farming system. The basic principle of integrated farming system, nothing is treated as waste in this system. Waste material derived from one farming system, is considered as input material for other farming systems. So, recycling of the waste materials between different farming systems is the main component of this type of system. In case of normal fish farming system, fish feed and fertilizer constitute the 60% of the total input cost. In case of integrated farming system, waste material is generated from duck, poultry or pig which are used as counterpart of the fish farming system. When these waste materials are used as organic fertilizer, amount of natural fish food organisms in the pond increased as a result, growth of fish increased enormously. Through the adoption of integrated fish farming, farmers can cut down the cost of supplementary feed and chemical fertilizers easily. Apart from these, egg and meat produced from the fish cum duck and fish cum poultry can act as additional source of income for farmers.

Duck Cum Fish Farming

1. Contribution of duck farming in fish culture:

a. The dropping from duck can directly use as fertilizer in the fish pond, so amount of natural fish food organisms in the fish pond increased naturally.

b. Duck eats away all unwanted harmful aquatic plants and organisms and make the environment safe for fish culture.

c. Duck can consume all unutilized and unutilized matter along the bank of the pond and clean the environment of the pond.

2. Contribution of fish in duck-farming:

a. Pond bank can provide ideal habitat for the living of duck so additional space is not required for the farming of the duck.

b. Duck can freely move in the pond and can collect their required feed from natural sources. Because of their free movement they can increase in size very rapidly.

c. By-products from fish culture act as supplementary feed for fish.

3. Mechanisms of fish cum duck farming:

a. For fish culture:

i. Selection of pond which can retain water for entire year.

ii. For removal of unwanted fishes from the pond, application of 250 ppm mohua oil cake should be done.

iii. Amount of lime should be 400 kg/ha/year in the pond.

iv. Netting should be done once monthly to enhance the growth and health benefit of the fishes.

b. For duck-farming: Generally, two varieties of duck i.e., khanki cambell and Indian runner should be selected as they can adjust well with their environment.

4. Balanced diet for duck: Balanced diet is very much important for laying adequate amount of eggs in optimum time. Farm-made feed is better for duck than commercial one as it offers better quality and it has less cost. Components of the diets should be easily available, cheap. Prepared feed should be kept in an air-tight container for preservation. Each and every components of the diet should be mixed properly and moisture should be avoided as much as possible.

5. Production from duck-cum fish farming: With proper care 3000-3500 kg/ha fish can be obtained from this type of integration without supplementary feeding also. Apart from the fish production, 275-300 eggs and 2-2.5 kg meat can be obtained from this integration.

Poultry Cum Fish Farming

The experiment was carried out using Kinnow plants at the Cenral Research field of Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the year 2019-2020. The experiment was conducted in Randomized Block Design with 5 various treatments (Control, Urea -1%,Pottasium – 1%,Zinc sulphate – 0.5%, Iron Sulphate – 1%,Boric acid – 0.2%) in three replications. The experimental site is situated at of a latitude of 20o and 15o North and longitude of 60o 3” East and at an altitude of 98 meters above mean sea level (MSL).

Results and Discussion

The poultry dropping can be act as organic fertilizer in fish pond which can stimulate the production of natural fish food organisms and fish. This type of integration can save the cost of fertilizer. For poultry farming, there is no requirement for separate habitat as they can lay egg in anywhere of the pond.

1. Mechanisms of fish cum poultry farming:

a. For fish-farming:

i. Selection of pond which can retain water for entire year.

ii. For removal of unwanted fishes from the pond, application of 250 ppm mohua oil cake should be done.

iii. Amount of lime should be 400 kg/ha/year in the pond.

iv. Netting should be done once monthly to enhance the growth and health benefit of the fishes.

b. For poultry Farming: Habitat for poultry farming can be made in two different ways:

i. Macha- house can be made on the pond water so that poultry dropping can be easily enter into the pond water.

ii. Poultry housing can be made in ‘’deep’’ litter method. For this method, 0.3-0.4 square metre area is needed.

iii. 500-600 bird/ha should be kept to make the pond fertile.

iv. ‘’Feed hopper” should be used for poultry feeding purpose so that excess feeding and wastage of feed are to be prevented.

v. They start laying egg after 22 weeks of farming.

2. Production from poultry-cum fish farming: Fish production: 3000-3500kg fish/ha production should be obtained from this type of integration. Apart from that, 70000 eggs and 1000 kg meat can be obtained from chicken.

Fish Cum Pig Farming

Pig dung is an excellent conditioner and fertilizer of the fish pond which can stimulate the natural fish food organism production of the pond. Pig dung contain indigestible food particle which serve as the fish-food efficiently. For excellent result, 30-40 pig/ha should be used.

1. Benefits of Fish cum pig Farming:

a. Pig-dung act as excellent pond fertilizer and this can easily supplement fish feed. So, the cost of fish production can be reduced greatly by using pig dung as fertilizer.

b. Land is very much valuable resource, so through Fish cum Pig farming land requirement can be reduced greatly as for piggery operations no additional land is required.

c. High rate of production of animal proteins can be achieved through Fish cum Pig farming.

d. This type of integrated farming can bring much return with less investments.

2. Stocking of Fish:

a. Variation of rate of stocking is between 8000-8,500 fingerlings/ha and it has a species ratio of 40% surface feeders, 20% column feeders, 30% bottom feeders, and 10-20% weedy feeders.

b. Stocking time of the pond should be in the month of October-November in case of Northern and North-western states of India.

c. Stocking time of the pond should be in the month of June to September in case of south, coastal and north-eastern states of India.

3. Systems of pig-farming: Basically, two kinds of systems are used in the farming of pig i.e., open air and indoor systems. In case of fish cum pig farming combination of the above said both systems are used.

4. Floor space requirement for each pig: 1.5 m^2

There are basically four types of pigs are available in our country for Fish-cum Pig farming, they are wild pigs, domesticated pigs or indigenous pigs, exotic pigs and upgraded stock of exotic pig. Slaughter maturity size is attained at 6 months of age when their size reaches at 60-70 kg of weight.

Conclusion

Integration of fish farming with agriculture and livestock products can uplift the rural life many folds because it can increase the return on investment many folds. This system can be solution of many problems like, increasing income, poverty alleviation and improving nutrition of small-scale farmers. But most important consideration is that, skill, knowledge and expertise is very much important for the proper implementation of the integrated farming. Lack of proper knowledge can cause great hindrance. So, proper knowledge is necessary for optimum implementation of the integrated farming.

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Biochar- An Environmental Solution

Article ID: 31502

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Summary

Soil is the most important source and an abode for many nutrients and microflora. Due to over exploitation of soil quality by means of ever-increasing population and an excessive addition of chemical fertilizers and pesticides, a rehabilitated attention is a need of the hour to maintain sustainable approaches in agricultural crop production. Biochar is the solid, carbon-rich material obtained by pyrolysis using different biomasses. Since biochar contains organic matter and nutrients, its addition increased soil pH, electric conductivity (EC), organic carbon, total nitrogen, available phosphorus, and the cation-exchange capacity (CEC) and it helps in mitigating climate change as well.

Introduction

Biochar an organic amendment, is a carbon-rich organic material and a by-product derived from biomass by pyrolysis under high-temperature and low oxygen conditions. Biochar is produced through a process called pyrolysis, which basically involves heating of biomass (such as wood, manure, or leaves) in complete or almost complete absence of oxygen, with oil and gas as co-products. Biochar has the potential to produce farm-based renewable energy in an ecofriendly way. Specifically, the quality of biochar depends on several factors, such as the type of soil, metal, and the raw material used for carbonization, the pyrolysis conditions, and the amount of biochar applied to the soil. In addition, the biochar amendment to the soil proved to be beneficial to improve soil quality and retain nutrients, thereby enhancing plant growth. Since biochar contains organic matter and nutrients, its addition increased soil pH, electric conductivity (EC), organic carbon, total nitrogen, available phosphorus, and the cation-exchange capacity (CEC).

Biochar vs Common Charcoal

Biochar is a charcoal-like substance that's made by burning organic material from agricultural and forestry wastes (also called biomass) in a controlled process called pyrolysis. The main difference between common charcoal and biochar is production process wherein biochar production is done by a specific process called pyrolysis to reduce contamination and safely store carbon. During the pyrolysis process, the organic material is converted into biochar, a stable form of carbon which cannot easily escape into the atmosphere and the or heat generated during pyrolysis can be captured and used as a form of clean energy. Biochar is by far more efficient at converting carbon into a stable form r than other forms of charcoal.

Composition

In terms of physical attributes, biochar is black, highly porous, lightweight, fine-grained and has a large surface area. About 70 percent of its composition is carbon. Nitrogen, hydrogen and oxygen constitute the remaining percentage. The chemical composition of biochar depends on the type of feedstocks used to make it and methods used to heat it.

Biochar Production

Biochar is produced under controlled conditions called pyrolysis (a thermal decomposition of biomass in an oxygen-limited environment). The quality of the final biochar product depends upon quality of feedstocks, or materials burned. Ideally, clean feedstocks with 10 to 20 percent moisture and high lignin content must be used (eg: field residues and woody biomass). Using contaminated feedstocks should be avoided.

Biochar is manufactured under small-scale industry using modified stoves or kilns, or through large-scale, cost-intensive production, by using larger pyrolysis plants and higher amounts of feedstocks. The most common way to make biochar for on-farm use is through pyrolysis using a top-lit updraft biochar machine.

Advantages of Biochar in Agriculture

Some of the advantages that biochar may help improve soil quality include:

1. Enhancing soil structure
2. Increasing water retention and aggregation
3. Decreasing acidity
4. Reducing nitrous oxide emissions
5. Improving porosity
6. Regulating nitrogen leaching
7. Improving electrical conductivity
8. Improving microbial properties.

The recommended method for applying biochar will vary depending on how healthy or nutrient-status of soil.

Biochar: An Environmental Solution

Biochar helps to solve a variety of global problems simultaneously.

1. It help to sequester a billion tons of carbon annually and hold it in the soil for thousands of years.
2. Clean and renewable energy is produced as a by-product during the production of biochar can be used as an alternative to burning fossil fuels.
3. Decreased groundwater pollution,
4. Lower cost of water filtration,
5. Decreased amounts of waste and higher profitability for farmers.
6. This technology also gives to food security by increasing crop yields and retaining water in areas prone to drought.

The Role of Biochar in Sequestering Carbon and Mitigating Climate Change

Biochar production is a carbon-negative process, which reduces CO2 in the atmosphere. During the process of biochar production, the unstable carbon in decomposing plant material is converted into a stable form of carbon which is then stored in the biochar. After the application of biochar to the soil, it stores the carbon in a secure place for potentially hundreds or thousands of years. Whereas in naturally decomposing feedstocks, higher amounts of carbon dioxide to the atmosphere which is unstable. By heating the feedstocks and transforming their carbon content into a secure structure that doesn't react to oxygen, biochar technology finally reduces carbon dioxide in the atmosphere. Biochar also contributes to the lessening of climate change by enriching the soils and reducing the need for chemical fertilizers, which in turn lowers greenhouse gas emissions. The improved soil fertility also stimulates the growth of plants, which consume carbon dioxide.

Conclusion

Biochar an organic amendment, is a carbon-rich organic material and a by-product derived from biomass by pyrolysis under high-temperature and low oxygen conditions. Biochar is produced through a process called pyrolysis, which basically involves heating of biomass (such as wood, manure, or leaves) in complete or almost complete absence of oxygen, with oil and gas as co-products. Biochar technology shows promise in mitigating climate change and improving soil quality, as well as reducing waste and producing energy as a by-product.

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Sustainable Agriculture: Need of the Hour

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Introduction

Agriculture carries a massive ecological footmark, contributing a colossal significance in inducing rapid climate change, water deficiency, land degradation, deforestation and many other processes that are consequently leading to environmental alterations. Agriculture has been modified considerably, more specifically since the end of World War II. Food and fibre productivity were ascended due to modern technologies, mechanization, enhanced chemical utilization, specialization and government policies that favoured acceleration of crop production. These transformations granted some farmers with declined labour requirements to produce majority of the food and fibre in many countries. Notwithstanding these modifications bear numerous positive impacts and can reduce certain hazards related to farming, there have also been significant and prominent costs which include deterioration of topsoil, groundwater contamination, decline of family farms, continued negligence of the living and working conditions for farm labourers, rising cost of production, and the disintegration of economic and social conditions in rural communities. Therefore, a developing movement has appeared during the past two decades for questioning the influence of agricultural practices that bestow to the social problems. Now-a-days, sustainable agriculture furnishes a potential explanation to empower agrarian systems to feed the burgeoning population within constantly changeable environmental situations. Currently this new type of agricultural methodology is assembling acceptance, awareness as well as public support within mainstream crop production. Sustainable agriculture not only can address many environmental and social concerns but also it can offer innovative and economically viable opportunities for growers, labourers, consumers, policy makers and many others in the entire food system.

What is Sustainable Agriculture?

The word ‘sustain’ arises from the Latin word ‘sustinere’ (sus- from below and tenere- to hold) that implies to keep in existence or maintain long term support or permanence. As it pertains to agriculture, sustainable describes farming systems that are "capable of maintaining their productivity and usefulness to society indefinitely and such systems must be resource conserving, socially supportive, commercially competitive, and environmentally sound".

Sustainable agriculture should be:
1. Economically viable.
2. Socially supportive.
3. Ecologically Sound.

It is a method of farming in sustainable ways, which means meeting the needs of present generation mainly food and textile needs, without compromising the ability for future generations to fulfil their requirements or without endangering the resource base for future (Agricultural Sustainability Institute, 2018)

"Sustainable agriculture" is defined as an integrated system of plant and animal production practices having a site-specific application that will, over the long term:
1. Satisfy human food and fibre needs.
2. Enhance environmental quality and the natural resource base upon which the agriculture economy depends.
3. Make the most efficient use of non-renewable and on-farm resources and integrate, where appropriate, natural biological cycles and controls.
4. Sustain the economic viability of farm operations.

5. Enhance the quality of life of farmers and society as a whole (US National Agricultural Research, Extension, and Teaching Policy Act of 1977).

Importance of Sustainable Agriculture

Based on a multi-pronged goal, sustainable agriculture seeks to:

1. Increase profitable farm income.
2. Promote environmental stewardship and expansion of the natural resources supply.
3. Enhance quality of life of farm families and communities.
4. Production of sufficient amount of food, feed, fuel, fodder and fibre to meet the needs of sharply rising population.
5. Sustainment of the economic viability or feasibility of agriculture systems.
6. Engage farmers and ranchers in the development and adoption of practices that are profitable and environmentally sound.
7. Support research and education intended to help farmers and ranchers to mitigate and adapt to climate change.
8. Improve production efficiency, productivity, and profitability.
9. Address threats from pests and diseases.
10. Improve the quality of surface water and groundwater resources.
11. Save energy for future due to reduced reliance on non-renewable energy sources.
12. Control of air pollution by incorporating crop residues into the soil, using appropriate levels of tillage and planting wind breaks, cover crops or strips of native perennial grasses to reduce dust.
13. Control of soil erosion by numerous practices including zero or minimum tillage, management of irrigation to reduce runoff, and keeping the soil covered with plants or mulch.
14. Enhance the biological and economic stability of farm.
15. Lead to overall development of livestock on long term basis.

Besides, sustainable agriculture faces some risk factors also:

1. Less crop yield.
2. Increased threat of food insecurity and malnutrition.
3. Increased farm expenditure.

Sustainable Agriculture Practices

1. Rotating crops and embracing diversity: Crop rotation and diversification such as intercropping or mixed cropping can have many advantages, involving healthier soil and improved pest control.

2. Planting cover crops: Cover crops mainly leguminous or pulse crops are planted during off-seasons when soils might otherwise be left bare which can protect and build soil health by preventing erosion, replenishing soil nutrients, and keeping weeds in check, reducing the need for herbicides also.

3. Reducing or eliminating tillage: Traditional ploughing or tillage operations prepare fields for planting and prevent weed problems, but can cause a lot of soil loss. No-till or reduced till methods, which involve inserting seeds directly into undisturbed soil, can reduce erosion and improve soil health.

4. Integrated pest management (IPM): A range of methods, including mechanical and biological controls, can be applied systematically to keep pest populations under control while minimizing use of chemical pesticides.

5. Integrating farming system: A growing body of evidence shows that a smart integration of crop and animal production can be a recipe for more efficient and profitable farms.

6. Adopting agroforestry practices: By mixing trees or shrubs into their operations, farmers can provide shade and shelter to protect plants, animals, and water resources, while also potentially offering additional income.

7. Managing whole systems and landscapes: Sustainable farms treat uncultivated or less intensively cultivated areas, such as riparian buffers or prairie strips, as integral to the farm, valued for their role in controlling erosion, reducing nutrient runoff, and supporting pollinators and other biodiversity.

Future of Sustainable Agriculture

Sustainable agriculture is designed with the intention of preserving the environment, expanding the earth's natural resources, all while creating a quality of life for animals and humans. It allows the desires of society need to be met without the fear of inhibiting the earth's natural resources for future generations. In addition to preserving the earth's natural resources, sustainable agriculture benefits the environment through maintaining soil quality, reducing erosion, and preserving water. In order to maintain a sustainable lifestyle, agriculturalists focus on certain criteria in order to compete with the current sustainability practices which consist of creating a healthy environment, while ensuring economic profitability in addition to maintaining social and economic equity. Every member of the food system can manage a sustainable lifestyle through remaining consistent within this criterion. In regards to the future of sustainable agriculture, many believe by the time earth's population reaches 9 billion we will be fully depleted of many natural resources that will require alternative sustainable solutions. This gives us 40 years to make a change towards sustainable lifestyles in preserving our agriculture and food sources. Sustainable agriculture is not the only step in the wave of preserving our planet, but it is an important building block in taking preventive measures in order to maintain the resources we have left.

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Artificial Fruit Ripening Room

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Introduction

The fruit production of India ranks second after China. However, share in global export is only 2%. This is due to lack of modern facilities and inadequate food processing infrastructures. Which directly leads to 4.5- 15.26% post-harvest losses of fruits and vegetables (Anonymous, 2018).

To increase its global export and minimize postharvest losses artificial fruits ripening is gaining its importance. In India, 80% fruits are artificially ripened with ripening agents and most of the it is harmful to the human health (Dhembare, 2013).

To promote safe artificial ripening government launched the schemed "Integrated Cold Chain and value addition infrastructure". Under which 531 ripening chambers throughout the country and five in Madhya Pradesh were established (Anonymous, 2016).

Ripening Room

The different kinds of ethylene ripening rooms such as lock sock, NTH model, side curtain type, air bag system, cold room or cold store etc. are used globally for ripening of fruits at large scale. In these ripening units, the fruit ripening is carried under controlled conditions of ethylene, temperature and relative humidity with uniform air flow circulation system.

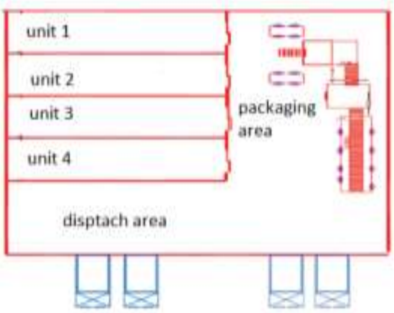
Proper ventilation systems, exhaust fans for CO2 emission and monitoring and control system and display devices. The ripening chamber is very efficient and widely used at industrial level.

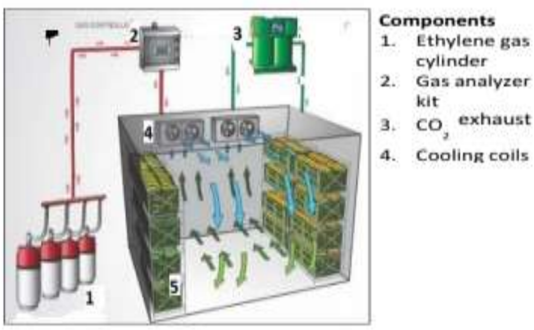
Table1: The appropriate range of controlling factor:

S. No.	Product	Ethylene concentration (ppm)	Exposure time (hours)	Ripening Temperature (oC)	Storage temperature after ripening (oC)
1	Banana	100-150	24-48	15-18	13-14
2	Mango	100	24	20-22	10-13
3	Papaya	100	24-48	20-25	About at 7
4	Pear	100-150	24-72	18-22	About at 0
5	Tomato	100-150	24-48	18-20	12.5

Industrial Ripening Room

The information on industrial ripening is culled by Technical Standards and Protocol for the Fruit Ripening Chamber in India (Anonymous, 2011).





Unit 1 - Ripening Room Type-1: This type of ripening room has insulated cold room with addition of ethylene equipment. For maintain desired level of low temperature and humidity, ceiling mounted fin coil evaporator (close to wall panel, leaving some gap for suction) will be connected to the condensing unit outside. Fruits with perforated plastic crates will be placed in the room.

The air is allowed through the plastic crates by modifying its flow by simple arrangements like tarp etc, thus ensuring uniform air circulation, uniform ethylene distribution and fruits ripening. A simple ventilation system is provided, to provide automatic or manual vent control to keep CO2 within the limits.

In an Automatic Ventilation system, a dual inlet/discharge damper operates in parallel with the fan to allow fresh air from outside to replace the air within the room when venting is required. In contrast to it, in a manual ventilation system, ventilating effect in ripening rooms in achieved by opening the doors for about 20 minutes every 12 hours after the first 24 hours of ripening.

Stacking will be done in floor (single tier) only, up to a reasonable height, which will facilitate for inspecting ripening status of fruits. Since, single tier system is generally considered; mechanized material handling equipment (Forklifts) need not be required. Simple Hand pallet trucks are more than sufficient to handle the produce.

Unit 2 - Ripening Units Type-2: This type of Ripening Units has special air flow system which generates desired static pressure in ripening chamber. The insulated cold rooms have a system of false ceiling, separated and sealed annular space between wall and palletised crates / CFB boxes with or without air-inlet locking system to isolate designated pallets etc.

Cool air is routed through false ceiling in to boxes with perforated holes of Crates / CFB boxes for air circulation) which, in turn are stacked in single / multi-tier system. In case of multi-tier stacking, fork lift operation is necessary to handle the produce.

Unit 3 - Lock shock system: As name suggested lock shock system prevent the shock to the stacked fruits. It is constructed with PUF-panels having ripening capacities from 12 tons to 25 tons. Moveable from one site to another.

The control over ripening environment can be done by micro process compatible with computer, this facilitates ease of operation. Forced Air circulation by sealing hoses through fruits having power efficient, uniform, quality ripening. The handling of single Tier can be loaded and unloaded by hand trolleys.

Unit 4 - Vertical air bag system: In vertical air bag system stacks are formed horizontally having inflated air bags on top of block with air flow. This leads to equal ripening of fruits to taste and premium quality.

Two or three tier pallets loading with electric fork lift. Refrigeration unit is plug-in type with Auto control of ripening parameters with low maintenance but costlier than compared to previous models.

Lock shock system **Vertical air bag system**

Conclusion

The artificial ripening by the chemical agents like carbide is dangerous to health. The use of carbide is prohibited. The alternate of it is ripening chambers, which have a vital role to accelerate the ripening at bulk quantity. The ease of maintains and can withstand with safety measurements ripening rooms gaining its importance.

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Protein Nanoparticles from Cereals

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Abstract
Nanotechnology is the emerging technique which nowadays fascinated the scientist by developing functional food and enhancing its bioavailability to human gut with minimal impact on the properties of the product. Cereals are one of the amazing crops in term of fibres, vitamins, minerals fats, proteins, carbohydrates and phytochemicals etc. Cereal grains are also having sufficient amount of protein content up to 7-12% indicating its good quality in term of essential amino acid. Nanoparticles are one of the different types of nano-sized carriers generally has size from 10 nm to 1000 nm. The selection of matrix material is depended upon nanoparticle size, profile and properties of desired drug and nature of the material. The physical, chemical and enzymatic techniques are used for the modification and formulation of cereals proteins.

Introduction
Cereals grains are rich in term of various aspects such as fibres, vitamins, minerals fats, proteins, carbohydrates and phytochemicals etc (Karkkainen et. al., 2018). The major cereal crops in the worlds are maize, wheat and rice are essential part of human diet. Cereals are inexpensive sources of nutrient which is less soluble in aqueous solution and reduced their implementation in food products. During refining process of cereals grains most nutrients dense parts bran and germ compartments were removed. The bran and germ compartments are rich in various healthy elements for instance dietary fibre, essential fatty acid, proteins and starch etc. and consumption of these complete grains directly promoting the healthy life of human (Karkkainen et. al., 2018). Cereal grains are also enough rich in protein content which contain up to 7-12% indicating its good quality in term of essential amino acid. These cereals proteins are isolated from different crops with different name for instance from maize it is call zain, from wheat it is gliadins and glutenins, protein from major and minor millet is known as kafirins specially from sorghum. The proteins can be classified according to their solubility for example proteins are soluble in water, salt solution, acid/base solution and some are mostly in soluble in most of the solvent (Fig 1). The cereal proteins may be a very promising raw material to produce nanoparticles as interfacial stabilizing agents for food industry.

Importance of Nanotechnology and Nanoparticles
Nanotechnology fascinated the today researchers by developing functional food and enhancing its bioavailability to human gut with minimal impact on the properties of the product. Nanoparticles are one of the different types of nano-sized carriers generally have size from 10 nm to 1000 nm that being developed for drug delivery applications. These Nanoparticles may be non-degradable and biodegradable but considerable attention have been taking to developing biodegradable nanoparticles due to their higher encapsulation efficiency, controlled release and less toxic properties (Martínez-Ballesta et. al., 2018). Nanoparticles became the major reason for the change in different properties of many conventional materials by virtue of their greater surface area per weight than micro particles which makes them to be more bioavailable.

Selection Criteria of Matrix Material
The selection criteria of matrix material are depending upon various factors for example nanoparticle size, profile and properties of desired drug (solubility and stability) and nature of the material (biodegradability and toxicity). The other properties of nanoparticles such as toughness, reactivity also deepens upon size and shape of the particles. The Proteins granules show unique functionalities and properties in biological materials and

manufacturing field. Due to toxicity and biodegradability properties of protein nanoparticles are used in pharmaceuticals and nutraceuticals industries (Khan et. al., 2019).

Modification and Formulation of Cereals Proteins

These protein molecules are widely utilized due their natural properties among that biodegradable and biocompatibility. The direct use of pure form of these bioactive compounds causes fast release, poor solubility and reduced the bioavailability. These issues with proteins can be resolved by modifying the structural and functional properties by using various approaches such as physical, chemical and enzymatic. Among these approaches used, most favourable are physical approach due to their simple procedure and not requiring relabelling of final product (Zou et. al., 2019). In physical modification of protein, mainly non covalent interactions as well as disulphide bonds are changed by high temperature, high pressure, irradiation, extrusion and milling which enhance their performance in nano- based delivery system. The chemical-based modification basically included the glycosylation or glycation and deamination. In enzymatic hydrolysis mainly protease is used for partial or selective hydrolysis is most common approach used for modification of cereal protein. The hydrolysis modification by single or multiple enzymes mostly increases the antioxidant properties of the proteins. (Zou et. al., 2019). The formulation of protein nanoparticles resulted in large number of changes including conformational (composition and concentration), chemical (pH, ionic strength, temperature) and type of solvent of protein occurring etc. The changes that take place during formulation can be stabilizing by using surfactant. The formulation of protein nanoparticles can be done by emulsification, coacervation, desolation and electrospray Technique etc.

Encapsulation of Protein Molecules and its Importance

Encapsulation is technique where bioactive compounds are fixed within outer covering by homogeneous / heterogeneous compounds resulted in nanostructure in order to protect deliver these compounds (Zou et. al., 2019). Encapsulated nanoparticles increase bioavailability in human gut as well as protect from degradation Encapsulated material also categorized into two groups on the bases of size i.e. micro (1mm – 200mm) and nano (20nm-500nm).

Delivery System

A nanoparticle for delivery system is the one of the applications of nanobiotechnology (Rieux et. al., 2006). Food delivery systems by proteins nanoparticles are one of the newly emerging techniques where protein nanoparticles are the promising carriers for delivery of food and drug as well which are fabricated based on different methods. A part forms the natural proteins, synthetic protein nanostructure too involved in delivery where synthetic acts as imitative of surrogate such as plasmid and virus for drug delivery.

Conclusion

Nanotechnology is rapidly growing technique by developing functional food and enhancing its bioavailability to human gut with minimal impact on the properties of the product. The cereals proteins can be resolved by modifying the structural and functional properties by using several techniques for instance physical, chemical and enzymatic method. Furthermore, the cereals protein such as zain, gliadins and glutenins and kafirins are mainly used for nanoencapsulation. In conclusion this article provides the basic information regarding the formulation, encapsulation and delivery of the nanoparticles.

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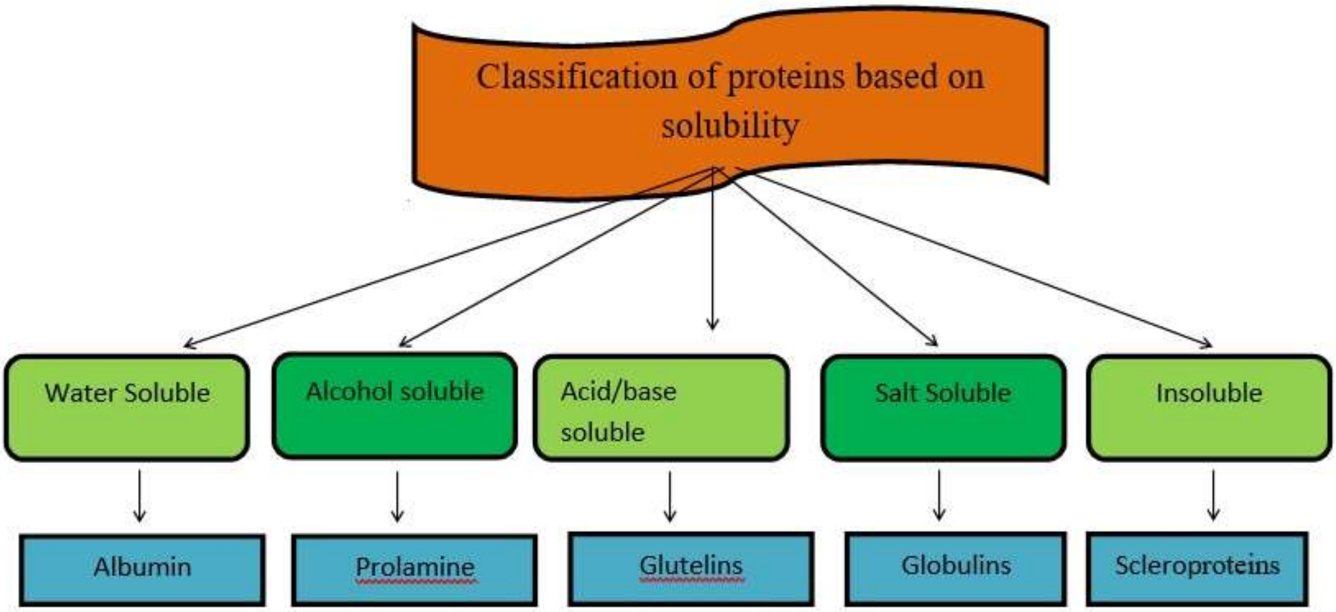

Fig 1. Distribution of different storage protein in cereals according to their solubility

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An Overview of Bluetongue

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Introduction

Bluetongue is also called as Sore Muzzle, Pseudo Foot-and-Mouth Disease and Muzzle Disease. Bluetongue is a non-contagious disease of domestic and wild ruminants caused by a virus within the Orbivirus genus of the family Reoviridae and transmitted by Culicoides biting midges. It is a reportable disease of considerable socioeconomic concern and of major importance for the international trade of animals and animal products. In the past, bluetongue endemic areas were found between latitudes 40°N and 35°S; however, bluetongue has recently spread far beyond this traditional range. This review presents comprehensive information on this dangerous disease including its, epidemiology, spread, transmission as well as the diagnosis of the disease. It also deals with treatment and relevant preventive and control measures to be implemented in areas with bluetongue outbreaks.

The Organism: Bluetongue Virus

1. Family- Reoviridae
2. Genus- Orbivirus

Bluetongue disease is non-contagious and insect-borne viral disease. In ruminants, the primary host is sheep and others infected animals include cattle, goats and deer.

Epidemiology

1. Morbidity / Mortality.
2. SHEEP: Severity of disease varies with breed, strain of virus and environmental stress. The morbidity is as high as 100% and the mortality is usually between 0-30%.
3. CATTLE and GOATS: The morbidity is up to 5% and death is rarely reported.
4. DEER and ANTELOPE: Severe infection usually occurs. The morbidity is up to 100% and mortality between 80-90%. Animals may remain lame and in poor condition.

Transmission

BTV is transmitted by biting midges in the genus *Culicoides*, with *Culicoides variipennis* var *sonorensis* the principal vector in the U.S. Ticks or sheep keds can be mechanical vectors, but are probably of minor importance in disease transmission. While bluetongue is not a contagious disease, the virus can be transmitted to the fetus *in utero* or spread mechanically on surgical equipment and needles. Although BTV can be found in semen, venereal spread does not appear to be a major route of infection (Sreenivasulu *et al*., 2004).

Clinical Signs

The incubation period for bluetongue is 5-10 days.

1. Sheep: In sheep, the clinical signs may include fever, excessive salivation, depression, dyspnea, and panting. The muzzle, lips, and ears are hyperemic, and the lips and tongue may be very swollen. The head and ears may also be edematous. Initially, animals have a clear nasal discharge; later, the discharge becomes mucopurulent and dries to a crust around the nostrils. Pregnant ewes infected during the first trimester may resorb the fetus, abort, or give birth to "dummy" lambs. The tongue is occasionally cyanotic ("blue-tongue") swollen, and protrude from the mouth.

2. Cattle: Cattle can become viremic starting at 4 days post-infection but rarely develop symptoms. Animals are usually infectious to the insect vector for several weeks. Infections in cattle are usually subclinical; often, the only signs of disease are changes in the leukocyte count and a fluctuation in rectal temperature. Rarely, cattle have mild hyperemia, vesicles or ulcers in the mouth, erosion and crusting around the nose, hyperemia around the coronary band, or lesions around the teats of lactating cows. Temporary sterility may be seen in bulls, and infected cows may give birth to "dummy" calves with hydranencephaly or cerebral cysts.

3. In pronghorn antelope and whitetail deer: The most common symptoms are hemorrhages and sudden death.

Post Mortem Lesions

In sheep, the face and ears are often edematous, and a dry, crusty exudate may be seen on the nostrils. The coronary bands of the hooves are often hyperemic; petechial or ecchymotic hemorrhages may be present and extend down the horn. Petechiae, ulcers, and erosions are common in the oral cavity, particularly on the tongue and dental pad, and the oral mucous membranes may be necrotic or cyanotic. The nasal mucosa and pharynx may be edematous or cyanotic, and the trachea hyperemic and congested. In some cases, hyperemia, hemorrhages, and edema are found throughout the internal organs. Hemorrhage at the base of the pulmonary artery is particularly characteristic of bluetongue. In newborn lambs, there may be hydranencephaly or cerebellar dysplasia (Maclachlan et al., 2009)

In cattle infected with BTV, the skin is often edematous and ulcerated, or eroded with dry, thick folds. Vesicles, ulcers, and necrotic debris may be found in the mouth; these erosions are most common on the buccal mucosa and dental pad. The oral mucosa can be intensely congested. The external nares may contain erosions and a crusty exudate. Hyperemia is often seen at the coronary band. Affected fetuses can have hydranencephaly or cerebral cysts. In deer, the most prominent lesions are widespread petechial to ecchymotic hemorrhages. More chronically infected deer may have ulcers and necrotic debris in the oral cavity, and lesions on the hooves, including severe fissures or sloughing.

Differential Diagnosis

The differential diagnosis includes foot-and-mouth disease, vesicular stomatitis, peste de petits ruminants, malignant catarrhal fever, bovine virus diarrhea, contagious pustular dermatitis (contagious ecthyma), infectious bovine rhinotracheitis, parainfluenza-3 infection, sheep pox, foot rot, actinobacillosis, *Oestrus ovis* infestation, and plant photosensitization. In cattle and deer, epizootic hemorrhagic disease can also result in similar symptoms.

Diagnosis

Bluetongue should be suspected when typical clinical signs are seen during seasons when insects are active. A recent history of wasting and foot rot in the herd supports the diagnosis. Bluetongue can be diagnosed by isolating the virus in cell cultures or embryonated chicken eggs. Virus identity is confirmed by antigen-capture enzyme-linked immunosorbent assay (ELISA), immunofluorescence (IFA), immunoperoxidase, virus neutralization (VN), or polymerase chain reaction (PCR) tests (Afshar., 1994). Bluetongue virus can also be isolated by inoculation into sheep, and sometimes suckling mice or hamsters. Serology and complement fixation tests are also used, and recently a method has been developed to examine bluetongue virus proteins and genes, which helps to differentiate between BTV and related viruses that cause epizootic hemorrhagic disease (EHD).

Treatment

There is no specific or efficient treatment that can be given for an acute case of bluetongue, only supportive therapy. Animals infected with bluetongue should be protected from the elements (e.g., the wind or sun), kept warm and dry, and given fluids and electrolyte solutions if needed, as well as antibiotics to prevent a secondary infection. Treatment procedures may also include vector control by insecticides, which will reduce transmission of the virus to non-infected animals.

Prevention and Control

If there is a case or outbreak of Bluetongue, contact the state and/or federal veterinarian immediately and establish a quarantine of the premise. Control strategies for bluetongue include using a combination of quarantine and movement controls to prevent spread of the virus. When there is suspicion of BTV circulating in an area, animals should be confined indoors at times when the vectors are active. Slaughter may also be necessary, depending upon the situation. Disinfectants cannot prevent the virus from being transmitted between animals; however, where disinfection is warranted, sodium hypochlorite or 3% sodium hydroxide are effective. Insect control is important in limiting the spread of the disease; synthetic pyrethroids or organophosphates are effective against *Culicoides*.

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No-Till Farming and Controlled Traffic for Sustainability of Agro-Ecosystem

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Introduction

An agro ecosystem is a spatially and functionally coherent unit of agricultural activity, and includes the living and non-living components involved in that unit as well as their interactions. With the increasing intensity of agricultural production there is growing interest in assessing the sustainability of these systems. In ecology, sustainability describes how biological systems remain diverse and productive over time, a necessary precondition for the well-being of humans and other organisms. Long-lived and healthy wetlands and forests are examples of sustainable biological systems.

Sustainability

Sustainability is the capacity to endure. The sustainability of agro ecosystems depends on the maintenance of the economic, biological and physical components that make up the system. The high level of integration of these components implies that any evaluation of agro ecosystem sustainability must consider the dynamics of multiple components.

Soil erosion, faulty irrigation practices, over use of nutrients etc. are major soil related constraints which are threatening the sustainability of agro-ecosystem which could be minimized by No –till farming and controlled traffic.

1. No-till farming: No-tillage is one of the components of conservation agriculture practices and is considered more environmentally friendly than complete tillage. Due to this belief, it could be expected that agro ecologists would not recommend the use of complete tillage and would rather recommend no-till farming, but this is not always the case. In fact, there is a general consensus that no-till can increase soils capacity of acting as a carbon sink, especially when combined with cover crops. No-till can contribute to higher soil organic matter and organic carbon content in soils, though reports of no-effects of no-tillage in organic matter and organic carbon soil contents also exist, depending on environmental and crop conditions. In addition, no-till can indirectly reduce CO_2 emissions by decreasing the use of fossil fuels.

Most crops can benefit from the practice of no-till, but not all crops are suitable for complete no-till agriculture. Crops that do not perform well when competing with other plants that grow in untilled soil in their early stages can be best grown by using other conservation tillage practices, like a combination of strip-till with no-till areas. Also, crops which harvestable portion grows underground can have better results with strip-tillage, mainly in soils which are hard for plant roots to penetrate into deeper layers to access water and nutrients. The benefits provided by no-tillage to predators may lead to larger predator populations, which is a good way to control pests (biological control), but also can facilitate predation of the crop itself.

Another factor to be considered is that organic residue from the prior year's crops laying on the surface of untilled fields can provide a favourable environment to pathogens, helping to increase the risk of transmitting diseases to the future crop. Other disadvantages of no-till include underground rot, low soil temperatures and high moisture.

Based on the balance of these factors, and because each farm has different problems, agro ecologists will not attest that only no-till or complete tillage is the right way of farming. Yet, these are not the only possible choices regarding soil preparation, since there are intermediate practices such as strip-till, mulch-till and ridge-till, all of them - just as no-till - categorized as conservation tillage. Agro ecologists, then, will evaluate the need of different practices for the contexts in which each farm is inserted.

2. Controlled traffic: Controlled traffic is the practice of running farm machinery over the same paths in the field, from event to event and year to year, so that compaction resulting from such passes will be confined to the smallest possible proportion of the field. Random wheel traffic patterns create compaction over the majority of the field as compared to controlled wheel traffic.

Outcomes of Controlled Traffic

1. Possible benefits include improved water infiltration and root growth, as well as a reduction in fuel costs associated with tilling compacted soils.
2. In a single year, nearly 90% of a field is compacted by normal field operations using a conventional tillage system. 80% of soil compaction from wheel traffic occurs on the first pass of a tire.
3. Compaction can reduce yields up to 60% depending upon the depth of compaction and its severity.
4. No differences in bulk density, soil penetration, and soil moisture content between regular and controlled traffic.

Limitations in Adoption of Controlled Traffic

1. Adoption of controlled traffic is probably most limited by incompatibility of farm equipment.
2. Perceived lack of benefits also inhibits adoption.

Conclusion

The goal of agro-ecosystem management is to pursue balance and coordination amongecological, social and economic systems. No –till farming and controlled traffic are important practice for sustainability of agro ecosystem.

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Recent GI Tag from Jammu and Kashmir: Saffron

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Saffron cultivation (http://agropedia.iitk.ac.in/sites/default/files/saffron_0.jpg)

Summary

We all might have heard that recently the Kashmir Saffron has been given the GI tag by the Geographical Indications Registry. This is a huge step that will help with the authentication of Kashmir grown Saffron on the world map. India ranks third largest producer after Iran and Spain. Kashmir grown saffron is also the costliest in the world. Thus, this article is all about to get a brief idea about the cultivation of saffron in India.

Introduction

We all know that India has been known as the Land of Spices. Kashmir Saffron receiving GI tag can be a game changer that can help increase the importance of it in the export market. Saffron is mainly cultivated in Iran, Spain, France, Italy and parts of India. In India, Saffron is grown in the highlands of Jammu and Kashmir, including in places like Pulwama, Budgam, Kishtwar and Srinagar.

It is locally known by the name Kesar, Jafran, Kong, Kesara, etc. It is one of the most precious and expensive spice in the world for which it is often nicknamed as “Red Gold”. Saffron is produced from the dried styles of plant *Crocus sativus* L. belonging to family Iridaceae. The genus Crocus comprises about 85–100 species, primarily originated in the Mediterranean – Europe and Western Asia.

Saffron is the golden-coloured stigmas of the flower of *Crocus sativus*, which are dried and used as a spice to flavour many dishes and as a dye to colour foods and other products and has a strong, exotic aroma and a bitter taste. Wild saffron is botanically called *Crocus cartwrightianus* and its domesticated species *Crocus sativus* is the commercially cultivated saffron. There are different types of Saffron grown in the world. Aquilla saffron is an Iranian variety.

The plants as well as the thread of this variety are shorter in length. The colour is slightly less red than Kashmiri saffron but because of its abundant availability in the market since, it is less costly than Kashmiri variety. The cultivar grown in US is Crème saffron which is of lower quality as compared to Iranian or Kashmiri variety and is the cheapest of all varieties of saffron available in the market. The one grown exclusively in Kashmir is the Lacha

Saffron which is very popular in terms of quality having strands of dark crimson red. The flavor, aroma and color that it imparts make it special worldwide and the most expensive type of saffron available in the market.

The Taxonomic Classification of *C. sativus* Series are as Follows

1. Division: Spermatophyta
2. Sub-division: Angiospermae
3. Class: Monocotyledonae
4. Sub-class: Liliidae
5. Order: Liliales
6. Family: Iridaceae
7. Genus: *Crocus*

There are only three stigmata in each saffron flower. Once the stigmata (and their red pistils) have been separated from the plant, they are dried to preserve their colour and flavour. The flowers close at night and in dull weather.


Saffron flower (left) and Piles of dried saffron/ Saffron thread (right)

Uses of Saffron

Saffron contains about 0.5 to 1 percent essential oil, the principal component of which is picrocrocin and the coloring matter is crocin. Saffron is used for both culinary and medicinal purpose. In ancient times, a golden-colored, water-soluble fabric dye was distilled from saffron stigmas in India.

Shortly after the death of Buddha, his priests made saffron the official color of their robes. The most popular use of saffron in India is as a flavoring and coloring agent in milk and milk sweets. Apart from this it is also being used as a seasoning agent in cheese, mayonnaise, meat, etc. They are popularly added as a flavoring and seasoning agent in the Mughlai cuisine. It has been also used in perfumes and cosmetics.

The stigma of saffron (*Crocus sativus* L.) are often used for treating several diseases such as arthritis, infertility, liver enlargement and fever in Ayurveda. Many data also reveal that these components exert anticarcinogenic and antitumor activities.

Why it is the Costliest Spice in the World?

It is labour-intensive crop; the three stigmas need to be handpicked from each flower, then spread on trays, and dried over charcoal fires for use as a food flavouring and colouring. It takes 75,000 saffron flowers to make one pound (0.45 kilogram) of saffron spice. Only a small amount of each saffron flower is used, and all harvesting must be done manually which undoubtedly makes it one of the most expensive spice in the world.

Basic Information Regarding Cultivation of Saffron

1. Cultivation place: Saffron in India is mainly cultivated in the states of Himachal Pradesh and Jammu and Kashmir.

2. Propagation by: Saffron is a bulbous perennial plant with globular corms and it is propagated through corms that are underground, compressed stems. The corms for saffron cultivation are planted directly into the pits. The surface is then covered loosely with soil. It can grow up to 20 cm in height.

Saffron Corms

1. Planting time: In India, saffron corms are cultivated during the months of June and July. At some places it is also cultivated in August and September.

2. Flowering: Saffron plant starts flowering in October. It needs extreme heat and dryness in summer and extreme cold during winter. Maximum vegetative growth takes place during winter.

3. Soil and Climate requirement: For growing saffron, warm and sub-tropical climate is suitable. It grows well at an altitude of 2000 meters above sea level. A photoperiod of 12 hours during the crop growth period is desirable. When it comes to soil, it prefers to grow in loamy, sandy or calcareous soil. Gravelly soil is also favourable for saffron farming. It should be well drained with pH ranging from 6-8. A heavy, clayey soil is not suitable and should be avoided for saffron farming.

4. Water requirement: Saffron crop requires little water. The soil must not be completely dry but just moist. In case of erratic rains, sprinkler irrigation is the most commonly followed and about 283 m3 per acre of water must be distributed throughout the period of saffron cultivation. Irrigation is done on weekly basis. The agricultural Directorate of Jammu and Kashmir recommend weekly irrigation for ten weeks among which the first seven is the most critical period. This is because it promotes vegetative growth and facilitates flowering. Pre-flowering irrigation must be done in the last week of August and continued up to mid-October.

5. Weeds: Weeds like saffron thistle compete with the crop for nutrition and sunlight. It is a prickly, hardy and stocky plant with sharp spines that cause injury. The most common method of weed control is mulching the plants with saw dust.

6. Major disease: The major diseases affecting saffron farming are Fusarium wilt, Violet root rot and Rhizoctonia crocorum.

7. Harvesting: Harvesting process in saffron is labour intensive and time consuming. Saffron plants start flowering within three to four months of planting. Therefore, if it is planted in June, ideally it would start flowering by October. Flowers bloom at dawn and wilt as the day progresses. Therefore, harvesting of flowers must be done at dawn. The flowers are then piled to remove the stigma which is the orange to red coloured part. The stigma strands are dried under the sun for five days and then packed in air-tight containers. In case of solar driers, it needs 7-8 hours of drying.

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Integrated Farming System (IFS) – A Solution for Doubling Farmers' Income

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During last five decades agricultural research has focused on the development of highly profitable crop varieties, better farm implements, increased fertilizer use and other production technologies which enabled the farmers to grow more food. At the same time, it over exploited the resources and resulted in decreasing factor productivity, resource use efficiency, less farm productivity and profitability. Crops productivity is largely restricted by uncertain and erratic rainfall, scarcity of water for irrigation and deterioration of soil-health. 70% of the farmers in India have annual per caput income less than Rs. 15,000. Only 10% of them earn more than Rs. 30,000 (Kumar and Chahal, 20186). The Government of India in annual budget of 2016-17set a policy for achieving the target of doubling farmer's income by 2022 and also our prime minister has dream project to how farmers income double by 2022 (Anonymous, 20171).

Integrated farming system (IFS) is only possible way out to increase the farmer's income and also full fill the need of food for increasing population. Integrated farming system may be defined as the linking together of two or more normally separate farming systems which become subsystems of a whole farming system. Farming system represents an appropriate combination of farm enterprises (cropping systems, horticulture, livestock, fishery, forestry, poultry) and the means available to the farmer to raise them for profitability. It interacts adequately with environment without dislocating the ecological and socioeconomic balance on one hand and attempts to meet the national goals on the other. Integrated Farming system demands multiple tasks in production and marketing. Therefore, rural educated youth who intuitionistic in operating smart phones and ICT tools be attracted in ease of doing marketing and realising premium price to their produce (Goverdhan et al., 20184).

Components of IFS

1. Crop production: The cropping system should provide enough food for the family, fodder to the cattle and generate sufficient cash for domestic and cultivation expenses. These objectives could be achieved by adopting intensive cropping (multiple cropping and intercropping). Alteration of crop geometry may help to accommodate intercrops without losing the base crop population (Rana, 2013[5]). There are various cropping system followed in India viz. Rice-based cropping system, Sorghum-based cropping system, Pearl millet-based cropping system and Wheat and gram-based cropping system etc.

2. Animal husbandry: Dairy farming is an important source of income to farmers. Besides producing milk and/or draft power, the dairy animals are also good source of farm yard manure, which is good source of organic matter for improving soil fertility. The farm by-products in turn are gainfully utilized for feeding the animals.

3. Goat and sheep rearing: Goat is mainly reared for meat, milk, hide and skin. Goat meat is the preferred meat in the country. A goat on hoof (live goat) fetches a better price than a sheep on hoof. Sheep are well adapted to many areas. They are excellent gleaners and make use of much of the waste feed. They consume large quantities of roughage, converting a relatively cheap food into a good cash product.

4. Fisheries: Ponds serve various useful purposes, viz., domestic requirement of water, supplementary irrigation source to adjoining crop fields and pisciculture. With the traditional management, farmers obtain hardly 300-400 kg of wild and culture fish per ha annually.

5. Piggery: Pigs are maintained for the production of pork. pig grows fast and is a prolific breeder, farrowing 10 to 12 piglets at a time. It is capable of producing two litters per year under good management conditions. The carcass return is high at 65-70% of the live weight.

6. Poultry: Poultry is one of the fastest growing food industries in the world. Poultry meat accounts for about 27% of the total meat consumed worldwide and its consumption is growing at an average of 5% annually. As per the nutritional recommendation, the per capita consumption is estimated at 180 eggs/year and 9 kg meat/year.

7. Duck Rearing: Ducks account for about 7% of the poultry population in India. Ducks are predominantly of indigenous type and reared for egg production on natural foraging. They have a production potential of about 130-140 eggs/bird/year. Ducks are quite hardy, more easily brooded and resistant to common avian diseases.

8. Mushroom production: Mushroom is an edible fungus with great diversity in shape, size and colour. Essentially mushroom is a vegetable that is cultivated in protected farms in a highly sanitized atmosphere. Just like other vegetables, mushroom contains 90% moisture with high in quality protein. Mushrooms are fairly good source of vitamin C and B complex. The protein have 6070%digestibility and contain all essential amino acids. It is also rich source of minerals like Ca, P, K and Cu. They contain less fat and CHO and are considered good for diabetic and blood pressure patients.

Species: There are three types of mushrooms popularly cultivated in India. They are (i) Oyster mushroom – *Pleurotus* sp. (ii) Paddy straw mushroom – *Volvariella volvacea* (iii) White bottom mushroom – *Agaricus bisporus*.

9. Agro-forestry: Agroforestry is an integrated selfsustained land management system, with introduction of various component like timber, pulp, pole, fuel wood, food and medicine with agricultural crops on the same unit of land, meeting the ecological and socio-economic needs of farmers. Agroforestry is an integrated selfsustained land management system, with introduction of various component like timber, pulp, pole, fuel wood, food and medicine with agricultural crops on the same unit of land, meeting the ecological and socio-economic needs of farmers.

An integrated farming system will provide food security for the household and all members within which ensure both physical and economic access to balanced diet, environmental sanitation and basic health care. Farming system has several components like dairy, poultry, goatery, fisheries etc. along with crop production. In this way, farming system would not only meet the food demand but also cater the need of protein, fat, vitamins and minerals required for good health. Income will be generated throughout the year in an efficient IFS and employment generation will be high compared to conventional cropping systems. Das *et al*. (2018[3]) reported that integrated farming system has resulted in almost 3 times higher net income compared to conventional cropping system in Meghalaya.

The effective recycling of farm resources is possible by adoption of farming system research. Crop by-product is utilized as fodder for animals, and animal by-product i.e. milk, and dung may be utilized for increasing income and soil fertility, respectively. Rice residue burning is very common in north western states which is the main reason for environmental pollution. Crop residues can be use as animal feed & other purposes in the IFS which will reduce the pollution**.** Labour requirement is present throughout the year in IFS unlike cropping systems where it is season specific. Goverdhan *et al.* (2018[4]) reported that integrated farming System could generate 750-man days/ha/annum which is 3 times higher than rice-maize (225-man days) cropping system in Telangana. Tanwar *et al*. (2018[7]) reported that integrated farming system has resulted in higher net returns as well as B:C ratio compared to arable farming and Employment generation is almost double in integrated farming system when compared to arable farming.

Conclusion

Integrated farming system is extremely important for the efficient management of available resources at the farm level to generate adequate income and employment for the rural poor, and improvement of their livelihoods in a sustainable manner. Low level of farmers' income can cause serious adverse effect on the present and future of agriculture and farmers health in the country. Government of India has targeted to double farmers' income by 2022. Integrated farming systems can be best solution to double the farmers' income in a sustainable manner. Diversification of activities which yields better remuneration (region specific) should be the ideal strategy and easy to increase the farmers income (Choudhary et al., 20192). The farming system approach to agricultural research and development efforts will accelerate agricultural growth and it can be the best way for transforming poverty-prone rural India into a prosperous India.

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Base Editing

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Introduction

Genome editing, also referred to as “gene editing”, “genome engineering”, “gene engineering”, is the introduction of desired change to the sequence of genomic DNA. Various genome editing tools – Meganucleases, Zinc finger nucleases (ZFN), Transcription activator like effector nucleases (TALENs) and Clustered regulatory interspaced short palindromic repeat (CRISPR)-Cas associated system have been developed and used. Out of these genome editing tools CRISPR/Cas has rapidly gained popularity.

RNA-programmable CRISPR-associated (Cas) nucleases have contributed in achieving the goal of precisely and efficiently editing DNA through their ability to generate a double-stranded DNA break (DSB) at a precise target location in the genome of a wide variety of cells and organisms. These DSBs are repaired through either the error-prone process of nonhomologous end joining (NHEJ) or by homology-directed repair (HDR) mechanisms. NHEJ often leads to small insertion / deletion and is usually used in generating loss-of-function mutants, whereas HDR is another approach to repair DSBs in a precise manner.

HDR is a high-fidelity repair method which results in gene insertion or gene replacements and can be used to correct point mutations in target genes. However, base editing is an emerging alternative and efficient powerful tool to HDR-mediated precise gene editing in plants for single base substitution. It was founded by two postdocs - Alexis Komor, Ph.D., and Nicole M. Gaudelli, Ph.D. in 2016 working at Harvard University. Base editing is a newer genome editing approach that uses components from CRISPR systems together with other enzymes to directly install point mutations into cellular DNA or RNA without making double-stranded DNA breaks (DSBs) (Rees and Liu, 2018).

In simple words, it is the conversion of one single base or base pair into another without creating and repairing any DSBs. Also, genome editing tools offer few limitations. They may cause off-targeted mutagenesis due to the introduction of mutations at sites other than the targeted site due to DSBs. NHEJ occurs more efficiently at the site of DSBs than HDR resulting in random insertion and deletion of nucleotides at the target locus. Including the technical limitations, production of nuclease can be laborious and delivery to cells can be challenging. These limitations have highlighted the need for new and alternative approaches which can result in precise and stable genome editing.

How Base Editing Works?

Creating point mutations with CRISPR is inefficient due to a low mutation rate of 0.1% to 5% with most of them resulting in indels because the breaks made are repaired by the DNA repair enzymes which may lead to random and undesirable insertions and deletions. Therefore, to increase the efficiency of gene editing, tools like base editing can be used. Base editing is done with the help of base editors.

DNA base editors are engineered ribonucleoprotein which comprise of a catalytically disabled nuclease fused to a nucleobase deaminase enzyme and, in some cases, a DNA glycosylase inhibitor that operate on single-stranded DNA (ssDNA) but not dsDNA. A catalytically dead Cas9 (dCas9) is used which is capable of binding to the DNA in a guide RNA-programmed manner via the formation of an R-loop but does not cleave the DNA backbone.

Base editing is based on the principle that when a base in one strand is converted, the cell is tricked to fixing the complementary base in the other strand to ensure that correct base pairing occurs. Unlike the CRISPR system base conversion in base editing is done chemically with the help of specially designed base editors. There are two classes of DNA base editor: cytosine base editors (CBEs) and adenine base editors (ABEs).

CBEs convert a C•G base pair into a T•A base pair, and ABEs convert an A•T base pair to a G•C base pair. The latter is more useful because mutations in which a G-C is mutated to an A-T base pair account for almost 50% of the 32,000 single point mutations associated with genetic diseases in humans.

DNA Base Editors

Cytosine base editors (CBEs): It comprises of a cytidine deaminase enzyme which is fused with the dCas9 at the N-terminus and is capable of converting DNA base cytosine to uracil. This will lead to the formation of a U:G mismatch. In addition to this an uracil DNA glycosylase inhibitor is added to prevent the repairing back of U:G mismatch to C:G. Since cytidine deaminase enzyme can bind to single stranded DNA only the local denaturation of the target DNA upon dCas9:sgRNA binding (R-loop formation) is essential.

Upon binding to its target locus in DNA, base pairing between the guide RNA and target DNA strand leads to displacement of a small segment of single-stranded DNA in an “R-loop”. DNA bases within this single-stranded DNA bubble are modified by the deaminase enzyme (Rees & Liu 2018). Once the R-loop forms, the cytidine deaminase enzyme directly binds the target nucleotide (C) and chemically converts it to U. The resulting U:G mismatch is repaired by the repair machinery of the DNA and ultimately is converted to T:A base pair. Therefore, overall transformation is from C:G to T:A.

The binding of the deaminase enzyme to only single stranded DNA restrict its activity to a small window of nucleotides within the single-stranded bubble created by Cas9.CBEs have been shown to be functional in many plant species, the narrow target range and low editing efficiency considerably limit their application in crop breeding.

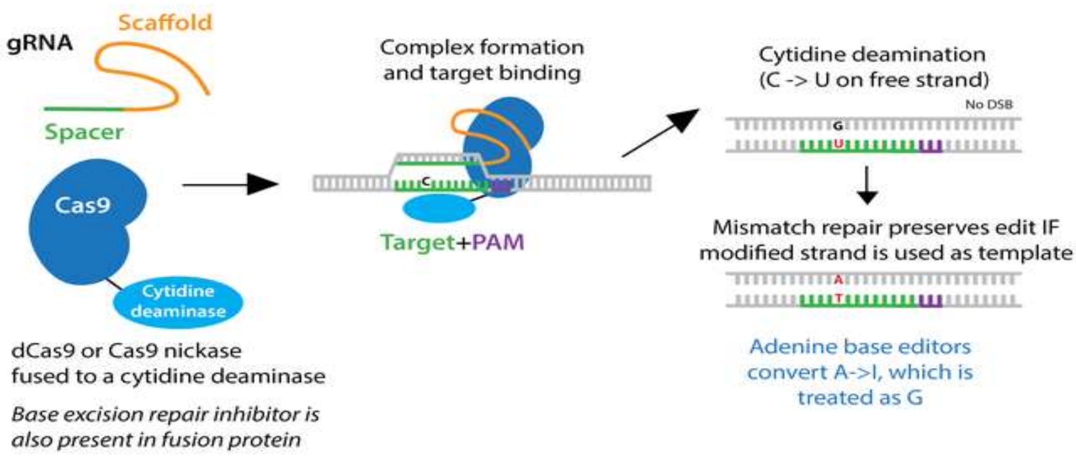

Figure 1: Diagrammatic representation of base editing using cytosine base editors

Adenine base editors (ABEs): They can introduce targeted A to G (or T to C) substitutions in a programmable manner. This substitution can be achieved by deamination of adenosine to inosine which pairs with cytosine and is therefore recognized by polymerase enzyme as guanosine (Rees and Liu, 2018). The ABEs consist of a Cas9 nickase (or nuclease dead Cas9, dCas9) fused with an evolved adenine deaminase enzyme.

This deaminase enzyme is taken from bacteria E. coli, tRNA adenosine deaminase (TadA) which catalyzes the targeted deamination of deoxyadenosine. The extensive directed evolution in this enzyme also known as the seventh generation ABEs has made them more efficient in creating more clean point mutations with a very low rate of indels (approximately not more than 0.1%) across a wide range of target genomic loci in human cells.

These base editors exceed the typical performance of the third-generation base editors (BE3). ABEs along with the previously described base editors enable the programmable installation of all four transitions (C to T, A to G, T to C, and G to A) in genomic DNA (Gaudelli et. al., 2017).

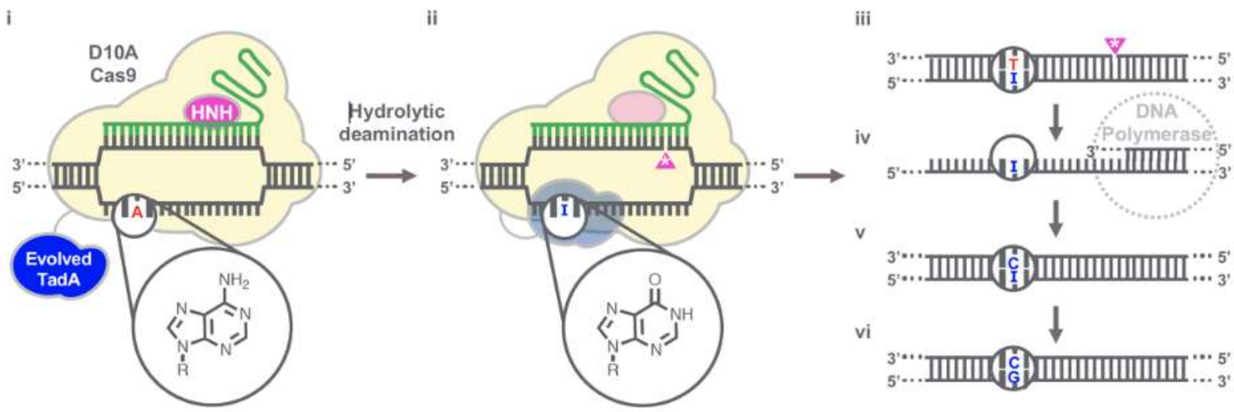

Figure 2: Diagrammatic representation of base editing using adenine base editors

Conclusion

Base editing presents an orthogonal strategy to engineer nucleotide substitution and is an alternative to HDR mediated genome editing. According to Komar one of the co-founders, “Base editing is not just a technology that is going to completely overtake CRISPR, but it can be used as a therapeutic to correct disease-relevant point mutations and also introduce these point mutations into the genome of live cells.”. Hence, it is a potential tool in genome engineering.

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Drying Without Senescence – Nature's Secret of Eternal Life

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Introduction

Global warming and rising temperatures have created havoc in the agricultural production scenario. Crop losses, shortening of growth periods, emerging newer pests and reduced yields are the most evident effects of higher temperatures. Increasing production under water deficit conditions is considered a major challenge by agricultural scientists. The increased incidence of droughts and water shortages necessitate the cultivation of drought adapted and temperature tolerant crops Exploration of the adaptations shown by plants to drought have led to the discovery of the unique ability exhibited by certain groups of plants to "resurrect" from "death" with the availability of water and has received wide attention in the recent years.

Desiccation Tolerance

Adaptation to desiccation is reported as one of the most formidable achievements in the evolution of life on Earth. Desiccation tolerance is defined as the ability to recover from almost complete loss (80 – 90 %) of protoplasmic water (Oliver et al., 2000), i.e. plants dry without senescence and recover with water availability. The ability to survive desiccation in their reproductive structures (pollen, spores and seeds) is common in plant species, but that in the vegetative stage is rare. However, the identification of this mechanism in certain group of plants has opened vistas for exploitation especially through genetic engineering in crop plants.

Vegetative Desiccation Tolerance in Plant Kingdom

Resurrection plants are plants that shows an extreme level of tolerance to desiccation throughout their vegetative tissues and can rehydrate and regain metabolic activity within hours when water becomes available. In other words, these are plants that confront extreme desiccation by drifting into a dormant state in which they can stand losing over 95% of their water content, and return to full activity upon rehydration. These plants have the extraordinary ability to remain in air dried state for months and even up to years and on wetting revive, green in a few hours and flower even before most plants do.

Majority of vegetative desiccation tolerant plants belong to algae, lichens and bryophytes. Among the larger and more complex groups of vascular land plants, some degree of vegetative desiccation tolerance is exhibited by the pteridophytes and angiosperms. However, gymnosperms represent the major class of vascular plants that does not have a species with desiccation tolerant vegetative tissues.

Table 1. Examples for resurrection plants:

Common name	Scientific name	Family	Origin
Monkey's Tail	*Xerophyta viscose*	Velloziaceae	Southern Africa
Bush tea	*Myrothamnus flabellifolia*	Myrothamnaceae	Southern Africa
Fibrous dropseed	*Sporobolus stapfianus*	Poaceae	Southern Africa
Wether love grass	*Eragrostis nindensis*	Poaceae	Southern Africa
Blue gem	*Craterostigma plantagineum*	Scrophulariaceae	Southern Africa
Rose of Jericho	*Selaginella lepidophylla*	Selaginellaceae	North and South America
Tortula moss	*Tortula ruralis*	Pottiacaeae	North America

(Bartels and Hussain, 2011)

Resurrection Cycle

Cycling between intensive dehydration and subsequent rehydration is a characteristic feature of resurrection plants. It is reported that these plants reduce the damage caused by dehydration by maintaining physiological integrity in dried state and mobilizing mechanisms upon rehydration.

As compiled by Kranner et al. (2002), desiccation tolerant plants must be able to:
1. Limit the damage to a repairable level.
2. Maintain physiological integrity in the dried state.
3. Mobilise mechanisms upon rehydration that repair damage suffered during desiccation and subsequent rehydration.

Mechanisms During Dehydration

1. Morphological changes: Curling or folding or shrinking of the leaves is the most prominent response by plants during dehydration, which reduces the effective transpiring surface.

2. Changes at cellular level: These include structural alterations of the cell wall, substitution of water with non-aqueous substances such as amino acids, small proteins and sugars to maintain the original cell volume, fragmentation of the central vacuole into a number of smaller units are adaptations by plants to tolerate desiccation.

3. Physiological changes: Dehydration leads to stomatal closure and inhibition of the photosynthetic activity which prevents photo – oxidative damage.

There are two types of resurrection plants based on whether they maintain or break down their photosynthetic apparatus in the dry state- *Poikilochlorophyllous and Homoiochlorophyllous* resurrection plants. This characteristic is important because when plants dehydrate, the primary, light-dependent, reactions of photosynthesis continues, but the biochemical reactions that follow become inactive due to decreased uptake of carbon dioxide as the stomata get closed.

This imbalance results in the enhanced formation of 'reactive oxygen species' (ROS) molecules that inflict damage onto various cellular components and can eventually lead to death of the plant. Poikilochlorophyllous resurrection plants cope with this problem by disassembling their photosynthetic machinery and degrading its components during dehydration (break down chlorophyll and dismantle thylakoid membranes on drying) while the homoiochlorophyllous resurrection plants, on the other hand, maintain most of their photosynthetic complement in the dry state (folding leaves, shading inner leaves and adaxial surfaces, increased anthocyanin production masking chlorophyll during dehydration). This allows them to quickly resume normal function upon rehydration.

4. Metabolic changes: It is generally thought that desiccation-tolerant systems substitute water with hydrophilic molecules that form hydrogen bonds to stabilize macromolecular interactions in their native configuration (Crowe *et al*. 1998).Typical water replacement molecules include sugars, particularly sucrose together with oligosaccharides. Accumulation of sucrose in resurrection plants protects the dehydrated cell. Cells are also protected by stabilization of cytoplasmic constituents through accumulation of organic compatible (proline, mannitol, and glycine betaine).

Mechanisms During Rehydration

Rehydration involves gradual recovery of cellular organization and reactivation of normal metabolic functions. The cells in leaves of resurrection plants that have shrunk upon drying due to cell wall folding extend during rewatering and recover their initial volume without suffering mechanical damage.

Homoiochlorophyllous plants regain their photosynthetic ability more rapidly in one to two days by resuming a lenticular shape of chloroplast with a correct organization and composition of thylakoids. On the contrary, the poikilochlorophyllous species, have to reconstruct chloroplasts and hence acquire the complete photosynthetic activity with a few days delay.

Potentials of Resurrection Plants in Agriculture

The innate capacity of the resurrection plants to tide over drought has huge potentials in agriculture including the activation of the endogenous genes for dehydration and rehydration mechanisms in all plant parts and transfer of genes for desiccation tolerance into crop plants.

Transgenic rice plants expressing osmotin (TIOsm) from the resurrection plant *Tripogon loliiformis*, showed increased tolerance to drought and salinity stress when compared to the wild type and vector control counterparts (Trang et al., 2018). Liu et al. (2009) generated transgenic tobacco by transferring LEA 4 group genes from the resurrection plant *Boea hygrometrica* and recorded little difference in the dry mass of wild type and transgenic seedlings under drought stress conditions. Upon watering, most of the transgenic plants recovered rapidly, whereas fewer wild type plants resumed growth.

Conclusion

Recent environmental changes challenge global agriculture and reconfirm the importance of wild flora as useful sources of valuable traits to withstand unpredictable weather occurrences. Drying without senescence and revival with availability of water is a unique strategy of certain groups of plants called resurrection plants. The mechanism can be considered as excellent model systems and serve as potential sources for desiccation tolerant genes. Developing crop plants with desiccation tolerance can be a major breakthrough for increased adaptation to drought and thus increasing production in the arid and semi-arid regions.

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Emission of GHG From Livestock Farming in India And Mitigation Options

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Introduction

Livestock is an integral part of sustainable agriculture. Livestock farming contributes significantly to Indian economy, sharing 4.9% of the country's gross value added (GVA) in the year of 2017-18 (Singh, 2020). It is the sole source of income for many landless farmers and helps to fulfil the protein requirement of people (20th livestock census report, 2019). But livestock sector emits a significant amount of greenhouse gases (GHGs) like methane, nitrous oxide and carbon dioxide etc, and becomes responsible for global warming (Sejian et al., 2016). The enteric fermentation mechanism in livestock animals like cattle, buffalo, sheep, goat causes a huge emission of methane (CH_4). But this emission not only results loss of dietary energy (6-8 % of intake) but also represent a significant loss in the context of India as feed cost is about 60-70% of total cost of animal production (NIANP, 2013-14). Therefore, finding out the possible strategic ways to minimize the emissions of GHGs from livestock sector gets a global attention.

Sources of Emission

The enteric fermentation and manure management are the direct sources of methane (CH4) emission, of which 90% of methane is generated by enteric fermentation (NIANP, 2014-15), while the emission of nitrous oxide (N2O) occurs solely from manures (Sejian et al., 2016). The emissions from on-farm burning of fossil fuel, feed production, livestock induced desertification, cultivated soil and post-harvest operations etc. being considered as the indirect sources of emission in livestock production (Sejian et al., 2016). Carbon dioxide (CO2) emission occurs largely due to burning of fossil fuel during the operation of farm machineries in the process of fertilizer production, processing and transportation of refrigerated products, deforestation, desertification, and release of carbon from cultivated soils (Sejian et al., 2016). The diverse anaerobic microbes living in the rumen of livestock animals help to degrade the complex carbohydrates and also remove the fermented metabolites in a syntrophic way (Malik et al., 2015). During the process of fermentation, a large volume of H2 gas is produced which needs to be removed from the rumen for maintaining a favourable condition for microbial population and host animal. Under this situation, the microbes like archea or methanogens, constitute only a small fraction of the rumen microbial community, use the H2 gas as substrate to convert CO2 into CH4 and the produced CH4 is gradually eructated to atmosphere through mouth and nostrils of livestock animals. Thus, the process of rumen methanogenesis becomes essential for animals, but it is a wasteful process as it causes a significant dietary loss (Sejian et al., 2016). The level of production of H2 gas in rumen decides the extent of methanogenesis and oxidation of feed (Hegarty et al., 1999). Besides the enteric fermentation, manure including dung and urine is also responsible for methane emission under anaerobic condition in slurry state and nitrous oxide under aerobic condition in solid state through denitrification process (Sejian et al., 2016). The rate of emissions of CH4 and N2O from manures depends on several factors like, amount of manure, type of feed, management systems and ambient temperature (Sejian et al., 2016).

Emission Scenario

India ranks first in the world, sharing 11.54% of the global livestock population (Singh, 2020). According to 20th livestock census report in 2019, the total livestock population in India is 536.76 million, of which the population shared by cattle 36.04 %, buffalo 20.47 %, goat 27.74%, sheep 13.83%, pig 1.69 % and other 0.23%. Therefore, Indian agriculture contributes 19.89% of the total emission of GHGs in the country, accounting for 19779.06 and

722.76 gigagram emissions of methane and nitrous oxide respectively. Out of the total methane generation, the contribution of enteric fermentation and manure management are 13830.51 and 1187 gigagram respectively. Similarly, the emissions of nitrous oxide out of manure management, manure applied to field and manure left on pasture are 13.26, 15643.70 and 214.9 gigagram respectively (FAOSTAT, 2017). The enteric fermentation shares 45.4 %, manure management 4.5%, manure left on pasture 10.4% in terms of CO2e out of total emission from agriculture sector, whereas globally enteric fermentation constitutes 38.8%, manure management 6.5% and manure left on pasture 16% in terms of CO2e out of total emission from agricultural sector (FAOSTAT, 2017). ICAR-NIANP has estimated that the livestock sector produces about 9.25 Tg enteric methane per annum in India. Among the livestock, cattles are the largest methane producer with a release of 4.92 Tg methane per year (56% of the total methane emission) followed by buffaloes (29%), sheep (5%) and goat (10%) (NIANP, 2018-19). The states like Uttar Pradesh, Bihar, West Bengal, Assam, Jharkhand and Andhra Pradesh are the major methane emitting states due to dense livestock population (≥204/km2) (NIANP, 2018-19). A comparative study for emissions from different parts of India indicates that North India contributes the maximum of enteric emission, about 25% of the total emission and that of 23.7%, 19%, 16.2%, 3.58% from the West, East, South and Northeast hilly regions of the country respectively (NIANP, 2018-19).

Mitigation Options

Several approaches have been recommended to restrict the major emission of methane by methanogens in the process of enteric fermentation in livestock system. But still they are not gaining much success. So far, the possible measures to reduce the methane emission from livestock production are stated below:

1. Feed management: Manipulation of feed is the easiest way to reduce methane emission. The amount of enteric emission varies with the intake rate of feed and capacity to digest (Grossi et al., 2019). Experimental finding reveals that the lower quality of feed produces more methane, while the feed consisted of more lingo-cellulose improves digestibility and produces less methane (Agrawal et al., 2010). Moreover, the addition of every 1% lipid in feed reduces methane emission by 4-5% (Grainger et al., 2011, Martin et al., 2010). Methane production is less in legume fodder than cereal one because of containing more soluble carbohydrates in legume fodder (NIANP, 2012-13). The analysis of methane production potential (MPP) of various feed samples exhibits that the lowest MPP is found in tree leaves followed by cereal grains, de-oiled cakes and cultivated fodder, and it is maximum in cereals by-products and straw (NIANP, 2013-14). Application of urea fertilizer in paddy straw feed also reduces methane generation (Zhang et al., 2019). The addition of oils, tannin (Bhatta et al., 2009) and saponin in diet has the potentiality to reduce methane emission. Like coconut oil or palm oil (Haque, 2018), about 20% reduction in methane emission can be achieved by application of peppermint (Mentha piperita) oil in wheat straw and also in concentrate mixture (Agarwal et al., 2009). An in vivo study by NIANP shows a reduction of 20.5, 20.7 and 26.2% methane emission in sheep due to addition of tropical tree leaves rich in tannin viz. Jack *(Artocarpus heterophyllus),* Neem *(Azadirachta indica)* and Banyan *(Ficus benghalensis)* leaves respectively. The leaves of som *(Persea bombycine)* and jamun *(Syzygium cumini)* trees mixed at the rate 8.5% of the feed reduce 19-21% emission (Vijayalakshmy et al., 2020). The mixture of tamarind seed husk with 5% of the straw and concentrate diet reduces 17% emission in cattle without any effect on digestion (Vijayalakshmy et al., 2020). Malik et al. (2010) reports a significant reduction in methane production by supplementation of feed with first cutting of alfalfa fodder. The results of an in vitro study by Malik and Singhal (2008) reveal around 29% reduction in methane generation due to addition of 4% commercial grade saponin in wheat straw and concentrate based diet and the same authors (2016) also report the reduction of 21% enteric methane emission in Murrah buffalo calves due to 30% supplementation of saponin containing lucerne fodder in the diet. The addition of ethanol extracts from the saponin rich seeds of Indian soapberry or washnut *(Sapindus mukorossi)* helps in reducing protozoa population in buffalo by 52% (Agarwal et al., 2009). The mixing of sunflower seed, canola seed, flaxseed, cottonseed, garlic and other oil plants with diet is also found to be effective in reducing enteric methane generation (Haque, 2018). The feeding of processed forages by grinding, chopping or pelleting decreases the NDF digestibility of rumen and CH4 emissions due to increased passage rate (Knapp et al., 2014). Another two anti-methanogenic products like *Tamarin Plus* and *Harit Dhara* developed by ICAR-NIANP from tamarind seed husk and natural phyto sources respectively may reduce enteric methane emission in the tune of 18-20% and 700 litres of CO_2e in a day in large animal like cattle, buffalo etc. and also help in improving the productive performance of livestock. The research work by the same institute suggests the use of silkworm pupae oil (Bombyx mori) as mitigating agent of methane emission which reduces 15-50% methane production in vitro when supplemented by graded levels of 2 to 20% in finger millet and concentrate diet, and also checks the current rate of feed fermentation more than 4%.

2. Animal health and breed: Breeds having higher feed efficiency emit less methane (Moumen et al., 2016). Improvement of reproductive efficiency and duration of reproductive life of animal will reduce the intensities of GHGs emission (FAO, 2017). Dairy cows, whose are capable of producing more milk, have better efficiency to utilize energy and emit less methane (Yan et al., 2010). The strategic breeding programme in order to increase the productivity of animals and conservation of genetic resources may help to ameliorate the problem (FAO, 2017).

3. Manure management: It includes the activities involving handling, storage and disposal of urine and faeces from livestock. A proper management of manure mitigates not only the emission of GHGs and other pollutants but also reduces the nutrient losses. Manure, when kept in solid form or deposited on pasture produces lesser methane than its storing in a liquid-based system. It is better to avoid the mixing of straw with manure as the straw encourages the growth of anaerobic bacteria which increases the generation of nitrous oxide (Malik et al., 2016). The practices like uniform application of manure over pasture, improvement of drainage, avoidance of soil compaction, increase in soil aeration, use of nitrification inhibitors and proper balance of amino acids in the diet help to minimize the amount of nitrogen excreted in urine, which in turn reduces the emission of nitrous oxide (Malik et al., 2016). The use of manure in biogas plant is one of best ways to capture methane for energy production and the bio-gas slurry can be used in the production of vermicompost within a short period to avoid methane generation (Vijayalakshmy et al., 2020).

Conclusion

The increasing demand of animal protein will be met by increasing the number of livestock population or intensifying the productivity (Malik et al., 2016), which may accelerate the emissions. The projected emission of methane from enteric fermentation as estimated by FAO would be 14504.52 gigagram in the year 2030 (FAOSTAT). Therefore, the reduction of GHGs or methane emission from livestock production must be taken into consideration to curb the problems of global warming. Apart from the possible feed alternatives, quality of breeds and proper management of manures, the other interventions are the adoption of cost-effective technologies, promotion of extension activities, execution of farm level demonstration, implementation of region wise strategic policy narratives, use of locally available feeds suitable in reducing emission and exploration of other facilities in the hands of farmers. More research and developmental works need to be carried out towards minimizing the emissions as much as possible.

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Crop Diversification: Way to Welcome Sustainable Agriculture

Article ID: 31513

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Introduction

India is a country of about one billion people where agriculture plays an important role in India's economy. Over 58% of the rural households are involved in agriculture and allied activities as their principal means of livelihood. Agriculture, along with the fisheries and forestry, is one of the largest contributors to the country's Gross Domestic Product. Agriculture in India had experienced radical changes after the introduction of New Agricultural Technology during mid-sixties. The Indian agriculture as a whole has undergone several transformative changes. Continuous growing population, changing lifestyles, expanding urbanization and accelerating climate changes are creating new challenges for national agricultural research and development for the nation. The introduction of hybrid seeds of wheat and rice, responsible for the green revolution since 1967 helped boost the economy. Transfer of area to wheat and rice crops mainly from the coarse cereals and pulses was experienced in the early phases of the green revolution period (Jha, 1996) More sustainable and climate-resilient farming systems are needed to decrease the impact of agriculture on the biosphere and ensure a stable food supply for the coming decades. Crop diversification covers a wide range of agricultural practices, from the introduction of one additional crop species in a rotation to the implementation of complex landscape management strategies. The term 'diversification' has been derived from the word 'diverge' which means to move or extend in the direction different from a common point. Agricultural diversification can be described in terms of the shift from the regional dominance of one crop towards the production of a large number of crops to meet the increasing demand of those crops. Ninety one percent of the 1500 million hectares of the worldwide cropland are mostly under annual crop monocultures of wheat, rice, maize, cotton, and soybeans.

Impact of Crop Diversification on Various Areas

1. On agriculture: Indian agriculture has been diversifying in favour of more remunerative and high-valued crops and also the livestock products in accordance with the changes in consumption pattern of the nation in favour of livestock's, fruits and vegetables. Transfer of area to wheat and rice crops mainly from the coarse cereals and pulses was experienced in the early phases of the green revolution period. Agroforestry systematically induces an improvement of biodiversity and soil quality in particular soil organic carbon. Crop diversification has been recognized as an effective strategy for achieving the objectives of food security, nutrition security, income growth, poverty alleviation, employment generation, judicious use of land and water resources, sustainable agricultural development and environmental improvement.

2. On pest regulations: A key task for agro-ecologists is to understand the link between biodiversity reduction and pest incidence in modern agro-ecosystems in order to reverse such vulnerability by increasing functional diversity in agricultural landscapes. One of the most obvious advantages of diversification is a reduced risk of total crop failure due to pest infestations (Nicholls & Altieri, 2005). Cover crops and corridors are all important practices to enhance insect biodiversity, but at times creating habitat on less productive parts of the farm to concentrate natural enemies may be a key strategy. Maintaining a green cover during the entire growing season is crucial to provide habitat and alternate food for natural enemies. An important advantage of intercropping systems is their ability to reduce the incidence of pest.

3. On poverty: In 2015, 193 member states of the United Nations adopted the sustainable development goals which include poverty (UN, 2016). The International Fund for Agricultural Development consider small holder (<2 ha & low asset base) is a route of poverty for many people living in rural areas (IFAD, 2010). Within agriculture, crop diversification is a pathway to poverty alleviation. According to world bank, growth & development of the agricultural sector is determinant to escape poverty in many developing countries.

Diversity Indices Used in Crop Diversifications

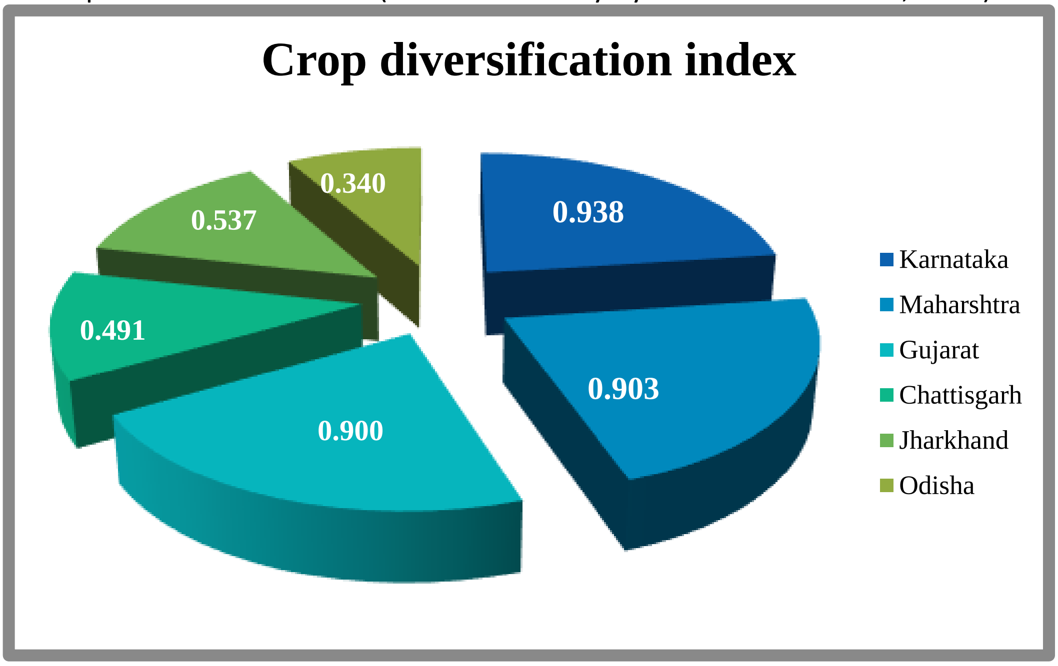
The extent of crop diversification at a given point in time may be examined by using several indices. Few main indices are as following:

1. Bhatia's Method.
2.Herfindahl Index (HI).
3. Transformed Herfindahl Index (THI).
4. Simpson Index (SI).
5. Entropy Index (EI).
6. Modified Entropy Index (MEI).

Among these indices, the HI, SI, Entropy and Modified Entropy index are widely used in the literature of agricultural diversification. All these indices are computed on the basis of proportion of gross cropped area under different crops cultivated in a particular geographical area (Hassan, B, 2001).

Status of Crop Diversification Index

Government used Gibb's & Martin's method of demarcating crop diversification to compute index for crop diversification. Index value ranges between 0 to 1. Higher the value, greater the diversification. Karnataka is only the state across the country that has shown stable growth in crop diversification. Odisha is the worst performer on the crop diversification index (Economic survey by Union Government, 2018).



Major Driving Forces for Adopting Crop Diversification

1. Increasing income on small farm holdings.
2.Withstanding price fluctuation.
3 Mitigating effects of increasing climate variability.
4. Balancing food demand.
5. Improving fodder for livestock animals.
6. Conservation of natural resources.
7. Minimizing environmental pollution.
8. Reducing dependence on off-farm inputs.

Approaches of Crop Diversification

1. Horizontal diversification.
2. Vertical diversification.
3. Land based approach.
4. Water based approach.
5. Varietal diversification.
6. Crop diversification for nutrient management.

Emerging Challenges in Crop Diversification

1. First, the cultivation of high value crops, especially horticultural crops, has started showing increasing symptoms of unsustainability due to, among other things, falling soil fertility, erratic weather conditions and the emergence of numerous insects, pests and diseases.
2. Second, new outward looking open trade linked strategy and the launching of WTO has posed competition from cheaper imports.
3. Third, the shifting/ erosion of micro niches/comparative advantages hitherto enjoyed by the state due to fast technological developments outside the producing regions has posed a new problem.
4. Fourth, slow but perceptible change in weather and climate conditions has posed yet another serious threat to the cultivation of some of the high value crops.
5. Fifth, the infrastructural facilities are increasingly proving to be inadequate to cope with the mounting pressure.

Needs for Crop Diversification

1. For sustainable income.
2. Ecological balance.
3. Reducing risk.
4. Employment generation.

Conclusion

Diversification in agriculture will have a tremendous impact on the agro-socio-economic areas and also in the uplifting of resource-inadequate farming communities. It will be able to generate income and employment opportunities for rural youth around the year for the utmost benefits of the Indian farmers. There are still numerous opportunities for crop diversification present and location specific approaches and full packages need to be prepared.

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Antitranspirant: A Weapon in Dry Land Agriculture

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Introduction

Dry land agriculture is the agriculture which limits the crop growth to a part of the year due to lack of sufficient moisture (Peterson et al., 2006). 68 per cent of the cultivated area in Indian agriculture comes under dryland, which contributes about 44 per cent of the total food production and plays a critical role in India's food security. A vast majority of the small-scale farmers depend on the dry regions for their livelihood. According to the Fourth five-year plan of India, dry lands are defined as areas which receive rainfall ranging from 375 mm to 1125 mm and with very limited irrigation facilities. Dry regions are economically fragile regions which are highly vulnerable to environmental stress and shocks. Dryland farming is cultivation of crops in regions with annual rainfall more than 750 mm. Degraded soils with low water holding capacities along with multiple nutrient deficiencies and depleting ground water table contributes to low crop yields and further leading to land degradation. In order to ensure long term sustainability for dry land agriculture in India, various components are to be taken into consideration like socio-economic resources, integrated water shed development, improvement of rain water use efficiency, diversification of agriculture through livestock farming alternative land uses and integrated soil–nutrient-water-crop management.

Transpiration from plants and evaporation from soil surface are the two main sources of water loss from dry land agriculture (Sinha, R. K. 2004). However, under dry land conditions where soil moisture conditions are critical, water loss may be very high from soils after the drying of the top layer. In recent years only, more attention has been paid for exploring the possibility of reducing transpiration from plants by the use of chemicals or other substances. In India, about 90% of the land is under rainfed farming; therefore, it is very essential to manage every drop of water received through rains. Though various measures are adopted to conserve the rain water, yet rainfed farming is often subjected to drought.

Antitranspirant

Anti-transpirants may control transpiration either by filming the leaf surface or by the regulation of stomatal aperture. Anti-transpirants are substances or chemicals applied on plant-foliage to control rate of transpiration. Nearly 99 per cent of the water absorbed by the plant is lost through transpiration and 1 per cent is use in plant. Anti-transpirants applied to transpiring plant surfaces for reducing water loss from the plant. Anti-transpirants are used on field crops, horticulture crops, christmas trees, cut flowers, newly transplanted shrubs, and in other applications to preserve and protect plants from drying out too quickly. They have also been used to protect leaves from salt burn and fungal diseases (Rao, N.K. 2015).

Types of Antitranspirants

Sr. No.	Types	Features	Examples
1	Stomatal closing type	It reduces the closure of stomata and rate of transpiration. A little rise in CO2 concentration from naturally 0.03 -0.05 % induces partial closure of stomata.	Phenyl mercuric acetate (PMA), alkanyl succinic acid (ASA)
2	Film forming type	It is plastic and waxy materials, which form a thin film on the leaf surface and act as a physical barrier to protect plant.	Paraffin wax and wax emulsions, power oil 1%. Tag 9, S - 789 foliate, Plastic films, Silicone oils

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		They form the mechanical barrier for stomatal movements.	
3	Reflacatance type	These are white materials which form a coating on the leaves and increase the leaf reflectance. By reflecting the radiation, vapour pressure gradient decreases and thus transpiration is reduced.	Kaolin, hydrated lime, calcium carbonate, magnesium carbonate and zinc sulphate.
4	Growth retardant type	Growth retardent chemicals reduce shoot growth and increase root growth and thus enable the plants to resist drought.	A.B.A. cycocel (ccc-chloro choline chloride, chlor mequat).

Mechanism to Reduce Transpiration (Water Loss) by Antitranspirants

1. By reducing the absorption of solar energy and by reducing leaf temperatures and transpiration rates.
2. By forming thin transparent films, which hinder the escape of water vapours from the leaves.
3. By promoting closure of stomata (by affecting the guard cells around the stomatal pore) they decreasing the loss of water vapours from the leaf.

Effect of Antitranspirants on Photosynthesis

Antitranspirant effect in size & number of stomata of the leaves and supply of carbon-dioxide for diffusion into the stomata cavity and it's necessary for the occurrence of photosynthesis. The reduction in stomata opening results in restriction of actual photosynthesis, so that yield reduction will be there.

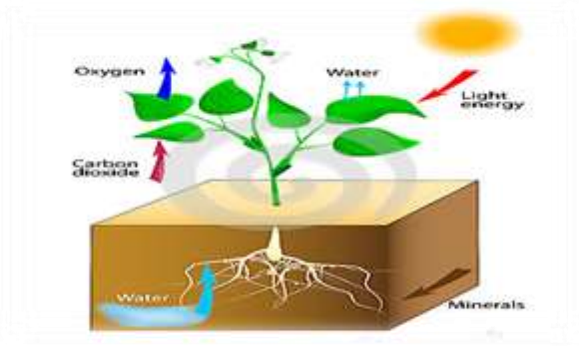

Fig.1. Photosynthesis process

Effect of Antitranspirants in Dryland Agriculture

Soil moisture is the limiting factor in dryland agriculture. It is lost as evaporation from the soil surface and as transpiration from the plant leaves through stomata. Evaporation has to be arrested as it is not directly related to productivity whereas transpiration can be reduced to some extent without affecting productivity of plants. Moisture stress and uncertain rainfall, inefficient storage of rainwater, use of limited crop varieties to grow, disposal of dry farming produce and socio-economic condition of farmer are the major constraints in dryland hence, use of antitranspirant plays a devastating role to reduce the moisture stress in dryland conditions (Peterson et al., 2006).

Good Features of Antitranspirants

1. Non toxicity.
2. Non-permanent to damage stomatal mechanism.
3. Specific effects on guard cells and not to other cells.
4. It effects on stomata should persist at least for one week.
5. Chemical or material should be cheap and readily available.

6. Antitranspirants generally reduce photosynthesis.
7. Therefore, their use is limited to save the crop from death under severe moisture stress.

Conclusion

Transpiration is necessary evil process so that antitranspirant can be used only when the problem of survival and only under critical condition. Antitranspirant increased water use efficiency, water saving percent as well as economic benefits in plant in dryland conditions. Antitranspirant conserve maximum plant moisture and reduced transpiration rate. It is sprayed at critical crop growth stage with appropriate methods, which gives better results for sustaining yield under water stress condition (drought conditions).

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Tobacco: A Major Threat for Human Consumption

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Introduction

Tobacco consumption and tobacco cultivation have assumed proportions of an epidemic. Tobacco disease has been termed as the communicated disease. Tobacco plant is therefore rightly called as a killer plant. But tobacco control cannot succeed until it is recognized that tobacco plant is not only a killer plant but it also is a highly costly plant to cultivate. India is the second largest consumer of tobacco globally. India also stands third in the production of tobacco. Use of tobacco poses a significant threat not only to health but also to social and economic fabric of families and communities. Besides, negative environmental impacts of tobacco cultivation at the local level lead to deforestation and soil degradation (Kaur et al., 2014). Both supply side and demand side interventions are important to achieve effective tobacco control in India. International commitment in the form of ratification of the World Health Organization Framework Convention on Tobacco Control by the Indian Government shall galvanize the agricultural fraternity to seriously ponder on the economically viable and sustainable crop diversification options for tobacco growers. A lot of effort has gone into creating evidence on economically viable alternate crops to tobacco over a period of time. Various projects and programmes for alternative livelihoods to tobacco growing have been initiated around the world. However, the initiatives on provisioning viable alternative crop options for tobacco growers in India are generally limited to sporadic experiments carried out in research settings. A detailed plan of action at the field level needs to be drawn based on the recommendations of available research. In the prevailing Indian scenario, shift by the tobacco farmers to alternative crops in near future seems unrealistic. However, concerted efforts on part of the agricultural fraternity in India coupled with timely corollary initiatives from other stakeholder departments may transform today's heresy into tomorrow's new paradigm.

Key Highlights

1. Tobacco kills up to half of its users.
2. Tobacco kills more than 8 million people each year.
3. More than 7 million of those deaths are the result of direct tobacco use while around 1.2 million are the result of non-smokers being exposed to second-hand smoke.
4. Over 80% of the world's 1.3 billion tobacco users live in low-and middle-income countries.

Effect on Human Health

Nicotine contained in tobacco is highly addictive and tobacco use is a major risk factor for cardiovascular and respiratory diseases, over 20 different types or subtypes of cancer, and many other debilitating health conditions. Every year, more than 8 million people die from tobacco use. Most tobacco-related deaths occur in low- and middle-income countries, which are often targets of intensive tobacco industry interference and marketing.

Tobacco can also be deadly for non-smokers. Second-hand smoke exposure has also been implicated in adverse health outcomes, causing 1.2 million deaths annually. Nearly half of all children breathe air polluted by tobacco smoke and 65 000 children die each year due to illnesses related to second-hand smoke. Smoking while pregnant can lead to several life-long health conditions for babies. Heated tobacco products (HTPs) contain tobacco and expose users to toxic emissions, many of which cause cancer and are harmful to health. Electronic nicotine delivery systems (ENDS) and electronic non-nicotine delivery systems (ENNDS), commonly known as e-

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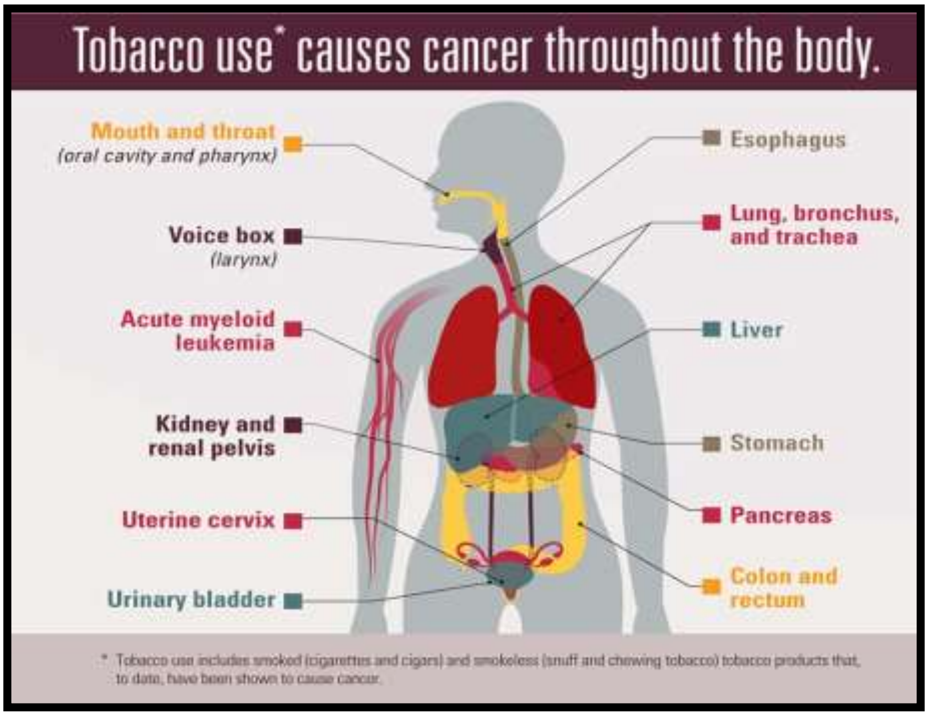
cigarettes, do not contain tobacco and may or may not contain nicotine, but are harmful to health and undoubtedly unsafe (GOA & IF, 2017).



Measures to Reduce the Tobacco Use and Demand

1. Second-hand smoke kills.
2. Pictorial health warnings work.
3. Bans on tobacco advertising lower consumption.
4. Taxes are effective in reducing tobacco use.
5. Tobacco users need help to quit.
6. Illicit trade of tobacco products must be stopped.

WHO Response on Tobacco Consumption

The scale of the human and economic tragedy that tobacco imposes is shocking, but it's also preventable. Big Tobacco – along with all manufacturers of tobacco products – is fighting to ensure the dangers of their products are concealed, but we are fighting back. The WHO Framework Convention on Tobacco Control (WHO FCTC) is the first treaty negotiated under the auspices of the world Health Organization. The WHO FCTC is an evidence-based treaty that reaffirms the right of all people to the highest standard of health (Huang et al., 2014). The WHO FCTC Protocol to Eliminate the Illicit Trade of Tobacco Products (ITP) sets out a range of important measures and interventions to reduce tobacco use and its health and economic consequences. The WHO FCTC is a milestone in the promotion of public health. Strengthening implementation of the treaty is specifically included in the 2030 Agenda for Sustainable Development Goals (SDG) as Target. In 2007, WHO introduced a practical, cost-effective way to scale up implementation of the main demand reduction provisions of the WHO FCTC on the ground and that is MPOWER.

The 6 MPOWER measures are:

1. Monitor tobacco use and prevention policies.
2. Protect people from tobacco use.
3. Offer help to quit tobacco use.
4. Warn about the dangers of tobacco.
5. Enforce bans on tobacco advertising, promotion and sponsorship.
6. Raise taxes on tobacco.

Conclusion

Cigarette smoke contains more than 7000 chemicals. Inhaling cigarette smoke exposes the numerous toxins in the human body. Cigarette smoking by youth and adults has immediate adverse health consequences, including addiction, and accelerates the development of chronic disease across the whole life. Hence, prevention efforts must focus on both adolescents and young adults because among adults who become daily smokers, nearly all first use of cigarettes occurs by 18 years of age (88 %), with 99 % of use by 26 years of age.

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Locust - An Overview

Article ID: 31516

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Introduction

Insects are omnipresent and are very much associated with man's life. Some insects are beneficial, and some are very dangerous to the human being. Desert locust is one of the most harmful insects in the world. Locust is a short-horned grasshopper capable of damaging a large area of agriculture fields. Locusts belong to the Acrididae family, Order –Orthoptera one of the most dangerous migratory pest distributed worldwide. Around 10,000 species of locusts found, India, only four species are reported, such as Desert locust, migratory locust, Bombay locust, and tree locust.

The most common locust found worldwide are listed in table 1. It will become dangerous when they come in the green meadows. Locust is polyphagous and can eat any kind of crop. They feed on almost any green vegetation –leaves, flowers, stem, bark, fruits, and seeds. The crop plants that locust eats are rice, maize, sorghum, millet, barley, sorghum, sugarcane, banana, etc. According to the existing report 10 percent of the world's population is affected by desert locust (1,3).

Table1. List of Commonly Occurring Locust in Different Countries

SI No.	Common Name	Scientific name	Country originated
1.	Desert locust	*Schistocera gregaria*	Deserts from West and North Africa to western India
2.	Bombay Locust	*Nomadacris succincta*	India, South-east Asia
3.	Migratory Locust	*Locusts migratoria manilensis; Locusta migratoria migratoria-oides*	Asia, Africa, and Eastern Europe
4.	Tree Locust	*Anacridium Spp.*	Europe, North Africa, and Central Asia
5.	Italian Locust	*Calliptamus italicus*	Semi-deserts and steppes from Morocco and central Europe to Central Asia
6.	Moroccan Locust	*Dociostaurus morocannus*	Semi-deserts and steppes from Morocco through North Africa and the Middle East to Central
7.	Red Locust	*Nomadacris septemfaciata*	Southern and south-central Africa
8.	Brown Locust	*Locustana pardalina*	Southern Africa
9.	South American Locust	*Schistocera paranensis*	Southern Africa
10.	Australian Locust	*Chortoicetes termenifera*	Australia

How to Differentiate Locust & Grasshoppers?

1. Locusts are 1.25 to 7.5 centimeters in length. They are commonly found in Asia and Africa and on all continents except North America and Antarctica.

2. Locust is the species of grasshoppers that can be differentiated by behavioral, morphological, and physiological changes from the solitary phase to a gregarious migratory phase.

Life Cycle and Swarm Development

1. Locusts are generally solitary and shy, and it avoids contact with each other. Solitary nymph is usually brown, capable of adjusting its colour near to the surrounding. Solitary nymph is sluggish possess low oxygen uptake and low metabolic rate. It has shorter wings, longer legs, and a larger head.

2. Under favourable conditions (mainly during rainy seasons), they are attracted to each other, and when they come in contact, rubbing causes a transformation in behaviour, colour, and appearance. Some studies show that due to the touch, rise in serotonin levels make them social, and crave more contact with others and swarm development occurs.

Swarm Development

1. The gregarious-phase is nymph. It has black and yellow or orange coloration in a fixed pattern. Gregarious nymph is active, nervous with high metabolic and oxygen intake rates. The adult of the gregarious phase has a more saddle-shaped pronotum, broader shoulders, and longer wings.

2. The desert locust is the best-known species found in Asia and Africa in dry areas of grassland and desserts. Desert locust can fly upward to about 1500 meters. In a group, they can fly ranging from 100,000 to 10 billion insects and can travel 100 miles (160 kilometres) per day, making it the largest group of the single congregation of an organism in the earth.

3. There are three breeding periods for the locusts that are:
    a. Winter breeding [November to December].
    b. Spring breeding [January to June].
    c. Summer breeding [July to October]. India has only one breeding period for locust that is Summer. Pakistan has two breeding period for locust, spring and summer.

4. The life cycle of the desert locust is about three to five months, and it depends mostly on weather and ecological conditions. The life cycle of a desert locust comprises of three stages - egg, nymph (hopper), and adult.

5. Female locust deposits their eggs in groups known as egg pods in hard, firm soil underground. A female locust will lay around one to three egg pods at a time.

6. The female solitary desert locust lays about 90-160 eggs, while gregarious locust can lay less than 80 eggs in egg pod in about 15-centimeter depth of sandy soil. A female locust can lay egg thrice in their life cycle at an interval of one to two weeks.

7. Eggs hatch in two to nine weeks after they were laid and referred as nymphs or hoppers. Nymph undergo five to six instar stages (melting stage), in 30-40 days to turn in to an adult.

8. After the fifth instar stage, locust's wings are fully developed and locusts are called as "fledglings". During this early adult stage fledgling cannot fly and it will take one more week to become capable of flight. At these stage fledglings continuously feeding in order to store energy for flying and reproduction.

9. Fledglings locust will take two weeks to become mature adults. Adults swarms in to group of thousands of locusts. Adult locust generally lives for weeks.

10. The gregarious adults fly during the day time contrary to this solitary desert locust flies in the night.

11. A single locust can consume about 2 grams per day. Still, gregarious swarms containing 40 million locusts will consume about 80,500 kg of food in a single day (according to USDA 2.3 kg food per day person approximately 35000 people's food in a single day) (4).

Impact of the Locust Swarm

Desert locust is highly voracious, consumes most of crop species create direct threat for the food security of the country as well as to the native fauna. For example, in Kenya, locust plague threatened the habitat of endemic species of Gravy's zebra. The ruined cropland and barren pastures affect the native grazing species that depend on the grassland and cropland for survival—the unavailability of fodder for animals resulted in reducing milk quality, leading to food insecurity and malnutrition issues.

Locust plague also affects the social and socio-economic status of the country aspects. In India, during 1940-46 and 1949-55, locust damaged crops of worth Rs.2.0crores per cycle, and 50 lakhs during 1959-62. FAO reported estimated damage of Rs. 2 lakhs and Rs. 7.18 lakhs during the years 1978 and 1993, respectively. Recently (December 2019), locust destroyed over 25,000 hectares of crops in Gujarat. In 2020, locusts already destroyed 5,00,000-hectare crops in India, which is the worst locust attack in 26 years can plague the Indian economy. This year 2020 locust attack near the monsoon season will add strain for the farmers that rely on the annual monsoon for crop production. However, locust plague does not affect the human being but can change the rural livelihood depends on agriculture (2,3).

Locust Management

Potential pest management techniques such as chemical and biological control measures, monitoring the swarms and expansion range, and wind as a marker are used for locust control. Once locust plague is developed, it is very difficult to stop or control. Destruction of egg masses laid by invading swarms is one of the control methods. It is always essential to locate and trench the egg laid by locust and entrap nymphs. Hand digging and plowing to remove eggs are necessary to remove. Mechanical methods such as use of hopperdozer entrapping locust into a trough containing water and kerosene. The chemical method for control is use of poison baits malathion, and are of fenvalrate, chloropyriphos, and dusting of insecticides dialdrin against hoppers to 25 -30 kg/ha can effectively control the pests. Aerial application of dialdrin has advantage since the vast area can be treated in a short time and effective while swarms in flight mode, the resting phase, or at breeding ground (2).

The use of chemical pesticides causes a risk to human and environment; biological pesticides mainly mycopesticide can be used to control locust. The fungus *Metarhizium anisopliae var. acridum* is a locust specific mycopesticide can penetrate inside cuticle, grow inside and kills the locust. The commercial formulation Green Muscle™ is found to be very effective against the locust and grasshoppers tested in Africa. Another biopesticide named Green Guard™ formulation successfully used is large scale in Australia. However, more field testing is required to test the potential and limitations of the product under different climatic conditions.

Semiochemicals are another control measure that utilizes methods like:

1. Mass trapping of pest.
2. Lure and kills.
3. Mating disruption.

The first two methods use specific olfactory signals like mimicking sex pheromone or food to attract the pest. While the latter is a direct method used to distract the insect go after mating. Such practices are sustainable for controlling the pest populations, but the challenge is understanding the locust behavior, and the correct selection of bait is required.

Climatic change influences the locust swarm and expansion range. This expansion range prediction observed by using species distribution modeling (SDM) that shows the relationship between environmental variables such as temperature, soil moisture, precipitation, and the dispersal pattern of a locust swarm. Thus, agriculture damage can be reduced by predicting the regions susceptible to future locust swarm. Few studies indicated that wind could be used as a marker as it used as a catalyst in locust dispersion. Thus, by using meteorological prediction and the expansion range right decision can be make for the control the pest before attack.

Organization for Locust Control

The Locust warning organization (LWO) Faridabad, Haryana is the working body for the locust control in India. It was established during April 1939 and later merged with the directorate of plant protection quarantine and storage during 1946. The scheme locust control and research (LC&R) were responsible for the supervision of desert locust. The United Nations Special Fund on Desert Locust Project sponsored by the FAO in 1960. FAO funds to several countries, including India to develop more effective and less expensive control of the desert locust (ppqs.gov.in).

Conclusion

Locust management also needs improvement in policies. The efficient way to control locust is by applying control strategies from its initial stages of the insect attack. The success requires cooperation between vulnerable nations and involves various government agencies to predict, monitor, and respond to locust swarms. For the effective control of locusts, the rapid monitoring alarm system needs to design based on the intensive survey, physical field monitoring, and chemical and molecular detection. Farmers, local communities, and ground forces need to train with the latest locust invasion and management technologies.

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Pseudomonas: A Bioagent for Plant Disease Management

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The basic requirement of society since ages is food, feed, fibre and fuel. But the pressure to fulfil the requirement of burgeoning population has led to a negative pathway of in discriminate and injudicious interference. Towards the end of century term quantity almost replaced with quality.

In order to give potential and sustainable yield, plants have to attain good growth which can be achieved through proper nutrition. Soil is the store house of nutrients and site for pest and diseases attack. In order to attain sustainable growth of microorganism, soil plays an important role. Many a soil organism have potential to effectively control soil-borne plant pathogens thereby enhancing growth, increasing the availability of nutrients to plants, accelerating the role of decomposition of organic matters in soil. For the prevention of soil-borne diseases, the improvement of soil biological condition is of prime importance.

In the agricultural soils a well-adapted to rhizosphere gram-negative, an aerobic ubiquitous organism pseudomonas is found. To act as a biological agent this rhizobacterium possesses many traits and can promote plant growth. By utilizing the exudates from roots and seeds it colonizes and multiples in rhizosphere and spermophere. A range of wide spectrum volatiles, siderophores, antibiotics and growth promoting substances are produced by pseudomonas in roots rhizosphere. Natural suppressive of some soil-borne pathogens can be easily attained the use of pseudomonas. In a way, rhizobacteria that exert beneficial effects on plant growth, development and its ability to suppress diseases are referred to as PGPR i.e. plant growth promoting rhizobacteria.

In the recent year wide use of PGPR like Azospirillum, Acinetobacter, Bacillus, Beiferimekia, Enterobacter, Pseudomonas, Serratia has increased many a fold to promote plant growth and disease suppression.

Pseudomonas induces systemic resistance and biological control of pathogens and also plays a vital role in promoting plant growth. The mechanism employed by the PGPR includes production of lytic enzymes like chitinase and β 1, 3 gluconate which arrest the growth of fungus as these enzymes results in degradation of fungal cell wall hence rendering it in effective.

The general mechanism as per which these acts in soil and help plants can be categorized as:

1. Direct mechanisms: It is quite evident and has been proved experimentally the role of *Pseudomonas* in nitrogen fixation. *Pseudomonas stutzeri* strains P_5 and P_{18} produced 4.437 and 3.836/L NH_4^+ in nitrogen free medium after four weeks. Apart from nitrogen fixation, *Pseudomonas solubleises* fixed phosphorus by production of organic acids like phosphatase enzyme, carboxylic acid, gluconic acid etc. Pseudomonas has found associated with the release of siderophores and organic acids like citric, malic and lactic acids which increase chelating substances and increased availability of Fe is observed. *Pseudomonas* produce IAA (Indole-3-acetic acid), that leads to plant growth promotion as increased number of roots, improve nutrient and water uptake by plant. IAA production done through the conversion of the precursor tryptophan. This conversion in bacteria mainly occurs through the IAM pathway indole-3-pyruvate (IPYA) pathways. Pseudomonas can effectively lower plant ethylene level by separate the precursor 1-aminocyclopropane-1-carboxylate (ACC) from the plant and then hydrolysing it through the action of the enzyme ACC deaminase. Cytokinin's also produced by some *Pseudomonas* strains and *Serratia* strains that lead to cell division, chlorophyll accumulation and leaf expansion.

2. Indirect mechanisms: It involves the important role of *Pseudomonas* as biocontrol agent through which these act s biological disease suppression agents suppressing the disease by releasing of antibiotics, and by releasing of enzymes e.g. oxidoreductase, hydrolase etc.

In the rhizosphere of the crop plants, *Pseudomonas* is known to have various mode of action against plant pathogens. Its efficiency, however, depends on various biotic and abiotic factors. Which inhabit and check the pathogenic activities of many fungi, bacteria, nematodes and in a way controlling various root and soil disease in plants.

The chief mechanisms by way of which *pseudomonas* suppress disease includes:
1. Production of siderophores.
2. Mechanism of antibiosis.
3. Mechanism of parasites.
4. Production of HCN.
5. Competition.
6. Induced Systemic Resistance ISR.

Production of Siderophores

Under non-iron limiting condition in soil, a wide variety of bacteria and fungi produces siderophores which are meant for enhanced iron uptake. Many deleterious rhizobacteria which act as minor pathogens while colonizing in roots and hampering plant growth are suppressed by siderophore production. In a way providing plants are disease free and nutrient rich medium for growth.

Mechanism of Antibiosis

Pseudomonas while inhabiting the rhizosphere is known to produce antibiotic compounds which suppress the disease growth. The role of strains of *Pseudomonas* fluoresens 2-79 and *Pseudomonas* aureofaciens 30-80 by production of phenazine antibiotics in rhizosphere of wheat crop is quite evident.

Mechanism of Parasites

Pseudomonas by the production of lytic enzyme degrades the fungal cell wall. Successful biological control of Pythium and Fusarium species has been reported by the use of certain strains of arthrobacter which act as parasite by praying its host through production of cellulolytic enzymes Chitinase.

Production of HCN

Certain strains of *Pseudomonas* produce Hydrogen cyanide which inhibits the electron transport system and hence energy supply in the cell is disrupted leading to the death of organism.

Competition

Pseudomonas being an active rhizosphere bacterium possess good competition for different plant pathogens in rhizosphere. The competition is chiefly for nutrients and the infection site. *Pseudomonas* is very effectively colonizing the root surface depriving the pathogen of the site for infection multiplying and growing many folds, it makes nutrients less available for pathogen and suppresses its growth and ability to cause infestation.

Induced Systemic Resistance (ISR)

Pseudomonas is an effective bioagent. It targets the pathogens directly and also by producing enzymes in the environment like Chitinase, β gluconate, Cellulose and Proteases which checks the growth of pathogen.

In a nut shell, it can be concluded that, PGPR is the key of low input sustainable agriculture it not only reduces the cost of production but also reduces the environmental pollution. In comparison to Trichoderma in fungi, pseudomonas is best bio-agent among bacteria and is directly involved in growth and development of plant and is also helpful for nutrient uptake and nutrient release from soil. It is an effective disease control method and it induces the induced systemic resistance in crop plants.

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Role of Reactive Oxygen Species as Defence Inducer and Growth Promoter

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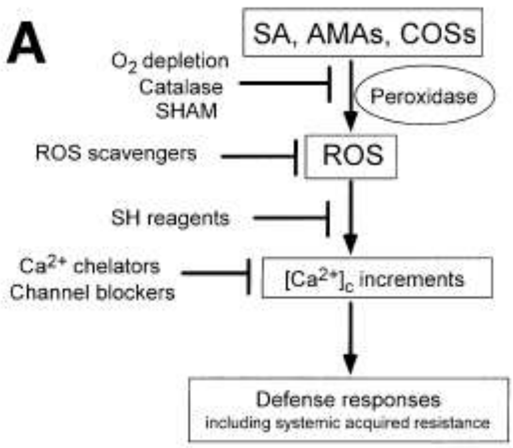
Introduction

Plants are suffering from various environmental abiotic and biotic stress throughout their life cycle. Reactive oxygen species or oxygen free radicals (ROS) play important role in maintaining and accelerating normal plant growth, and improving their tolerance to stress. POXs (peroxidases) exist as isoenzymes with wide expression profiles. They participate in various physiological mechanism or catabolic processes, such as suberization lignification, auxin catabolism, wound healing and defence mechanisms against pathogen infection. The plant POXs in the apoplastic or non-living space are considered to catalyse the production of aromatic oxyl radicals from several aromatic compounds and the POX-dependent production of such organic radicals that result in the generation of reactive oxygen species (ROS) The plant POX-mediated oxidative signalling mechanisms mainly stimulated by indole-3-acetic acid (IAA) and plant defence-related molecules such as salicylic acid (SA) and biogenic amines such as aromatic monoamines (AMAs), chito oligosaccharides (COSs) and. ROS act as both growth promoter and as defence inducer.

Role of ROS as Plant Defence Response

Hydrogen peroxide is an electron-accepting substrate for a diverse-variety of POX-dependent reactions, thus POXs are generally considered to be merely ROS-detoxifying enzymes. The breakdown of H_2O_2 by the POX reaction is highly active mainly in the presence of Flavonoids, act as a ROS-scavenging POX substrate. The concentration of ROS is elicited by SA signalling pathway. The flow chat given below that the process of defence induction as SA signalling is induced in plant catalase and Peroxidase gets activated that act as oxygen scavenge and oxygen availability to pathogen gets inhibited, hence their growth and multiplication is inhibited. The main site of their action inner membrane of mitochondria where Kreb cycle of respiration occurs that is catabolic process and provides metabolic energy to plant and pathogen in the form of reduction of glucose and these ROS activate the calcium chelators that block the passage of the entry of pathogen. Thus, inhibits the further invasion and colonization of pathogen. SA-induced increase in [Ca_2+] is a consequence of an O_2-stimulated influx of Ca_2+ across the PM. At the same time, the first findings indicating the involvement of POX activity in SA signal transduction was obtained (Kawano et al. 1998).



Role of ROS as Growth Promoter

IAA-induced cell elongation is known to be a consequence of cell-wall loosening. The production of peroxide radical mediates the IAA-induced cell-wall loosening that occurs both *in vitro and in vivo* (Schopfer 2001), which in turn leads to elongation growth of maize plants coleoptiles. Cell-wall loosening occurred when the polysaccharides in the cell-wall matrix were cleaved by peroxidase. The source of ROS, including peroxidase radicals and its precursors $O_2\cdot$ and H_2O_2, mediating the IAA action is thought to be the POXs bound to the cell-wall matrix. The metabolism of Indole acetic acid (IAA), the principal form of auxin in higher plants, is of immense interest to plant biologists. Plant POXs are believed to be indulged in the metabolism of IAA by oxidizing IAA via two different mechanisms:

1. A conventional H_2O_2-dependent pathway.
2. One that requires O_2 but not H_2O_2.

Conclusion

ROS play an important role as defense inducer by SA mediated signaling pathway and as growth promoter by enhancing IAA production. They are involved in induce resistance (ISR and SAR).

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Factors Affecting of Biomass Briquetting Use and Different Technology

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Abstract
Every year millions of tons of agricultural wastes are generated which are either destroyed or burnt inefficiently in loose form causing air pollution. These wastes can be recycled & can provide a renewable source of energy by converting biomass waste into high density - fuel briquettes without addition of any binder. This recycled fuel is beneficial for the environment as it conserves natural resources. For this the biomass briquetting is the main renewable energy resource.

Introduction
In India a large quantity of agricultural waste is generated every day. These are either dumped off or burned inefficiently causing extensive pollution to the environment. This results in large amount of transportation costs and man power. If it is used for some other productive purpose then the burning produce low thermal efficiency and pollute the environment. To overcome these problems, the concept of "Biomass Briquettes" is used. Biomass briquettes are made from agricultural waste and are a replacement for fossil fuels such as oil or coal Briquetting of residues takes place with the application of pressure, heat and binding agent on the loose materials to produce the briquettes. The briquettes can be used for domestic purposes (cooking, heating, barbequing) and industrial purposes (agro-industries, food processing) in both rural and urban areas.

General in Briquette
1. Advantages of biomass briquetting: Briquettes produced from briquetting of biomass are fairly good substitute for coal, lignite, Firewood and offer numerous advantages. This is one of the alternative methods to save the consumption and dependency on fuel wood. Densities fuels are easy to handle, transport and store. They are uniform in size and quality. The process helps to solve the residual disposal problem. The process assists the reduction of fuel wood and deforestation. It provides additional income to farmers and creates jobs. Briquettes are cheaper than coal, oil or lignite once used cannot be replaced. There is no sulphur in briquettes. There is no fly ash when burning briquettes. Briquettes have a consistent quality, have high burning efficiency, and are ideally sized for complete combustion.

2. Disadvantages of biomass briquetting: High investment cost and energy consumption input to the process. Undesirable combustion characteristics often observed e.g., poor ignitability, smoking, etc. Tendency of briquettes to loosen when exposed to water or even high humidity weather.

3. Factors affecting densification / briquetting: There are many factors which are to be considered before a biomass is to be qualified as feedstock for briquetting. For different briquetting machines, the required parameters of raw materials like their particle size, moisture content, and temperature are different.

4. Effect of particle size: Particle size plays an important role in the densification process. Fine particles give larger surface for binding. The biomass material of 6 – 8 mm size with 13 – 15 % powdery component (<4 mesh) is best suited. If the particles are oversized, then the briquetting will not be smooth and it will result in clogging at the entrance of die which ultimately leads to jamming of machine.

5. Effect of moisture: Moisture content plays an important role since it facilitates heat transfer. Generally, when the feed moisture content is 8 – 10 %, the briquettes will have 6 – 8 % moisture content. If this amount of moisture content is maintained, then the briquetting process is smooth. But when the moisture content exceeds 10%, the briquettes are poor and weak and the briquetting process is not feasible. Also, at high moisture content, excess steam is produced leading to the lockage of incoming feed from the Hooper. Hence it is necessary to maintain the optimum moisture content.

6. Effect of Temperature: The temperature of biomass has variation with the briquette density, briquette strength and moisture stability. Hence unlike above mentioned parameters, temperature also has a critical effect in densification process. The temperature of biomass, however, should not be increased beyond its decomposition temperature which is around 300°C. If the temperature is higher than this value, then the friction between the raw material and die wall decreases such that compaction occurs at lower pressure which results in poor densification and inferior strength. On the contrary, low temperature will result in higher pressure and power consumption and lower production rate.

Material and Method

The raw materials used in briquetting process are as follows:

1. Rice husk: Rice husk is available with 10% moisture and the ash contains lesser alkaline minerals.

2. Groundnut shell: Because of low ash (2-3%) and a moisture content of less than 10%, it is also an excellent material for briquetting.

3. Cotton sticks: This material is required to be chopped and then stored in dry form.

Coffee husk: An excellent material for briquetting having low ash and available with 10 percent moisture content.

4. Mustard stalks: Like cotton sticks, it is also an appropriate material for briquetting.

The process to make briquettes is may not compulsorily require binders. But in some cases, binders are added to give proper shape. The natural binder lignin is readily available in wood. In some cases, starch is added in little quantity as a binder.

This Process Involves Two Major Steps

1. Semi fluidizing of the biomass through the application of high pressure (at the range of 1200-1400 kg/cm2) under which condition the residue gets heated to about 182°C, and the lignin (material of which cell walls are made) begins flow and act as a binder.

2. Extracting the diversified material around the room temperature. When densification is done in the above manner (semi fluidizing), there is no need to add external agent like glue or binder. The machines are available in the capacity range of 100-3000 kg/h operating on electric power.

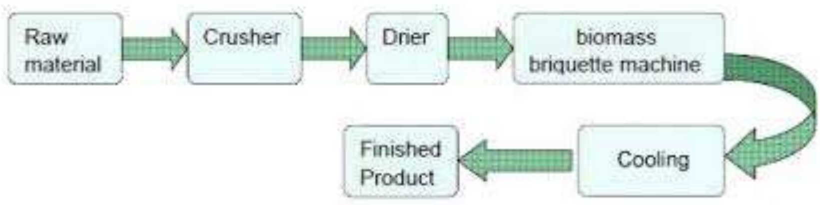
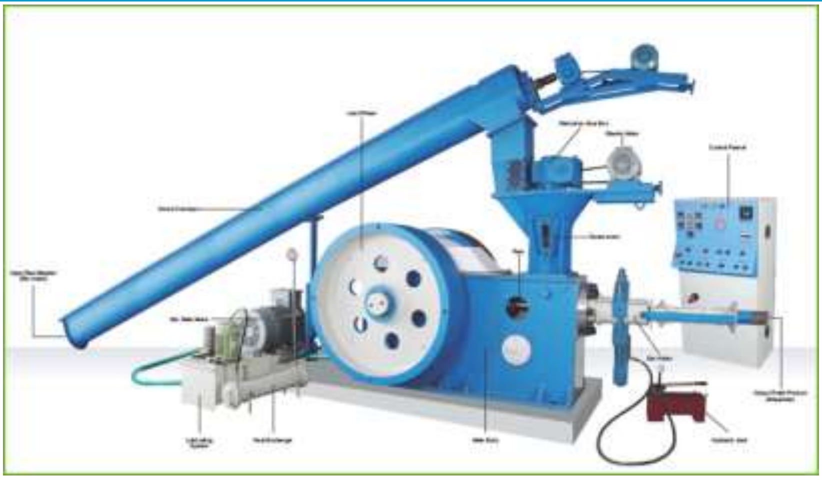


Figure: 1. Steps involved in briquetting

Biomass Briquetting Technologies

There are different types of technologies available for briquetting process. The technologies differ from each other on the basis of equipment's used. The most commonly used technology in India is Piston Press and Screw Press technology. These are the high compaction technology i.e. the biomass is compacted very tightly to form a briquette. In Piston Press Technology the power consumption is high as compared to Screw Press Technology. Though Screw Press Technology consumes more power, the quality and method of production of briquettes is superior on comparison with Piston Press Technology.



Piston Press Technology

The piston press technology is also known as ram and dies technology. Here the biomass is punched into a die by a reciprocating ram with very high pressures ultimately compressing the mass to obtain briquettes. The briquettes produced have external diameter of 60 mm. This machine has a 700 kg/hrs. capacity and the power requirement is 25 kW. The ram moves approximately 270 times per minute in this process. The hydraulic press process consists of first compacting the biomass in the vertical direction and then again in the horizontal direction. The standard briquette weight is 5 kg and its dimensions are: 450 mm x 160 mm x 80 mm. The power required is 37 kW for 1800 kg/h of briquetting. This technology can accept raw material with moisture content up to 22%.

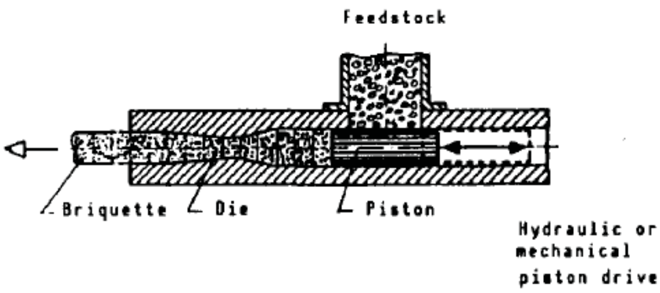


Figure: 2. Piston press machine

Screw Press Technology

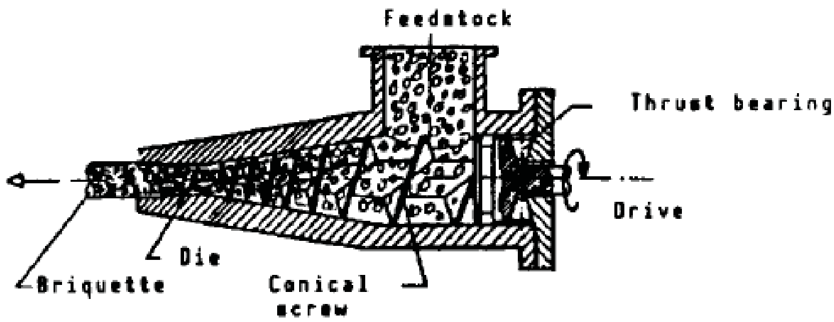
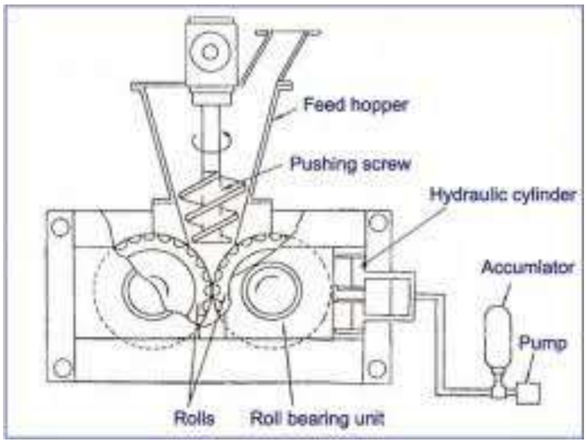


Figure: 3. Screw press machine

The dry raw material free from foreign matter (like iron pieces, stones, etc.) is fed into the hopper of the Screw Extruder. From the hopper, the raw material flows into the compressing zone (screw extruder) where from it enters into the heating chamber (barrel). The heating chamber is controlled thermostatically at a pre-set temperature. From the heating chamber the briquette is formed and extruded out continuously. The process requires no binder or any other material. However, it is essential that the initial moisture content and size of biomass is less than 12% and 4mm respectively. The capacity of the machine employed is 100 – 150 kg/hr. The diameter of briquettes produced is 75mm.

Roller Press

In a briquetting roller press, the feedstock falls in between two rollers, rotating in opposite directions and is compacted into pillow-shaped briquettes. Briquetting biomass usually requires a binder. This type of machine is used for briquetting carbonized biomass to produce charcoal briquettes.



Pelletizing

Pelletizing is closely related to briquetting except that it uses smaller dies (approximately 30 mm) so that the smaller products are called pellets. The pelletizer has a number of dies arranged as holes bored on a thick steel disk or ring and the material is forced into the dies by means of two or three rollers. The two main types of pellet presses are: flat/disk and ring types. Other types of pelletizing machines include the Punch press and the Cog-Wheel pelletizer. Pelletizers produce cylindrical briquettes between 5mm and 30mm in diameter and of variable length. They have good mechanical strength and combustion characteristics. Pellets are suitable as a fuel for industrial applications where automatic feeding is required. Typically, pelletizers can produce up to 1000 kg of pellets per hour but initially require high capital investment and have high energy input requirements. Shown the below photograph of cow dung Pelletizing made in Department of Renewable Energy Engineering, College of Agricultural Engineering & technology, Junagadh Agricultural University (8mm, 10mm,12mm and 20mm made dies).

Application of Biomass Briquettes

The briquettes are utilized in gasifiers. Gasification is a process in which combustible materials are partially oxidized or partially combusted. The process is carried out in oxygen lean environment.

1. Gasifier: The working of gasifier can be understood by dividing it into various zones.

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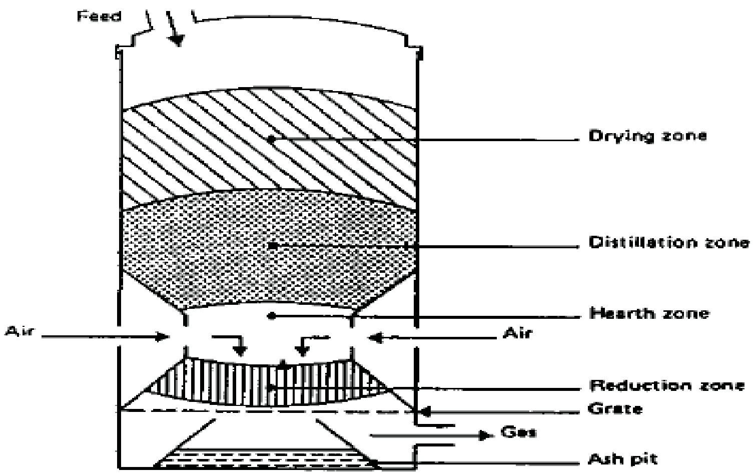

Figure: 4. Gasifier

Drying Zone

Briquettes are introduced into the gasifier at the top. Due to heat transfer from the lower parts of the gasifier, drying of the wood or biomass fuel occurs in this section. The water vapour flow downwards and add to the water vapour formed in the oxidation zone. Part of it may be reduced to hydrogen and the rest will end up as moisture in the gas.

Pyrolysis Zone

At temperatures above 250°C, the briquettes start pyrolyzing. The large molecules such as cellulose, hemi-cellulose and lignin break down into medium size molecules and carbon (char) during the heating of the feedstock. The pyrolysis products flow downwards into the hotter zones of the gasifier. Some will be burned in the oxidation zone, and the rest will break down to even smaller molecules of hydrogen, methane, carbon monoxide, ethane, ethylene, etc. if they remain in the hot zone long enough. If the residence time in the hot zone is too short or the temperature too low, then medium sized molecules can escape and will condense as tars and oils, in the low temperature parts of the system.

Oxidation Zone

A burning (oxidation) zone is formed at the level where oxygen (air) is introduced. Reactions with oxygen are highly exothermic and result in a sharp rise of the temperature up to 1200 - 1500 °C. The important function of the oxidation zone, apart from heat generation, is to convert and oxidize virtually all condensable products from the pyrolysis zone. In order to avoid cold spots in the oxidation zone, air inlet velocities and the reactor geometry must be well chosen.

Reduction Zone

The reaction products of the oxidation zone (hot gases and glowing charcoal) move downward into the reduction zone. In this zone the sensible heat of the gases and charcoal is converted into chemical energy of the producer gas.

The end product of the chemical reactions that take place in the reduction zone is a combustible gas which can be used as fuel gas in burners and after dust removal and cooling is suitable for internal combustion engines. The ashes which result from gasification of the biomass should occasionally be removed from the gasifier. Usually a moveable grate in the bottom of the equipment is considered necessary.

This makes it possible to stir the charcoal bed in the reduction zone, and thus helps to prevent blockages which can lead to obstruction of the gas flow.

Results

Use of briquettes is mainly for replacing coal substitution in industrial process heat applications (steam generation, melting metals, space heating, brick kilns, tea curing, etc) and power generation through gasification of biomass briquettes. Being derived from renewable resources, the briquette has superior qualities as well as environmental benefits in comparison with coal, Engineering Properties of Various Agricultural Residue also find (Makavana et. at, 2018) as shown in Table 1.

Table 1: Comparison of coal and biomass characteristics.

Sr. No.	Fuel	Density g/cm3	Calorific Value Kcal/kg	Ash Content %
A	Coal	1.3	3800-5300	20-40
B	Biomass Briquettes From:			
1	Saw Dust Wood	1.1	4600	0.7
2	Ground Nutshell	1.05	4750	2.0
3	Rice Husk	1.3	3700	18.0
4	Rice straw	380.54	-	15.20
5	Saw Dust Cotton	1.12	4300	8.0
6	Cotton stalk(kg/m^3)	206.14	-	6.93
7	Cow Dung (kg/m^3)	655	-	-
8	Sugarcane bagasse (kg/m^3)	723.2	-	3.28

Economic Analysis of Biomass Briquetting

About 70 biomass briquetting machines were installed in India by 1995. By 2007 the number of briquetting plants increased to 250. As the technology is locally mastered and economically viable, the number is increasing annually. Two biomass briquetting technologies dominate the Indian market: the ram and die machine and the screw machine. These two machines use different processes to densify sawdust and agricultural waste, and the end products also have different densities and shapes. The two types of machines are locally manufactured. A third kind of press, the hydraulic press has not been used in India and is considered unsuitable for Indian raw materials. The most common raw materials for heated-die screw-press briquetting machines are saw dust and rice husk.

Table: 2. Values of different heads for economic analysis of biomass briquetting factory in India.

	Head (unit)	Value (Rs.)
1.	Initial cost of machine	12,000,000
2.	Life (yr.)	10
3.	Annual use time (hr)	960
4.	Interest on cost (%)	15
5.	Depreciation (%)	10
6.	Junk value (%)	10
7.	Annual repair	5% of the initial cost of machine
8.	Labour required	4
9.	Labour rate (Rs./hr)	15
10.	Av. machine capacity (t/hr)	1
11.	Fuel consumption (kwh)	9
12.	Fuel cost (Rs/kwh)	4.68(commercial charges)
13.	Oil and lubricant charges	20% of fuel cost
14.	Working capital 12,000,000	12,000,000

Table: 3. Economic analysis for biomass briquetting factory:

Item	Value (Rs.)
Fixed costs	429,000

Variable costs	1,298,035.2
Total cost /yr.	1,727,035.2
Revenue:	
1-Returns from 960 tons of briquettes at Rs. 3.0 per kg	
2- net returns(assuming 5% losses during storage)	2,880,000
3-Total revenue per yr.	2,736,000
4- Total cost incurred per year	1,727,035.2
5- Net profit per year (3-4)	1,008,657.2
6- Total initial cost	1,825,000
7- Payback period	6 months

Conclusion

It is concluded that briquettes produced from biomass are fairly good substitute for coal, lignite, firewood and offer numerous advantages. The energy content of briquettes ranges from 4.48 to 5.95 kilojoules per gram (kJ/g) depending on composition, whereas the energy content of sawdust, charcoal and wood pellets ranged from 7.24 to 8.25 kJ /g.

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QTL Mapping: General Description

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Introduction

Quantitative traits show continuous variation, polygenic inheritance, and large environmental effects along with cumulative small individual effects on the trait phenotype. Classical Mendelian methods cannot be used to follow the inheritance of polygenes. Therefore, there is the emergence of a variety of statistical tools, which will identify the locus carrying polygenes governing various economically important traits. QTL (quantitative trait locus) are the genomic regions associated with the expression of a quantitative trait. A QTL may contain one or more genes affecting the concerned quantitative trait.

Brief History

Scientist	Remarkable works
Yule (1906)	First notable work on inheritance of quantitative traits/"Multiple factor hypothesis"
Nilsson-Ehle (1908)	First experimental evidence to support Multiple factor hypothesis
Morgan (1910)	Linkage concept in Drosophila
Strutevant (1911)	Construction the first linkage map of Drosophila
Sax (1923)	Basic principle/Concept of QTL mapping in French bean
Thoday (1961)	Concept of QTL mapping further elaborate
Gelderman (1975)	Coined term "QTLs"
Botstein (1986)	Development 1st molecular marker "RFLP"

Types of QTLs

QTLs	Roles
Main effect /major QTLs	Produce direct effect on the expression of the concerned traits. It shows 10 % or more of the phenotypic variance for the trait.
Small effect /minor QTLs	A QTL with a smaller effect on the trait. Most quantitative traits are governed by few major QTLs and many minor QTLs.
Epistatic QTLs	Interact with the main effect QTLs to influence the trait phenotype, also similar as modifying genes or modifiers.
Stable QTLs	The phenotypic effect of the QTL is little affected by the environment and it can be detected across environments. This includes major QTLs.
Unstable QTLs	Shows the opposite behaviour and sensitive to environmental variation. This includes minor QTLs.
Expression(eQTLs)/ regulatory QTLs	QTLs affect the expression level the level of RNA transcript produced in a tissue, of various genes showing expression level polymorphism.
Metabolic QTLs (mQTLs)	Control metabolic traits, i.e., rates of various metabolic reactions and metabolite levels. Generally, show epistatic interactions and moderate phenotypic effects.
Protein quantity QTLs (pQTLs)	This explains quantitative variation in the cellular content of specific proteins.
Heterosis QTLs (hQTLs)	The QTLs involved in heterosis. They do not affect the expression of the traits.

QTL Mapping

The process of identifying the regions on chromosome responsible for the trait of interest, mapping them to improve genes and transfer them through MAS. This based on the basic principle of meiotic segregation of all the genes and markers together into the progeny because of tight linkage between them. In natural population, this consistent linkage relationship is rare; hence, QTL mapping involves segregation plant population.

Requirements for QTL Analysis

1. A suitable mapping population.
2. A dense marker linkage map for the species.
3. Reliable phenotypic evaluation for the target trait.
4. Appropriate software packages for QTL detection and mapping.

Procedure

1.	Two homozygous lines having contrasting phenotypes for the trait(s) of interest are selected and crossed to develop a suitable mapping population, preferably, a doubled haploid (DH) or recombinant inbred line (RIL) population.
2.	Precisely phenotyping of target trait in replicated trials
3.	Identify of polymorphic molecular markers covering the whole genome at a sufficient density.
4.	Genotyping of all the individuals/lines by using these polymorphic markers.
5.	Genotype data are used to construct a framework linkage map for the population depicting the order of the markers and determine genetic distances between marker pairs in terms of Centimorgan (cM).
6.	The marker genotype and the trait phenotype data are analysed to detect association between marker genotypes and the trait phenotype.
7.	The plants are divided into separate groups based on their marker genotype. For each of these groups, mean and variance for the trait phenotype are estimated and used for comparison between the groups.
8.	In case the genotype groups for a marker differ significantly for the trait of interest, it is concluded that the concerned marker is associated with the trait, *i.e.,* the marker is most likely linked to a QTL controlling the trait phenotype.

Three Major Issues

1. QTL genotypes of different individuals are not observed and, have to be deduced.
2. An appropriate genetic model for QTL analysis has to be selected.
3. The loci located in the same chromosome are correlated and, as a consequence they are difficult to separate.

QTL Mapping Approaches

1. Single QTL Mapping: Detects a single QTL at a time. It does not take into account other QTLs affecting the target trait that may be present in the genome

a. Single-Marker Analysis: This is the simplest and the earliest used method of QTL detection (Soller et al., 1976). Each marker is separately tested for its association with the target trait. The phenotypic means for the plants placed in the different marker genotype groups are compared to detect a QTL at or near the site of the marker. The significance of differences between the means of the marker classes can be tested by Student's t-test, analysis of variance, linear regression analysis, likelihood ratio test, or maximum likelihood estimation.

b. Simple Interval Mapping: Lander and Botstein (1989) developed the interval mapping (IM) procedure, which is generally known as simple interval mapping (SIM). SIM requires a marker linkage map for QTL search as it uses neighboring marker pairs to define marker intervals and searches QTLs within these intervals. SIM makes a systematic linear or one-dimensional search for a QTL at several locations, say, at every 1 or 2 cM, within each marker interval.

2. Multiple QTL Mapping: Multiple QTL mapping (MQM) combines multiple regression analysis with SIM to include all the significant QTLs in the genetic model used for mapping.

a. Composite Interval Mapping: Combines interval mapping with multiple regression analysis. CIM first carried out single-marker analysis and builds up the model using stepwise or forward regression method. In this approach, the marker with the highest LOD score is selected first; then the marker with the second highest LOD score is added, and the two markers are reevaluated for significance, and so on. All the significant markers brought together to fit into the model as cofactors; serve as proxies for other QTLs since these markers are detected to have significant association with the target trait. Minimize the background effects of other linked QTLs.

b. Multiple Interval Mapping: MIM approach is devised for simultaneous QTL mapping in multiple marker intervals (Kao et al., 1999). Maps multiple QTLs and detects QTL x QTL interaction (the results from both CIM and MIM are highly dependent on the genetic model used for QTL analysis, as well as marker cofactor selection for CIM).

c. Bayesian Multiple QTL Mapping: It has been designed for the detection of multiple QTLs. It treats the number of QTLs as a random variable and uses reversible-jump Markov Chain Monte Carlo (MCMC) procedure for specific modelling (Banerjee et al., 2008).

Advantages

1. Consideration of other QTLs affecting the trait tends to reduce residual variation.
2. Increase the QTL detection power.
3. Linked QTLs can be detected as separate QTLs.
4. The estimates of QTL effects are more reliable than those estimates with single QTL methods.
5. QTL x QTL interaction can be detected.

Confirmation and Validation of QTL Mapping Results

Detected QTL is real and verify the QTL position and effect reported by the primary study; this is the confirmation of QTL mapping results. The confirmation of QTL mapping results is necessary before the markers linked to a QTL can be used for MAS for the QTL.

QTL Fine Mapping: QTL fine mapping consists of identification of markers located very close to, preferably at <1 cM from, the concerned QTL. This facilitates the occurrence of all possible crossing-overs close to the target QTL and scoring. Near-Isogenic Lines, Intercross Recombinant Inbred Lines (IRILs), Recurrent Selection Backcross (RSB) QTL mapping, the Multiparent Advanced Generation Intercross (MAGIC) populations are several strategies used for fine mapping of QTLs.

Variation in QTL effects: The reasons may be:

1. Segregation of different QTLs in different mapping populations.
2. QTL x genetic background interactions.
3. QTL x environment interaction (QTL x E interaction).
4. The Beavis effect.

Advantages

1. Detects and maps each of the QTLs governing the target trait within relatively short intervals.
2. Identifies markers flanking the QTL regions; these markers can be used for MAS.
3. The two lines crossed to generate the mapping population which ensure the frequency of rare allele to be 50% in the mapping population, facilitate its mapping by increasing QTL detection power.
4. QTL fine mapping can facilitate cloning of the genes located in the QTL region.

Limitations

1. Biparental population limits the genetic variation in the quantitative traits.

2. The effects of only two alleles of the genes/ QTLs can be studied in biparental mapping population.
3. A QTL detected in a biparental population may not be equally effective in other genetic backgrounds.
4. It is difficult to detect QTLs with strong epistatic effects and QTLs sensitive to environmental influences unless suitable experimental and analytical designs are used.

Software

MapMaker /QTL, QTL Cartographer, MapManager QT/QTX, R/QTL, R/QTLBIM, QTL Express, QGene 4.0 and several others software are available for QTL analysis.

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"Farmers Producer Organisation" (FPO): Its Key Features

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What is a Producer Organisation (PO)?

A Producer Organisation (PO) is a legal entity formed by primary producers, viz. farmers, milk producer, fishermen, weavers, rural artisans, craftsmen. A PO can be a producer company, a cooperative society or any other legal form which provides for sharing of profits/benefits among the members. In some forms like producer companies, institutions of primary producers can also become member of PO.

What is the Need for PO?

The main aim of PO is to ensure better income for the producers through an organization of their own. Small producers do not have the volume individually (both inputs and produce) to get the benefit of economies of scale. Besides, in agricultural marketing, there is a long chain of intermediaries who very often work non-transparently leading to the situation where the producer receives only a small part of the value that the ultimate consumer pays. Through aggregation, the primary producers can avail the benefit of economies of scale. They will also have better bargaining power vis-à-vis the bulk buyers of produce and bulk suppliers of inputs.

What is a "Farmers Producer Organisation" (FPO)?

It is one type of PO where the members are farmers. Small Farmers' Agribusiness Consortium (SFAC) is providing support for promotion of FPOs. PO is a generic name for an organization of producers of any produce, e.g., agricultural, non-farm products, artisan products, etc.

Can there be a PO for Non-Farmers?

Yes. The PO is an organization of the primary producers. If the produce in question is a non- farm item (for example, handloom or handicraft), then the PO will be that of non-farmers. The objective of the PO is to ensure better income realization to its members (who are producers) through aggregation and, if feasible, value addition.

What are the Essential Features of a PO?

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

Who Owns the PO?

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

Who can Promote a PO?

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

Who Provides Support for Promotion of PO?

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

Can an NGO Promote PO?

Yes, it can. The NGO may be a non-profit organization, but not the PO. The NGO can promote PO which will provide better income to the members. Sharing of profit among members is an important objective of the PO.

Conclusion

FPOs are group of farmers united together to start business and also reduce the risk and uncertainty in business. It also increases the ease in availability of funds to start any business in pandemic also such as COVID-19.

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Engineering Interventions for Sustainable and Profitable Agriculture

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Introduction

Agriculture is backbone for India's economy as it accounts for 16.5% of the country's Gross Value Added (GVA) for the year 2019-20 (at current prices) with total workforce of 54.6%, engaged in agricultural and allied activities [Census 2011]. The Agriculture and Allied sector performed very poor in recent years with growth of -0.2 per cent in 2014- 15, 0.6 per cent in 2015-16, 6.3 in 2016-17, 5.0 per cent in 2017-18 and 2.7 per cent in 2018-19 at 2011-12 basic prices [Annual Report 2018-19, ministry of agriculture and farmers welfare, GoI]. The first and the foremost goal of agricultural development should be to raise the income of farmers to a higher level without altering the ecological harmony. This will not enhance only the standard of living but also the dignity of farmers.

Agriculture is sustainable when it is ecologically balanced, economically viable and socially acceptable and must be based on a holistic scientific approach. With rapidly increasing population, it is being difficult to meet the food and nutritional security to every human being. Intensive use of chemicals and fertilizers owe to environmental problems which is major concern for human being as agriculture is the prime source for food and livelihood. Therefore, interventions of engineering technology with scientific approach to a greater extent for agriculture and allied sector are need of day for holistic growth of it. It has the potential to increase food productivity, reduce the dependency of agriculture on chemicals, lower the cost of raw materials and reduce the negative environmental impact associated with traditional production methods.

Sustainable Agriculture

A farming system which is economically viable and meet the demand of food and textiles of the growing population with least impact on environment termed as sustainable agriculture. The term "sustainable agriculture" refers to an agricultural system that will continue to be productive in the future. It is economically viable and also maintains the ecological harmony. It integrates three main goals namely environmental health, economic profitability and social acceptability.

Steps for Analysing the Sustainability of the Agriculture System

Step 1: Identify the engineering tools and techniques for the purposed agriculture system and plant factory unit framework.
Step 2: Define a sustainability measurement model by defining sustainability indicators.
Step 3: Collect data by thorough case study of each and every unit framework.
Step 4: Assess the sustainability performance of plant factory cultivation compared to conventional cultivation.

Technological Interventions in Agriculture and Allied Sector

Technological interventions are required in agriculture and allied sector for its sustainable and holistic growth. There are tremendous scopes of technological interventions in areas production and processing of paddy, pulses and oil seeds which will lead to increase output of rice, pulse and oil at much lower cost than that from the conventional production and processing system and ultimately, increase the income of farmers by increasing output with lesser input cost. Similarly, the various technological interventions are required in water harvesting (including design and development of water harvesting structure) and ground water recharging, micro- irrigation (drip and sprinkler irrigation), drainage of water logged field, optimum use of insecticides, pesticides and fertilizers, development and introduction of suitable crops (especially hybrids of maize, wheat, paddy, pulses and oilseeds), organic farming. Again, soil and water conservation practices required huge engineering interventions in designing and development of various structures, ponds, canals and dams to conserve soil and water.

Conclusion

The prominent inputs (fertilizer, chemicals, seed, water, fuel and labor) conserving machines are laser land leveler, precision planters, happy seeder, cultivator, rotavator, sub-soiler, zero-till drill, raised bed former, sugarcane cutter planter, rotary power weeder, aero-blast sprayer, wheat straw combine & balers, etc. The proper use of all these machines and implements will reduce timeliness loss and cost of the inputs significantly and thus enhance the income of the farmers. It is estimated that application of laser land leveler in 2 million hectares under rice-wheat system could save 1.5 million ha-m of water, 0.2 million tons of diesel and reduce greenhouse gases emissions equivalent to 0.5 million tons of carbon. Use of zero-till drill results into a saving of Rs. 2000-3000/ha consisting of 70 liters of diesel, time and labor. Today, zero till drills are being used over an area of about 2 million ha resulting into a saving of about Rs. 500 crores annually. The need is to expand the area under resource/ inputs conserving technologies and machines to make farming more profitable.

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Interventions of Image Processing Techniques (IPT) for Profitable Agriculture

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Introduction

Image Processing Technique (IPT) is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. It is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines.

Need of Image Processing Techniques (IPT) in Agriculture

The migration of people from rural to urban area creates a serious problem of shortage of farm workers at peak times for agricultural operations. IPT provide the precise and judicious use of resources such as seeds, water, pesticides, weedicides and fertilizers etc collectively lead to enhance the income of the farmers. Therefore, IPT can help us to mitigate the risk of food security of the rising population and also lack of man force for agriculture and allied sector. Another aspect that IPT can help agriculturists is the harvest of the fruits and vegetables at the right time and also harvest only the products, which are ready or matured for harvest.

Methods Used for Image Processing

There are two types of methods used for image processing:

1. Analogue image processing: Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques.

2. Digital image processing: Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display.

General Steps for Image Processing

Image processing basically includes the following three steps:
1. Image acquisition through image acquisition tools.
2. Analysis and manipulation of the image.
3. Output in which result can be altered image or report that is based on image analysis.

Applications of IPT in Agriculture

Image processing techniques can be used for agricultural products like fruits, vegetables and crops for various aspects listed below:
1. Sorting and grading of fruits and vegetables.
2. Detection of insects and pest management in crops.
3. Identification of nutrient deficiencies in crops and soil.
4. Fruits quality inspection.
5. Land estimation and object tracking.
6. Determining the vegetation indices and canopy measurement.

7. irrigated land mapping with greater accuracies.

Constraints in Use of IPT for Agriculture

1. Lack of familiarity with image processing tools.
2. High cost of the image processing device and its hardware.
3. Lack of skilled worker.
4. Lack of research and developments in the area.

Conclusion

Image processing technique (IPT) has been proved as effective method for overall growth of agriculture and to make it more profitable than existing system. More research and developments are required in this area to explore all the possibility of use of IPT in agriculture and allied sector in feasible and easy way. Thus, we can conclude that image processing is an effective tool that can be applied for the agriculture and allied sector with great accuracy for analysis of agronomic parameters and to make agriculture more profitable.

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Impact of COVID-19 on Agriculture and Rural Development

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Introduction

Agriculture plays a vital role in India's economy as it accounts for 16.5% of the country's Gross Value Added (GVA) for the year 2019-20 (at current prices). A total workforce of 54.6% is engaged in agricultural and allied activities [Census 2011]. Given the importance to agriculture sector, Government of India has taken several steps for its development in a sustainable manner. However, COVID-19 has presented a serious challenge to the agriculture sector. Outbreak of novel corona virus in India and the consequent lockdown, unfortunately, also coincided with the country's peak harvesting time of a variety of crops of the season. This period saw another unprecedented development: the large-scale migration of labours from cities to their respective villages, fearing death by hunger as all economic activity came to a halt. This mass departure of the migrants to their homes has created serious problem of farm labour in the states of Uttar Pradesh, Punjab and Haryana, which largely depends on farm labourers from eastern India.

Matters are especially worse for farmers who grow fruits and vegetables, considering that the shelf life of these commodities is usually very short. At the same time, reports of cucumbers & bell peppers rotting in the fields due to the disappearance of buyers and retailers. Further, it is also likely to lead the way to the next major challenge – a smaller window to plant next season's crops. Planting of cotton and summer 'moong' pulses need lot of farm labourers which is a challenge for farmers in Madhya Pradesh, UP, Haryana, Punjab and Rajasthan.

Challenges

1. Due to migration and lack of farm labourers, several agricultural activities adversely affected like harvesting, collection and marketing of food grains, fruits and vegetables. Considering the facts that fruits and vegetables are highly perishables which need to market at earliest for better returns. The lack of buyers, retailers and consumers badly affect the fruit and vegetable farmers which need to be addressed on urgent basis by government.

2. Fall in the prices of a range of commodities in agriculture is also a major concern for farmers which need to be addressed at earliest. Due to lockdown, economic activities are on hold and need to be revived for the sake of agriculture and rural development. Transports are on hold due to lockdown which also limits the farmers to get fare price of their produce.

3. Disrupted supply chains across the country for a range of commodities causes huge post-harvest losses which badly impact the income of the farmers.

4. Lack of mechanization is also responsible for the dependency on the farm labors. Mechanization reduces dependency on farm labors, enhance timeliness in operation, optimize cost of input, increase output and hence increase income of the farmers.

Mitigation Strategies

1. For laborer surplus states, there is a need to develop agricultural raw material-based industries so that no farmers or their dependents have only agricultural activities, they must have some alternative source of fixed

income too. The Farmer Producer Organization (FPO) company developing under ATMA scheme solely devoted for farmers may be game changer if function in proper way.

2. For states having shortage of laborer may go towards fully mechanized precision Agriculture, mechanized Post-harvest operations and on-line marketing systems (like e-NAM). For example, the labor deficit state should immediately shift to Direct Seeding Rice instead of transplanting for which machinery are used here and there successfully. In any case, Indian Agriculture to secure future needs now major emphasis on Research, Development and Investment in Agricultural Engineering.

3. Agricultural mechanization is important to reduce the problem of farm worker at peak time. It also helps to optimize the cost of input and enhance the timeliness in operation resulted in greater output and hence, increase the income of the farmers.

4. Skill development of migrant labor through training on various sector like mushroom production, honey production, pearl farming, dairy farming and poultry production etc. could help to mitigate the economic problem of the migrant labor. The skill development program is conducted by various state and central agencies like, Agricultural Technical Management Agency (ATMA), Krishi Vigyan Kendra (KVK) and various NGOs. For becoming country self-reliant each and every one district and panchayat has to be self-reliant. This can be achieved through skill development program for migrant labor district level. This is also beneficial for long term economic model of rural development.

5. Set up price regulation authority at district level to control the fall of price of various agricultural commodities and also, to get the fare price for the same. This will help to reduce the risk of market uncertainty and also, farmer can negotiate better to get fare price of their produce.

6. Instruct various government agencies to provide single window clearance of transport vehicles carrying agricultural produce and also make possible of disruption free supply chains across the country for agricultural commodities to reduce post-harvest losses.

7. Each family must have at least one or two members involved in some salary / business-based jobs so that they can earn some extra money to enhance standard of living.

Conclusion

The economic impact of the COVID-19 pandemic in India has been largely disruptive. An alternate plan must be in place to combat situation like COVID-19, if any in future. In this pandemic, shortage of farm labor which adversely effect on agricultural activities like sowing, harvesting and post-harvest operations. Fall of price of perishables commodities like fruits and vegetables also made concerns for farmers which need to addressed properly and market at earliest for getting better price. There must be capacity to produce high amount of good quality protein food, vitamins, minerals and other immune strengthening instant food products for feeding masses in such situations in future. Mismatch of economic activities of different states and different district within states must be addressed properly so that labor surplus states and states facing shortage of labor could make policy according to their need.

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Effects of Puddling on Physical Properties of Rice Soils

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Summary

Puddling of soil is the process of working saturated or near-saturated soil into soft structureless mud for growing rice. Puddling is achieved by cultivating the soil under saturated conditions using animal-drawn or tractor driven implements. The operation is an important management practice in wetland rice culture Puddling softens the soil and assists manual transplantation of rice seedling, minimizes water use through reduced percolation losses and, effective weed control. Over the time, soil puddling also creates a compacted layer below the puddled zone which further reduces percolation losses but destroys soil structure.

Introduction

Puddling can be defined as the process of breaking down soil aggregates into uniform mud, accomplished by applying mechanical force to the soil at high moisture content. It may also be defined as the mechanical reduction of the apparent specific volume of soil. Puddling is achieved by cultivating the soil under saturated conditions using animal-drawn or tractor driven implements. Puddling of soil is the process of working saturated or near-saturated soil into soft structureless mud for growing rice.

Tillage in lowland rice production systems (paddy rice) is synonymous with puddling. Puddling softens the soil and assists manual transplantation of rice seedling, minimizes water use through reduced percolation losses and, effective weed control. Over the time, soil puddling also creates a compacted layer below the puddled zone which further reduces percolation losses. To a farmer, puddling is mixing soil with water to make it soft for transplanting and impervious to water. To put it simply, it is an act or method of making a puddle.

The least permeable zone is usually found just below the puddled layer where tillage implements created a thin smeared layer. Wet cultivation or soil puddling is the common soil preparation technique used for lowland rice production in which soil structure is deliberately destroyed and the soil dispersed by plowing and harrowing the soil in a flooded or saturated state. The operation is an important management practice in wetland rice culture.

The steps involved in puddling:

1. Saturating and flooding the soil.
2. Plowing the supersaturated soil.
3. Plowing or harrowing at progressively lower water contents.
4. When the soil moisture content increases, soil aggregates swell, soften, and weaken. Cohesion between aggregates increases reaches a peak at field capacity and decreases. When such soil is plowed or harrowed the aggregates are destroyed.

Effects of Puddling on Soil Physical Properties

During puddling, soils are subjected to two kinds of deforming stresses:

1. Normal stress (load) associated with compression and the compression is more effective below the upper plastic limit moisture content at which the soil-water system can flow as a sticky fluid paste.

2. Tangential stress causing shear. Shearing effects dominate above the upper plastic limit.

Puddling or wet tillage coupled with submerged conditions are responsible for making drastic effects on soil physical characteristics of rice soils. These effects can be continued either for a short time or a long time such as:

1. Bulk density and soil strength: The arrangement and organization of primary and secondary particles into a definite pattern under field conditions is known as soil structure (Sharma, 2017). Bulk density is an important parameter of soil structure which reflects the changes in soil structure. Puddling effects on bulk density are dependent on the aggregation status of the soil before puddling. If a parallel oriented, closely packed structure is produced from a well aggregated open structure, bulk density would increase. The strong inter-particle forces favor a well-oriented structure, while weak inter-particle forces favor an open gel structure. Initial submergence before tillage also decreases bulk density.

2. Porosity: Soil porosity is an important index of soil structure that has a significant effect on water and air movement in soil and plant root growth. Change in the orientation of soil particles in the puddled layer brings about changes in soil porosity. Tillage effects on lowland rice observed that puddling decreased drainage pores and increased water retention pores. Changes in pore space (pore size distribution) upon puddling effects other soil physical properties like the aeration status, the retention-transmission characteristics and, evaporation losses of soils.

3. Water retention and transmission characteristics: Water retention in puddled soils is always higher than the non-puddle soil. Puddling creates a plow layer that reduces hydraulic conductivity and reduces water percolation losses (Zhou et al., 2014). When the submerged puddle soils revert to upland non-puddle condition, its water retention falls. Re-saturation of such soils may not necessarily restore the soil's original water retention capacity.

4. Thermal regime: Wet tillage (puddling) in rice soils affects the thermal regime by changing soil properties, such as bulk density, moisture regime and, the transmission characteristics. Thermal conductivity (k) and the volumetric heat capacity (c) increase with bulk density and moisture content, because the k and c of soil particles and water are much higher than those of air.

Advantages of Puddling

Puddling has numerous advantages to transplanted rice crop but it is harmful to the upland crop in rice-based cropping systems. Its advantages are:

1. Reduces soil permeability and thus helps in water stagnation in rice fields. Studies have indicated that puddling reduces percolation losses to about one-third of those in non-puddled soils (Wickham and Singh, 1978).
2. Controls weeds in rice fields.
3. Improves water and nutrient availability by creating anaerobic conditions.
4. Facilitates transplanting by softening the soil (Kirchhof et al., 2011).

Disadvantages of Puddling

1. Destroys soil aggregates and creaks capillary pores.
2. Lowers soil strength in the puddled layer.
3. The long-term puddling leads to plow pan or traffic pan formation that may reduce percolation drastically. These plow pans are formed due to physical compaction and chemical precipitation of iron, manganese and, silicone (Sharma et al., 2003).
4. Plough pan (compacted layer) resists root penetration of following crop (Kirchhof et al., 2000)
5. Can cause waterlogging.
6. Forms large clods in finer textured soils preventing seed-soil contact.
7. Forms impermeable clayey layer on the surface in coarser soil.

Conclusion

Puddling of soil is the process of working saturated or near-saturated soil into soft structureless mud for growing rice. Puddling is achieved by cultivating the soil under saturated conditions using animal-drawn or tractor driven implements. Puddling or wet tillage coupled with submerged conditions are responsible for making drastic effects on soil physical characteristics of soils. Puddling has numerous advantages to transplanted rice crop but it is harmful to the upland crop in rice-based cropping systems.

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Impact of Social Media in Enhancing Agriculture Extension

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Abstract
Social media are tools meant for digital communication that aids in the interaction among a group of people and acts as information exchange media across the globe. Since ages newspapers, television, and magazines have been the most used source of information in the agriculture sector. But now the power of the 21st century is literally in our hands (Lathiya et al., 2015). Platforms like Facebook, YouTube, and WhatsApp have 2.6 billion, 2 billion, and 1.6 billion active monthly users respectively as of 2020 (Anonymous1 2020). The present study focuses on laying out the current and future perspectives of social media in the agricultural and extension sector. Facebook is one of the prominent social media applications for pages and profile creation. YouTube videos are an excellent source of dissemination of knowledge using audio-visual aids. WhatsApp is the handy use of social media and mostly preferred for related groups (Balkrishna et al., 2017). In some studies, shreds of evidence obtained revealed that many social media platforms are being used in agricultural extension service delivery worldwide with Facebook having the highest popularity (64.7%). Social media is continuously growing and getting the attention of users with the emergence of several smartphones. However, it has not grown widely for agriculture in India because of various challenges prevalent in rural India that are the shortage of infrastructure, limitation in participation, illiteracy in rural zones, non-institutionalization, lack of quality control, etc. Nowadays, social media is gradually being appreciated in agricultural extension service delivery but continuously facing several challenges. Thus, the need of the hour is to put structures in place and efforts to be made by training and other methods by all stakeholders to ensure good use of its benefits in agricultural extension and rural development.

Keywords: Agriculture Extension, Facebook, Social Media, WhatsApp, and YouTube.

Introduction
Agriculture plays an important in the Indian economy as 56.4% of the total population is involved in agriculture and allied sectors, which contributes 15.4% to the nation's G.D.P (Joshi 2019). Sustainable agricultural production requires current and relevant information by experts in this field is a major issue for the country. ICT facilities have been very impressed with how broadcast and broadcast these days total. The delivery of agricultural extension services in India has a limited scale, stability, and impact. Only 6.8 percent of farmers average her public extension services (GFRAS, 2012). The NSSO, 2014 indicated that 40.6 percent of households received extension assistance, with only 11 percent of services coming from physical government machinery extension agents, agricultural science centers, and agricultural universities. There is a need to fill this gap by exploring other options for alternative agricultural extension service delivery mechanisms. Information and communication technology (ICT) can provide information on agricultural extension with more precision, faster, relevant, and higher quality (Goyal, 2011, Kritiken 2012 and World Bank, 2016). These technologies are reviving agricultural expansion and advisory services worldwide (World Bank, 2016). ICT-based tools in agriculture Vary from web portals, Telechenters, mobile telephony, and hybrid projects (ICT with traditional extension elements) (Shantichandra et al., 2013). Mass media including the Internet is now the second most important source of useful information for agricultural families in India (NSSO, 2014). Besides, ICT interventions have received

encouragement from the Indian Ministry of Agriculture (ICAR, 2016). Recently two mobile apps were launched on crop insurance and agriculture market (GOI, 2015). Social media is yet another ICT-based tool, once used purely for entertainment, with great potential for knowledge sharing and collaboration in agriculture (Goyal, 2011). These ICT devices are relatively easy to use and gaining popularity in the agricultural sector (Saravanan and Bhattacharjee, 2016). Social media has great potential to be used as a tool of communication and networking for the benefit of the farming community. Infection, many of them recognized it and started using it.

A Brief About Social Media

Social media refers to the interaction with people in which they create, share, consume, and exchange information and ideas in virtual communities and networks. Kaplan and Heinlein (2009) define social media as "a set of Internet-based applications that build on the conceptual and technological foundations of Web 2.0 and that allow the creation and exchange of user-created content". "Social media are web-based tools of electronic communication that allow users to exchange information individually or in groups, share ideas and opinions, make decisions and create, store, retrieve and exchange information -Allows to provide the facility of providing (text, images, videos, etc.), by anyone in the virtual world (Suchidipata and Saravanan, 2016).

These are digital networks that use user-created information - opinion, Video, audio, and multimedia are used to share and discuss. Andres and Woodard, (2013). Merriam-Webster (2015) defines social media as forms of electronic communication through which user information, ideas, can create online communities to share personal messages and other content. Ahlquist et.al. (2008) Definition focuses on three core components - content, community, and Web 2.0 - and the conduct of social media as a form of people interaction. And makes comments in content creation, exchange, and viral dual communities and networks.

Why Social Media

Is social media important for agriculture? Although many outsiders would never think of connecting farmers, dairy farmers, animal keepers with Facebook and Twitter, they both represent a large group of active users on social networking sites. According to some farmers and scientists, social media is an indispensable communication tool to educate farmers about their industry.

Social media can be advantageously used in agricultural extension, as discussed below (Saravanan et al., 2015):

1. Highly cost-effective
2. Simultaneously reaches large numbers of clients.
3. Location and client-specific, problem-oriented.
4. User-generated content and discussion among the community members.
5. Easily accessed from mobile phones.
6. Increases the internet presence of extension organizations and their client reach.
7. The democratization of information by making it accessible to all.
8. Brings all stakeholders into a single platform.
9. Can measure reach and success by tracking the number of visitors, friends, followers, mentions, Facebook 'likes', conversation index and number of shares.

Social Media Tools Commonly Used in Agriculture Extension

The use of social media in the agriculture sector and expansion has gained momentum in recent times, with only popular platforms such as Facebook, Twitter, and YouTube being used for agriculture and extension related works. WhatsApp is another major platform used by extension professionals to communicate with peer or client farmers but as communication (individual and group) is personal, more information is available about groups other than being referred to by media Is not. The various social media tools popular these days are listed below.

Facebook

Facebook is the most used social media platform in the world, with more than 1.87 billion monthly active users on its site (We Are Social, 2017). And this means a huge potential for extension professionals. Some examples where Facebook is being used as an extension tool by individuals, professional networks, and extension organizations.

Twitter

Microblogging site Twitter is one of the most popular social media platforms globally with 320 million users. In a social context, it has been one of the major catalysts used for creating public opinions and for organizing people into groups. In agriculture too, it is one of the most used platforms.

YouTube

YouTube It is the video-sharing platform with a mission to give everyone a voice and show them the world and is based on four values: Freedom of expression, Freedom of information, Freedom of opportunity, and Freedom of belonging. Users can upload and watch the videos, and there is provision for sharing and commenting on videos with additional facilities for the subscription of other users.

Blogs

Blogs contain detailed information on specific topics. They create and facilitate an in-depth discussion on any issue through comments from the readers. With increased popularity, many blog competitions are also organized worldwide for rural youth to encourage them to start a discussion about farming. Even organizations like World Bank, Food and Agriculture Organization (FAO) and International Food Policy Research Institute (IFPRI) have their blogs not just to discuss issues but announce their new publications like policy papers, working papers, and reports and so on; communicate summaries of important publications, and to increase awareness and discussion on important issues related to agriculture and rural development.

WhatsApp

A messenger app for smartphones, it is an internet-based messaging platform that supports text, audio, video, pdf, and various other forms of files. Real-time video chatting has also been integrated recently, making it more popular among users. Currently, there are more than one billion users of the app in 180 countries. Though initially used for personal messaging, it is gaining more popularity among agricultural professionals and practitioners to share information, which is aided by the group messaging feature. There are a few hundred thousand WhatsApp groups created for agricultural extension and advisory services in India.

Role of Social Media in Farming

In the global context, the agricultural sector is using social media to promote relevant information and knowledge within the industry and to network with other like-minded agricultural professionals. Social media channels enhanced and strengthened the relationships of agri-based communities and helped rural workers combat the segregation created by their work. It has crossed geographical boundaries, thereby connecting the peasant communities to mutual interest.

So far, blogs have a large presence covering topics on agriculture, animal husbandry, health, education, and other topics/topics of general interest. Social media such as Facebook, Twitter, YouTube, and blogs are emerging as an appropriate platform to share information and create awareness among various stakeholders to generate and shape the content of the event.

These media complement traditional media as a viable source of information and facilitate the marketing of agricultural products and their products using pictures, links, and videos. They provide opportunities for users to share and exchange information and to discuss burning issues in agriculture based on their knowledge and experience and to formulate effective solutions to such problems, thus marketing and building networks We do.

Conclusion

Social media are electronic communication tools that allow users to interact, create, share, retrieve and exchange information and ideas in any form that can be discussed upon, archived, and used by virtual communities and networks. Agricultural is not in new concept; however, changing platforms for communication can seem foreign to some people. Perception of social media as a valuable tool rather than a time-wasting application is important to change to extend to the value to more people. The popular social media tools i.e. Facebook, WhatsApp, and YouTube are being used for information delivery and sharing across different agriculture subsectors (crops, horticulture, dairy, goat farming) in India. Most of them are through individual efforts. There is a definite lack of organized efforts to use social media from the public extension system in India.

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Locust Swarms in India – Damaging to Crops

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Insects damage seasonal crops, devasting farmers already struggling with the impact of coronavirus lockdown.

Introduction

During this pandemic period the other attack from desert locust, amidst concerns of heatwaves and crop failure comes the desert locust, a migratory insect from eastern Africa and Southeast Asia. The multifaceted impacts of this pest are causing mass panic in an already tenuous situation, especially given its implications for future food security in India. According to a recent report by the Food and Agriculture Organization (FAO), the locust swarm currently affecting parts of India, was responsible for crop infestation in 2,80,000 hectares across 13 countries prior to arrival in India. It entered India through the western state of Rajasthan on May 13, 2020. This year's attack is the worst seen in 27 years and scientists predict that the crisis will increase as we enter monsoon season.

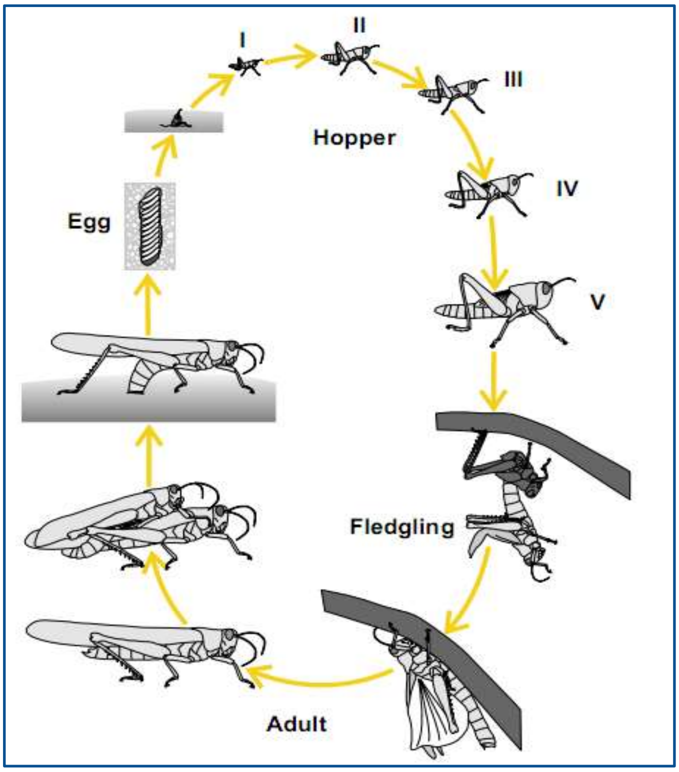
Desert Locust

Desert locusts *(Schistocerca gregaria)* are a short-horned grasshopper species. The FAO deems them the most dangerous migratory pests in the world due to their ability to change behavior and form swarms that consume everything in their path. These swarms prefer arid or semi-arid areas for egg-laying and nymph development. During periods of low density, the locust inhabits a broad belt of arid and semi-arid land which stretches from the Atlantic Ocean to northwest India, spanning 16 million square km in 30 countries. However, as locust density rises, crowding releases serotonin, promoting rapid movement and a varied diet, spawning mass migration. The migration area of desert locust covers about 30 million square km in nearly 64 countries, including parts of the Indian subcontinent.

Locusts are voracious feeders, eating up to their body weight daily. They damage crops by devouring all parts of the plants and also by breaking trees by their sheer weight when they settle down in masses. These insects can fly up to 150 km daily. One square km of a locust swarm contains up to 80,000 adults that, each day, consume the equivalent of food for 35,000 people. According to the FAO, a solitary female lays about 95-158 eggs. Up to 1000 eggs have been found in a single square mete.

Locust Sighted in India

The desert locust *(Schistocerca gregaria)* is a short-horned grasshopper. Innocuous when solitary, locusts undergo a behavioral change when their population builds up rapidly. They enter the 'gregarious phase' by forming huge swarms that can travel up to 150 km per day, eating up every bit of greenery on their way. These insects feed on a large variety of crops. If not controlled, locust swarms can threaten the food security of a country. At present countries in the Horn of Africa such as Ethiopia and Somalia are witnessing one of the worst locusts' attacks in the last 25 years.



In India, locusts are normally sighted during July- October along the Pakistan border. Last year, parts of Western Rajasthan and Northern Gujarat reported swarms that caused damage to growing rabi crops. These were the first swarms reported in India since 1997. This year, the first sightings of small groups were reported early - on April 11 - by scientists of the Agriculture Ministry's Locust Warning Organization (LWO), from Sri Ganganagar and Jaisalmer districts of Rajasthan.

Earlier Arrival of Locust

Locust can be traced back to the cyclonic storms Mekunu and Luban that had struck Oman and Yemen respectively in 2018. These turned large deserts tracts into lakes, facilitating locust breeding that continued through 2019. Swarms attacking crops in East Africa reached peak populations from November, and built up in southern Iran and Pakistan since the beginning of 2020, with heavy rains in East Africa in March-April enabling further breeding. Locusts are being seen in areas not historically associated with such sightings - Jaipur, MP's Gwalior, Morena and Sheopur, and recently stray swarms in Maharashtra's Amravati, Nagpur and Wardha.

Damage to Crops

Crop damage are low given that farmers have already harvested their rabi crop. Orange growers in Maharashtra have expressed concern but as Gurjar said, the swarm in Maharashtra would be easy to control. The bigger problem will come once the present swarms breed. An adult female locust lays 80-90 eggs thrice in her three-month life cycle. If left uncontrolled, a swarm can grow exponentially to 40-80 million locusts per square kilometer, Gurjar and others estimate. The locusts will start laying eggs after the monsoon starts and continue breeding for two more months, with newer generations rising during the growth phase of the kharif crop.

Locust attack to crops

Causes of Locust Swarm

The locust swarm also has economic and social impacts. The FAO reports the decadal economic impacts of locust plagues since the 1920s. Although no locust plague cycles have been observed after 1962, large scale upsurges were reported during 1978 and 1993 in India. Estimated damage was Rs. 2 lakhs in 1978 and Rs. 7.18 lakh in 1993. In December 2019, the locusts destroyed over 25,000 hectares of crops in Gujarat.

In 2020, the locusts have already been reported to have destroyed crops in 18 districts of Rajasthan and 12 districts of Madhya Pradesh while crops in Uttar Pradesh, Punjab, Haryana, and Maharashtra are under threat of an attack. Given that locusts swarm just prior to the monsoon, this adds economic strain to a tenuous system that relies on the annual monsoon for crop success. Locust plagues also pose a threat to livestock grazers by turning grasslands into barren wastelands.

Locust plagues not only rob rural families of their livelihood and income but also take a toll on the lives of women and children. Children often leave school to help their families recover from losses due to locust swarms. Malnutrition was observed in children post-locust plagues, as locusts consumed the same fodder as domestic cattle, reducing the milk quality produced by the cattle and leading to food insecurity and malnutrition. (CTA).

Fighting Against Locust Attack – Some Preventive Measures

The primary effort is conducted by the United Nations Food and Agriculture Organization, which runs the Desert Locust Watch to surveil and track locust migration patterns and oversee regional response efforts. At present

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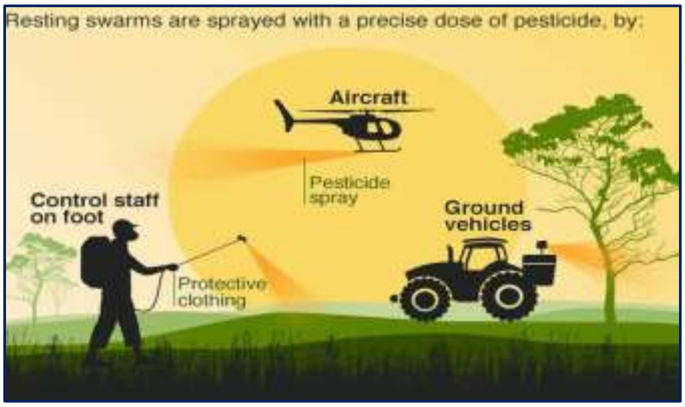
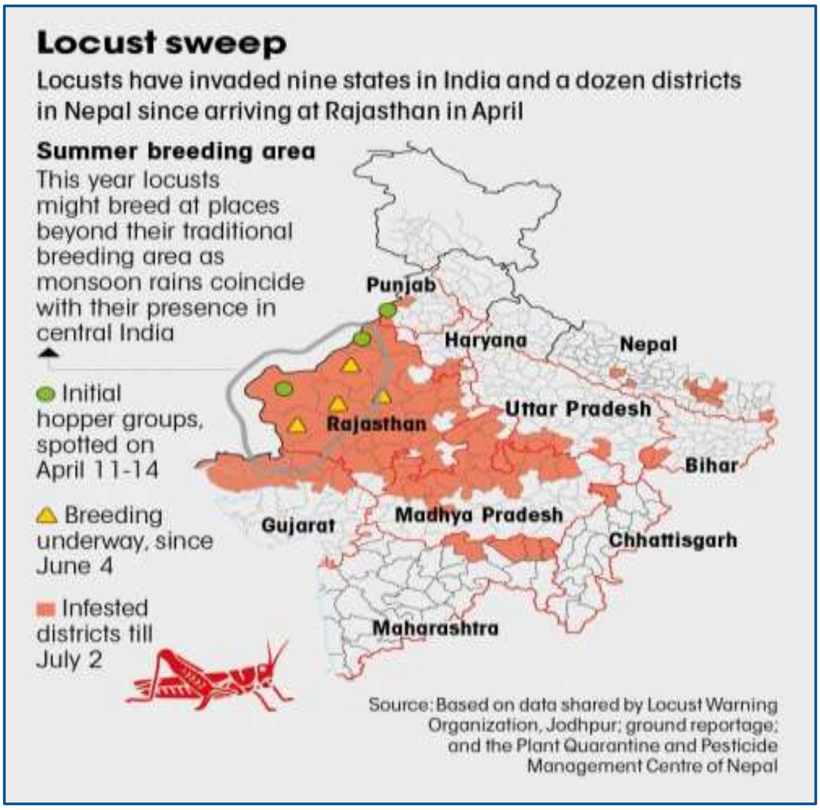
the primary method of controlling Desert Locust swarms and hopper bands is with mainly organophosphate chemicals applied in small concentrated doses (referred to as ultra-low volume (ULV) formulation) by vehicle-mounted and aerial sprayers and to a lesser extent by knapsack and hand-held sprayers. In India, after hungry swarms crossed into the state of Rajasthan, officials mounted pesticide sprayers on hundreds of tractors in an effort to save farms. In a single day, a modestly sized swarm can eat as much food as 35,000 people and travel more than 100 miles.





Source: Plant Quarantine & Pesticide Management Centre of Nepal

The Covid-19 pandemic is posing fresh challenges for some 100 odd workers who are battling the insects, using vehicle-mounted sprayers, pesticides and drones in the searing desert heat. They are staying in the villages, where they are being given foods by locals, and going out at night to hunt down the insects in face masks and wearing some basic protective clothing. Locusts are migratory, transboundary pests. The locusts are in your field for a morning, and by midday, there's hardly anything left in your field," he says. "It's just eaten. Source: (UN FAO).

Conclusion

The desert locust is the world's most dangerous migratory pest with a voracious appetite unmatched in the insect world. Within the desert locust's range, which is equivalent to 20% of the earth's land surface, the insects annually reproduce, concentrate and then form swarms that can move up to 150 kilometers per day in search of food. These swarms are able to migrate across long distances, and can even jump from continent to continent. A single desert locust swarm the size of Brussels could consume Belgium's entire food supply in a single day. To find insect infestations, these teams rely on their own knowledge as well as on information from nomads. This knowledge is combined with up-to-date satellite imagery indicating rainfall and green vegetation, allowing the teams to identify potential breeding sites and growing locust infestations.

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Boosting Your Immune System to Beat COVID – 19: Herbs & Spices

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KEEP YOUR IMMUNE SYSTEM TO BE STRONG

Introduction

Today scenario the whole world id fighting against COVID 19, it is necessary to take extra precautions to keep yourself protected from getting infected. This is why you need a healthy and strong immune system. Strong immunity plays a vital role in keeping the disease-causing virus and bacteria away from you and reduce the risk of falling sick. People with compromised immunity often get sick and even their symptoms are more severe as compared to others. There are different ways to improve your immune system, making your body ready to fight any foreign pathogens. You can do it by making some lifestyle changes or by including some immunity-boosting food items in your diet. In this article, we will tell you 8 herbs and seeds you can have at this time to stay healthy.

Strengthen Your Immune System

Desert locusts *(Schistocerca gregaria)* are a short-horned grasshopper species. The FAO deems them the most dangerous migratory pests in the world due to their ability to change behavior and form swarms that consume everything in their path. These swarms prefer arid or semi-arid areas for egg-laying and nymph development.

During periods of low density, the locust inhabits a broad belt of arid and semi-arid land which stretches from the Atlantic Ocean to northwest India, spanning 16 million square km in 30 countries. However, as locust density rises, crowding releases serotonin, promoting rapid movement and a varied diet, spawning mass migration. The migration area of desert locust covers about 30 million square km in nearly 64 countries, including parts of the Indian subcontinent.

Locusts are voracious feeders, eating up to their body weight daily. They damage crops by devouring all parts of the plants and also by breaking trees by their sheer weight when they settle down in masses. These insects can fly up to 150 km daily. One square km of a locust swarm contains up to 80,000 adults that, each day, consume the equivalent of food for 35,000 people. According to the FAO, a solitary female lays about 95-158 eggs. Up to 1000 eggs have been found in a single square meter.

Locust Sighted in India

COVID - 19 outbreak, many people are concerned about staying healthy and maintaining a healthy immune system. The benefit of our body defenses against viruses, bacteria, and other pathogens. Chronic stress depresses the immune system and increases the risk of several types of illnesses. Being stressed out leads to increased levels of suppressor T cells, which suppress the immune system. When this branch of the immune system is impaired, you are more susceptible to viral illnesses including respiratory conditions like colds, flu, and the novel coronavirus infection. Stress leads to the release of histamine, a molecule involved in allergies. Combat stress with strategies like deep breathing, meditation, exercise, and relaxation.

Some of the Herbs and Spices that Increase Immune System

1. **Ginger**
2. **Fenugreek**
3. **Turmeric**
4. **Garlic**
5. **Cinnamon**
6. **Cardamom**
7. **Black Cumin**
8. **Neem**
9. **Tulsi**
10. **Moringa**

COVID – 19 or Coronavirus was declared as a global pandemic by WHO and while the countries are grappling with imminent dangers that this virus poses to humanity, there are few key measures that individuals can take to fight this pandemic. In this pandemic, there's been a lot of interesting ways to strengthen one's immune system. Immunity cannot be built up in a day, that eating a well-balanced diet and being physically and mentally active is usually enough to keep your immune system in good health.

Ginger

It's anti – inflammatory, antifungal, and anti - cancer properties. In traditional medicine, ginger has been extensively used for curing cold and cough, asthma, travel sickness and even depression. Consume it as ginger tea, which involves crushing ginger and boiling it with tea leaves and water. Ginger has been an age-old remedy for flu and the common cold. It can also be effective against COVID-19. It contains gingerol – an antioxidant that can power up our immune system and kill viruses. Ginger is particularly good in preventing respiratory tract infections.

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Fenugreek

Fenugreek naturally an antioxidant and strengthens immune system. It is not only used as an herb dried or fresh leaves, spice but also as a condiment in artificial flavoring of maple syrup or in the production of steroids. It is rich in vitamin E. While fenugreek fiber can be used to cure constipation.

Turmeric

It contains a bioactive compound known as curcumin, which acts as an anti - inflammatory agent. Every time your grandmother said you need to consume turmeric for your health, she was right. Turmeric contains curcumin- a phytochemical that can remove toxins from your body and strengthen your immune system to fight off germs and bacteria. Add an extra dash of turmeric to your meals or consume it with milk.

Garlic

Just like ginger, garlic too will protect you from coronavirus by stimulating your immunity. It contains allicin- a plant compound that acts as a germicide. But remember, to make the most of garlic, consume it raw or partially cooked. It has potent anti – oxidant properties, and helps in reducing stress and high blood pressure.

Cinnamon

This spice is a great source of antioxidants. Cinnamon flavors every fall treat, but it can also help you fight off those fall colds as an immune stimulator. Plus, it prevents blood platelet clumping, inhibits inflammatory substances, and can regulate blood sugar. This spice also has antibacterial properties that can help prevent nausea. Ginger also contains antimicrobial compounds that allow it to help in treating infectious diseases.

Cardamom

The antioxidant compounds in cardamom may help protect cells from damage and slow down and prevent inflammation in your body. The presence of vitamin C, an essential antioxidant, helps improve blood circulation throughout the body. The seeds of the black cardamom have antiseptic and anti-bacterial properties that protect against infections, further boosting the immunity system.

Black Cumin

Black cumin extracts can keep you safe from a range of viruses and bacteria that attack your immune system. Both black cumin seeds and oil act as antioxidants and help flush out free radicals that weaken your immunity.

Neem

Neem has been respected and widely used as an immunity booster. It is very effective in keeping the body safe from attacks by harmful pathogens, thanks to its anti-viral, anti-bacterial and anti-fungal properties. Neem can also keep your blood clean. It purifies the blood by flushing away toxins and this can strengthen immunity.

Moringa

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Moringa is an herb that can ward off many health complications. Moringa such a powerful immunity booster, it contains 7 times more Vitamin C than even oranges. Vitamin C is the chief nutrient that our bodies need to build strong immunity. Moringa also contains some other vital nutrients that strengthen your cells, muscles, tissues and help your body heal. Consume moringa for its high levels of potassium, iron, calcium and amino acids.

Conclusion

In present situation natural ingredients help to boost our immunity, since older day's herbs and spices were well known for their medicinal properties, with over 80 spices grown in different parts of the world, particularly in Asia. India is home to several spices that are used extensively in traditional medicine. The immune system is a complex network of cells and proteins that defends the body against infection. The immune system keeps a record of every germ (microbe) it has ever defeated so it can recognize and destroy the microbe quickly if it enters the body again.it is necessary to take extra precautions to keep yourself protected from getting infected. This is why you need a healthy and strong immune system. Strong immunity plays a vital role in keeping the disease-causing virus and bacteria away from you and reduce the risk of falling sick. People with compromised immunity often get sick and even their symptoms are more severe as compared to others.

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Green Manuring to Improve Soil Health and Crop Production

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The green manuring is a better option to meet out the requirement of essential nutrients to crops and sustain the soil fertility. To maintain the soil fertility on sustainable basis, green manuring is found equally good as farm yard manure. Green manuring is the process of turning green plants into the soil either by raising them in same field or plants grown elsewhere at the green stage before flowering and incorporated into the soil. Green manure crops have the ability to absorb nutrients from deeper layers of the soil and leave them in surface when ploughed. Thus, green manuring helps improving nitrogen, organic carbon and overall soil fertility status and consequently crop yields. Moreover, it improves soil physical properties by making soil porous and aerated. Green manuring also improves beneficial microbes in the soil. Thus, green manuring improves overall soil physical, chemical and biological properties. Beside above benefits, sandy soils where iron deficiency oftenly appears, green manuring helps in ameliorating that deficiency. Generally, legume crops such as sun hemp, sesbania, sweet clovers, guar, cowpeas, lupins, vetches, alfalfa, soybeans, etc. are preferred for green manuring purpose as they have ability to fix atmospheric nitrogen (*presence of Rhizobium in root nodules*) and add it into the soil. However, non-legumes such as buckwheat, mustard, etc. could also be utilised for green manure purpose as they have leafier portion, ability to grow faster and also enrich soils by adding organic matter. Thus, green manure crop besides improving soil fertility status also saves expenditure on costly fertilizer inputs especially urea.

Green manuring is generally divided into two groups i.e. *in-situ* and *ex-situ* green manuring. In the *in-situ* method, green manure crops are grown in a field prior to main crop cultivation and ploughed/buried back in the same field with help of disc harrow or rotavator at recommended/suitable stage. For *in-situ* green manuring, generally legumes are preferred because of their ability to fix nitrogen. Sunhemp (*Crotalaria juncea*), Sesbania (Dhaincha), cowpea, green gram, clovers, lentils, cluster bean etc. are commonly used for *in-situ* purpose. whereas, in *ex-situ* method, green tender foliages of the shrub and herbs that are usually grown along the boundaries of the farm and along the main bunds of the fields are collected and incorporated in the existing crop field. *Azadiracta indica, Pungamia pinnata, Glyricidia sp, Thespesia populina, Cassia seamia, etc.* are commonly used for *ex-situ* purpose.

Characteristics of Green Manure Crops

The green manure crop should possess following characters:

1. Short duration, fast growing, tender and high nutrient accumulation ability.
2. Should produce succulent tops and have high biomass production.
3. Should have deeper root system so that it could mobilize nutrients from deeper layers.
4. Should contain sufficient root nodules (as it bears Rhizobium) to fix greater amount of atmospheric nitrogen.
5. Should highly efficient in water use and have wider ecological adaptability.

Sowing Time of Green Manure Crop (In-Situ Purpose)

The green manure crop is ready to plough back/incorporate in the field within 45-60 days, so it should be sown accordingly 45-60 days before sowing of main crop. In states like Punjab and Haryana, its sowing could be done in first week of May after harvesting of wheat crop. In other states under irrigated condition, it could be sown 15-20 days prior to onset of monsoon, whereas under un-irrigated conditions its sowing could be done immediately after onset of monsoon.

Agronomic Practices for Green Manure Crop

A seedbed for green manure crop should be prepared using standard techniques by loosening the soil to a fine seed bed. Green manure crops could be sown by broadcasting and drilling method. The seed rate for different green manure crops is given below:

Green manure crop	Seed rate ha-1
Sun hemp	45-50
Sesbania	45-50
Cowpea	25-30
Berseem	20-25
Lucerne	15-20

For the good germination, soak the seed of sun hemp and sesbania for 8 hrs in water. Inoculate the seed with *Rhizobium* culture followed by drying in shade for 30 mins before sowing. The fertilizers should be added on the basis of soil test in green manure crop or apply 20-25 kg N (40-50 kg urea) and 40-50 kg P_2O_5 (250-300 kg SSP) per hectare. If there is deficiency of potassium in soil then add 20-25 kg K_2O (35-40 kg MOP) per hectare.

Ploughing / Incorporation of Green Manure Crop in Field

Effective incorporation of the green manure crop is as important as growing of the crop. It is important that the green manure has not become too mature and woody at the time of incorporation. As discussed earlier, 45-60 days green manure crop is ready to plough back in the field. It is recommended to plough/incorporate the green manure crop in field one day prior to transplanting of paddy crop and 10 days before sowing of maize crop with the help of disc harrow or rotavator. One can save 135-140 kg urea ha^{-1} by cultivating green manure crop prior to sowing of main crop. If farmers want to sow basmati crop after green manuring than there is no need to apply urea absolutely to basmati, if they are interested to raise paddy then apply urea @ 125-130 kg ha^{-1} only.

Advantages of Green Manuring

1. Lower fertilizer N requirements for succeeding crops as they have ability to fix atmospheric nitrogen that reduce the expenditure on fertilizer like urea.
2. Green manuring not only improves nitrogen and carbon status of soil but also make soil porous, improve soil structure, increase aeration and water holding capacity.
3. Increase solubility of certain elements such as phosphate, trace-element, etc., by producing organic acids during decomposition. Green manuring also prevents leaching of nutrient to lower layers.
4. Green manuring enhance soil microbial population that accelerate the decomposition and mineralization process in soil and in turn improve soil fertility and crop production.
5. Green manuring helps in ameliorating Fe deficiency in sandy soils.

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Deep Water Rice

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Rice *(Oryza sativa)* belongs to family Poaceae, is one of the leading food crops in the world. It is a staple food of half of the world's population, mostly in Asia. It provides 20% of the per capita energy, and 13% of the protein consumed worldwide. Rice is known as a semi-aquatic plant and can be grows in a wide range of soil and water regimes. There are mostly five agro-ecosystem of rice: irrigated lowland, irrigated upland, rainfed lowland, rainfed upland and deep water/ flood prone.

Water is very essential for all life, and living being. However, in excess it also causes the great damage. Generally, rice (Oryza sativa L.) cultivars are grown in dry or irrigated areas, and are comparatively tolerant to water as compared to other cereals crops, such as maize and wheat. However, it does not have complete tolerance to flooding. If it is submerged or flooded completely for long periods, plants may lead to death due to oxygen starvation and energy depletion. Flooding levels may vary, depending on the amount and duration of rain, underlying geological formations and distance from the water bodies.

The vast region of Kushinagar situated in the agroclimatic zone of middle Gangetic plain region of India which receives a normal annual rainfall of 1145.1mm in 72 number of rainy days. District receives a rainfall of 988 mm during the south west monsoon season. But the landforms, non-uniform distribution and heavy rainfall during southwest monsoon season (June to September) and congestion of drainage channels aggravate the problems of waterlogging in this area. This waterlogging situation is rainfall dependant, seasonal and remain submerged for about 3 months (July-September) under varying water depths from 0.5 m to 2.0 m. At the end of the rainy season when drainage channels become empty, the accumulated surface water starts to recede and the lands become dry from December onwards. In the waterlogged areas most of the farmers grow rice during rainy season under rainfed condition but success of getting profit depends on the distribution and amount of monsoon rain, and the depth of flooding / waterlogging. Erratic / early heavy rainfall, results in sudden waterlogging in the rice fields and submerges the crop at early seedling stage of crop growth.

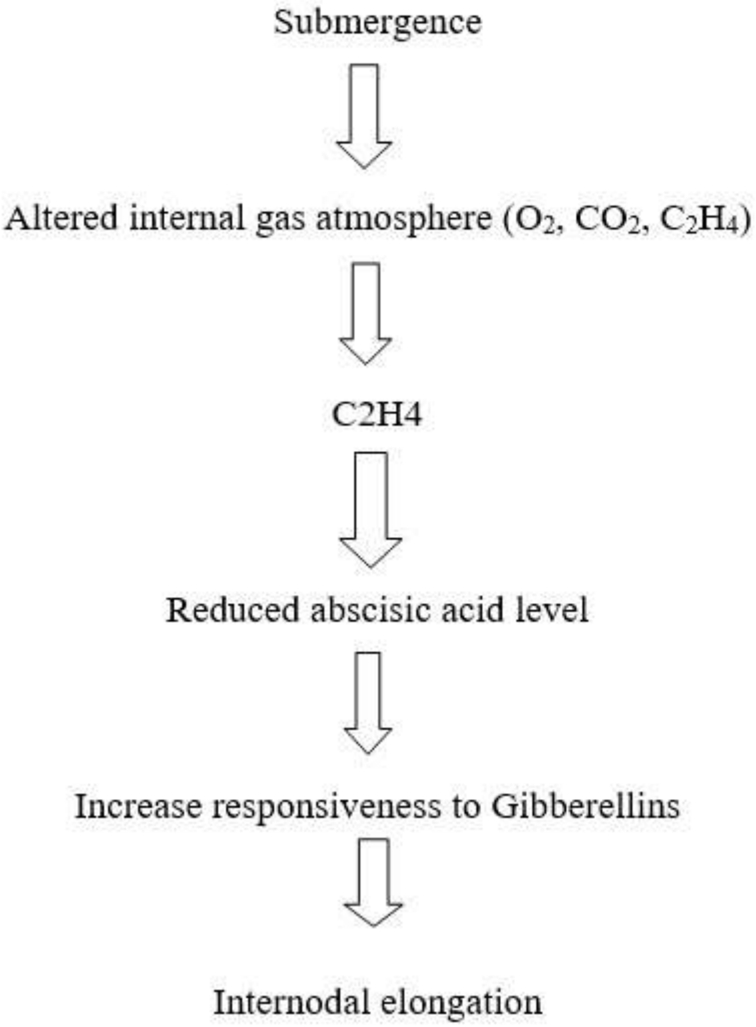
Cultivation of Deep-Water Rice

Normal lowland rice varieties fail to grow successfully in deep-water ecosystem (0.5-2.5 m depth). Prolonged waterlogging for most part of the crop growth reduces the tillering ability and normal growth of the rice crop. To overcome that problem, DWR varieties should be introduced in these areas. These are the varieties of rice (Oryza sativa) grown in flooded conditions with water more than 50 cm (20 in) deep for a, minimum of one month during the crop growth.

In other words, "Deepwater" are of those areas with depth of flooding of more than 1 m during the peak of the monsoon season and "intermediate deep-water" areas are of land with flooding depth of 30 to 100 cm (Huke and Huke, 1997). Deep water rice faces drought in the early growth stages to a deeply flooded condition with variable flooding patterns during the rest of the growth cycle. The deep-water rice produces basal tillers when grows under rainfed dry land conditions for about 1-1.5 months before the onset of flood. With inundation, the plant acts as an emergent microphyte and grows in an aquatic environment for the rest of 3-4 months of its life.

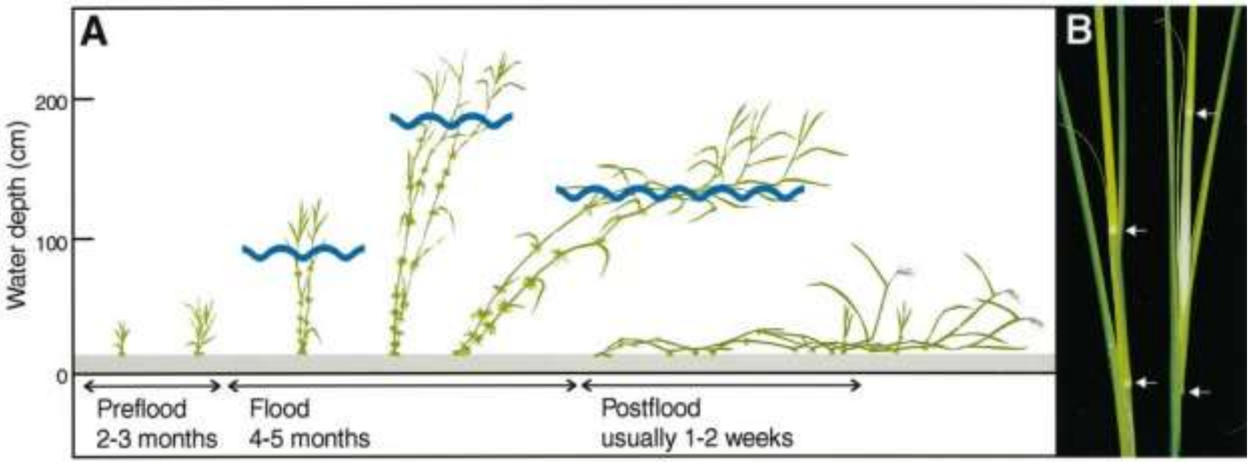
Nodal roots absorb N, P and probably other nutrients from floodwater. Partial submergence stimulated the elongation of stem by; cell division and elongation of cells in the control of two complementary genes. The growth response is induced by environmental signal and is controlled by three interacting hormones, namely ethylene, ABA, and GA. Internodal elongation is based on the increased cell-division and cell elongation in well-delineated zones of the internode. Also, the unusually high growth rates magnify the growth-related cellular, physiological, biochemical, and molecular processes.

There are two types of flooding: Flash flooding, which results in rapid ascending of water levels with submergence for 1-2 weeks. This could result in substantial reduction in stand establishment. 2. Second type is deep-water and floating rice where depth of water exceeds 100 cm and remains at these depths for several months. In kushinagar mostly this type of flooding occurs. Plants may become completely submerged for a long period if flooding is severe. To keep pace with the increasing water levels and escape complete submergence elongation ability of leaves and internodes are essential. Floating rice is grown in 100 cm or deeper situations through advanced elongation ability. This means when a field where rice is growing floods, accelerated growth in the internodal of the stem allows the plant to keep some of its foliage on top of the water. The stems are hollow and this allows gas to be exchanged between the plant and the atmosphere. Once the flooding ends the plant is left lying on the ground. The nodes at the top of the plant then start growing upwards towards due to gravitropic sensitivity (Hans Kende et al., 1998). Almost all the deep-water cultivars are strongly photoperiod sensitive. Photosensitivity fixes flowering time at a favorable point in the flooding period, enables the plant to escape the adverse effect, of low temperature in the reproductive phase, and usually ensures crop maturity as soon as floods have receded. The panicle is often waned, spreading type, and seeds are prone to shatter. Seeds have dormancy period lasting for several weeks. Stem may reach 5-6 m in very deep-water (3-4 m) situations. Deepwater (floating) rice has three special adaptations: (i) ability to elongate with the rise of water levels; (ii) develop nodal tillers and roots from the upper nodes in the water; and (iii) the upward bending of the terminal part of the plant called 'kneeing' that keeps the reproductive parts above the water as the flood subsides.



During March-April deep-water rice varieties are usually seeded dry in the field following the first monsoon shower. Farmers can also establish deep-water rice by transplanting of seedlings. Until the onset of flooding in June/July, the crop depends on rain. Very little fertilizer is used and weeds are controlled by harrowing and hand weeding, twice before flood. Crop matures between mid-October and mid-December, depending on the degree of photoperiod sensitivity of the cultivars.

The plant population usually varies to the highest of 200-400 stems per sq. m at the maximum tillering stage in the pre-flood period. During flooding period, some stems may be damaged by submergence and pest attack. Grain production tends to increase with the increase in biomass up to 12 m tons/ha (dry weight). The harvest index typically, varies from 0.12 to 0.16 and tends to increase in shallow water situation. Heaviest panicles are borne on the main tillers followed by basal tillers, and lightest panicles by nodal tiller. Panicle density usually varies between 50 and 120 per sq. m. Average grain yields are 2.3 mtons/ha and some cultivars have the potential of producing yields more than 3.0 m tons/ha.



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Immuno-Diagnostic Methods for Detection and Identification of Seed Borne Pathogens

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Introduction

Food losses due to crop infections caused by different pathogens such as bacteria, viruses and fungi are permanent issues in agriculture for centuries across the globe. The timely detection and appropriate identification of casual agents associated with diseases of crop plants or seeds are considered to be the most important issue in formulating the management strategies.

Seed health testing to detect seed-borne pathogens is an important step in the management of crop diseases. Specificity, sensitivity, speed, simplicity, cost-effectiveness and reliability are the main requirements for the selection of seed health test methods. Examples of frequently used seed assays include visual examination, selective media, seedling grow-out and serological assays which, while appropriate for some pathogens, often display inadequate levels of sensitivity, specificity and accuracy.

Polymerase chain reaction (PCR) has emerged as a tool for the detection of microorganisms from diverse environments. Thus far, it is clear that nucleic acid-based detection protocols exhibit higher level of sensitivity than conventional methods. Unfortunately, PCR-based seed tests require the extraction of PCR-quality DNA from target pathogens in backgrounds of saprophytic organisms and inhibitory seed-derived compounds. The inability to efficiently extract PCR-quality DNA from seeds has restricted the acceptance and application of PCR for the detection of seed-borne pathogens.

To overcome these limitations, several modified PCR protocols have been developed including selective target colony enrichment followed by PCR (Bio-PCR). These techniques seek to selectively concentrate or increase target organism populations to enhance detection and have been successfully applied for detecting fungi in seed.

Ultimately, improved protocols based upon PCR, ELISA, etc. will be available for the detection of all seed-borne pathogens and may supersede conventional detection methods. This chapter provides a comprehensive overview of modern tools used for the early detection and identification of seed-borne fungal pathogens.

Immunodiagnostic Methods

Mainly it includes:

1. Micro-titre ELISA.
2. PCR based seed detection assays.
3. DNA microarray technology.

Micro-Titre ELISA

Serological seed methods depend on antibodies (polyclonal or monoclonal) generated against unique antigens on the surfaces of plant pathogens. Antibodies bind strongly and specifically to their antigens and can subsequently be detected by the enzymatic digestion of substrates or fluorescent tags.

This method does not require pure isolations of the pathogen and, hence, are applicable to biotrophic and necrotrophic seedborne pathogens. Serology has also been widely used for the detection of bacterial and fungal plant pathogens, but the unavailability of species-specific antibodies is a limitation.

PCR Based Detection Method

PCR consists in vitro enzymatic amplification of an initial quantity of target DNA and, due to its specificity, speed and sensitivity; it has been used in the diagnosis of many seed borne pathogens. Which mainly includes – Bio PCR, Immuno-magnetic Separation and PCR (IMS-PCR), Magnetic Capture Hybridization and PCR (MCH-PCR), real time PCR.

Bio-PCR

Bio-PCR consists of the preventive growth of target pathogens on selective media and their selective increase, relative to non-target microorganisms, followed by DNA extraction and amplification by PCR. In Bio-PCR there is no need to identify the pathogen based on its colony since specific PCR primers are used.

Different plant pathogens eg. Ex. Pseudomonas syringae pv. *Phaseolicola, Acidovorax avenae* spp. *Avenae, Xanthomonas oryzae* pv. Oryzae can be detected by Bio-PCR method. Major disadvantage of this method is that it cannot be used for obligate pathogens as they cannot be cultured in artificial media. Secondly this method requires a well-defined selective media for pathogen culturing which makes it time consuming procedure.

Immunomagnetic Separation and PCR (IMS-PCR)

Immunomagnetic separation refers to the use of microscopic magnetic beads (IMBs) coated with antibodies produced against a specific microorganism, to selectively seize target cells from suspensions containing heterogenous cell mixtures. Captured cells can then be incubated on selective media in order to increase the amount of the target pathogen or, alternatively, they could be used directly for DNA extraction and PCR run. Though IMS-PCR is more efficient and sensitive than conventional PCR but it depends on specific antibodies which may not be always available. More-over, due to the difficulty of beads for capturing cells of filamentous fungi, it can be successfully used for bacteria only.

Magnetic Capture Hybridization and PCR (MCH-PCR)

Magnetic capture hybridization and polymerase chain reaction is similar in format to IMS-PCR. The techniques differ however, in that MCH-PCR uses single stranded DNA probes to capture and concentrate specific DNA fragments that can then be used as templates for PCR. MCH-PCR is a relatively new technique, first described in 1995 for the detection of *Pseudomonas fluorescens* in nonsterile soil. This technique has been used to detect fungi, bacteria and viruses in materials containing PCR inhibitory compounds. This technique is rapid and able to overcome the inhibitory effects of seed compounds but it also cannot distinguish between viable and non-viable cells.

Real Time PCR

This method consists of coupling DNA amplification with fluorescence substances which can be easily measured, giving an indirect measurement of DNA amplification. Real time PCR has the possibility of quantifying a certain pathogen in a seed lot. Beside this, there is no need for electrophoresis as all the process is completed inside the same machine. Though it is efficient and rapid in comparison to conventional PCR but still quite expensive.

As compared to conventional PCR, real-time PCR has several key advantages that potentially make it more acceptable for use in routine seed testing. These include:

1. Rapid cycling which reduces DNA amplification time significantly.
2. Completion of PCR in a closed system which reduces the risk of cross-contamination i.e. DNA amplification and subsequent DNA detection is accomplished in the same tube.
3. There is no need for time consuming post-PCR electrophoresis to determine PCR results.
4. The use of different dyes and probes can allow for multiplex PCR, by which multiple pathogens can be detected in the same reaction.
5. Real-time PCR can allow quantification of template DNA which may be of use in determining levels of seed infestation.

DNA Chip (Microarray) Technology

In DNA chip technology, a large number of oligo nucleotides are positioned on a small glass or silica surface (chip). Target pathogen DNA is digested into small fragments which are labelled with fluorescent markers and hybridized with oligo nucleotides on the DNA chip. The presence of fluorescence indicates the presence of the pathogen of interest is present in the chip. DNA chip technology has a possibility of detecting more pathogens at the same time in a low completion time.

Conclusion

Nucleic acid-based methods have certain advantages over conventional methods especially in early diagnosis of seedborne fungal pathogens as often, infected seeds appear symptomless. The integration of different methods (traditional and innovative) depending on the particular features of each host-pathogen combination could be conveniently used in order to select only for the advantages, avoiding the limitations of each method.

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Pulses – The Secondary Cereals

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Better economic stability, better environment sustainability along better Health and nutrition are the basis needs of a nation. Crop diversification can improve impact of green revolution in sustainable and ecological manner. For agriculture, cereals play a central role in survival but for nutritional values pulses empower the goal of nutritional health challenges.

Pulses are next to cereals in nutritional as well as economic status of human diet. These edible seeds packed in pods, enriched with protein-fibres belongs to family Fabaceae or Leguminosae. Among cereal based vegetarian diets, pulses have its prominent place due its important chemical constituents that will contribute to healthy and balanced diet. Pulses are cultivated globally, whereas India is largest producer and consumer in the world. Major pulses which are cultivated in India are Chickpea (*Cicer arietinum*), Pigeonpea (*Cajanus cajan*), Greengram (*Vigna radiate*), Blackgram (*Vigna mungo*), Lentil (*Lens culinaris*) and Field pea (*Pisum sativum*) (Basu *et. al.,* 2016). But, due to climate changing patterns, nutritional quality decreases and arising the problem of malnutrition. Malnutrition is a big challenge for developing countries. Due to enriched with nutrients, pulses can be used as an effective tool in alleviating malnutrition problem.

As Nutritional Source

In Agriculture, pulses are always underrated. Also, during period of Green revolution, cereal production was almost tripled than pulses production (FAO 2019). Pulses enriched with many plant-based proteins, amino acid, minerals and other vital nutrients. As pulses like pea and fabacean contain higher protein content than cereals, it can be replaced on non-vegetarian diet. If pea plant is included in diet, then it can increase all the essential amino acids content which further help in improving health status. Having almost negligible fat content, pulses contain essential micronutrients like iron, manganese, zinc, selenium etc. Pulses seeds contain ample amount of starch content and act as potential source of energy. That’s why, pulses are consumed as staple food in countries like Africa, South America and India. Pulses consumption also reduce the carbon footprints which reduce risks of heart problems and maintain body weight. It should be consumed by both adults and children.

Improving Soil Productivity

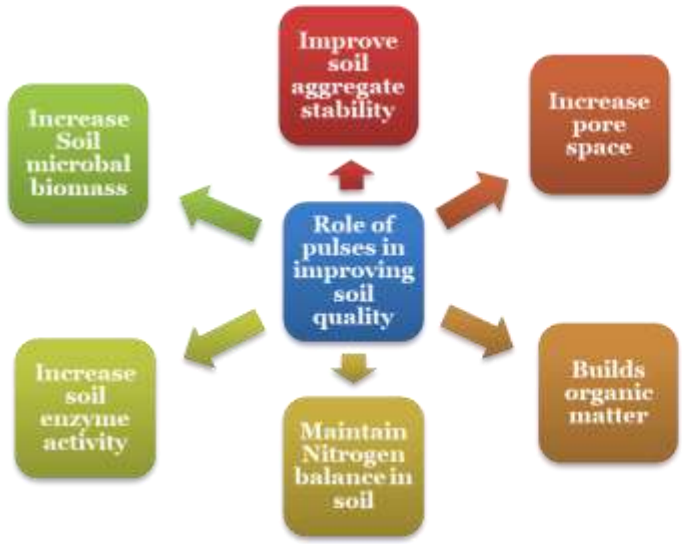

Figure 1 Role of pulses in improving soil quality

For meeting the food demands of rising population, the crop production system, shifting more towards cereal based cropping system. But, in this there is higher input of fertilizers as well as highly nutrient exhaustive. This over exploitation of nutrients leads to poor soil health, decline in water level and other environmental issues. Introduction of pulses in cropping systems can play considerable role in enhancing soil quality. Pulses introduction exploits symbiotic bacteria for nitrogen fixation, that is utilized by subsequent crop, increasing its yield. The major benefits provided by pulses are shown in Figure 1.

As with pulses the soil aggregation stability increases, the main reason is production of protein named 'glomalin' by the roots. As it is insoluble and sticky in nature and serves as 'glue' which bind soil particles. Due to aggregation, pore space increase which further reduce soil erosion and crusting. Another advantage of soil aggregation is that microbial activities increase, which effectively decompose organic matter and mineralized nutrients present in the soil. These soil aggregates act as fertilizer pellets which slowly provide nutrition to growing crop. Leaf litter of pulses also contributes in organic matter composition of soil (Ganeshamurthy et. al., 2006).

Mostly pulses have deep root system which penetrate deeply into soil. Due to nitrogen rich roots, it promotes activities of earthworm and helps in improving soil quality. It also reduces the concentration of N2O gas by fixing atmospheric nitrogen. Dinesh et. al., (2000) also reported that residue of this crop also increases soil enzymatic activity like activity of amylase, cellulase, β-glucosidase etc. Recent literature also concluded that organic acid which is released from roots of pulses help in mobilizing the unavailable nutrients in soil (Kumar and Yadav, 2018).

In Mitigating Climate Change

As food quality, food production and climate change are intrinsically linked with each other. Changing climatic conditions, effects not only average yield but also reduce the nutritional quality that ultimately affect the health and economic status of country. Inclusion of pulses into cropping systems can increase adaptive potential of plants during adverse climatic conditions.

Three major approaches by which climate change mitigation can be done by:
1. Decreasing the use of fertilizers in agricultural lands.
2. Sequestration of carbon in the soil.
3. Decreasing the fossil energy inputs in the system.

Forage plants also contribute in climate changes either directly or indirectly by emitting greenhouse gases. Methane and Nitrous oxide are major gases which play role in warming effect. Cultivation of pulses as forage crops help in reducing greenhouse gas emission which may be attributed to presence of tannins, lower fiber content, higher dry matter intake and very fast passage rate (Beauchemin et. al., 2008).

Conclusion and Future Perspectives

Pulses reduce price volatility, high output return to farmers and sustain their economy. These maintain promising protein source via controlling health benefits such as blood sugar level, lower cholesterol level and reduce risks of heart arrest. Pulses have great potential in reducing malnutrition level, improving soil health and mitigating the climate change effect.

Pulses are climate smart as it simultaneously adapts to climate change as well as play key role in mitigating the adverse effects of climate change. Pulses have broad genetic diversity, from which elite varieties can be selected. By this method, crop resilience varieties can be developed. Due to multiple benefits, introduction of pulses in cropping system enhance resource use efficiency as well as livelihood security. Hence, more emphasis should be given on policy initiatives for bringing more area under pulse production.

To rethink the equation of crop water availability, pulses are imperative for food security with less input cost (water and fertilizer) and high market price. For the countries, where every drop of water is hope pulses provide better opportunity for health of human being as well as for health of our planet.

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Preservation Techniques of Green Fodder

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Introduction

Green fodder is an important source of Vitamin A which is present in the form of Carotene. About 1 kg of green grass provides around 50 mg of Vitamin A and 15 to 20 g of protein to the animal. These green fodder acts as source of energy, protein and vitamins for ruminant animals. Due to lack of availability of green fodder in all seasons, they can be preserved and used for feeding of livestock. Two methods are available for preservation of seasonal excess of green fodder. They are hay making and silage making.

Silage

The conservation of green fodders under anaerobic conditions in the green form is called silage and the conserved green fodder is called as Silage. The surplus green fodder can be preserved as silage and stored upto a period of six months and used for feeding during lean seasons. The excess green fodder that are to be preserved as silage should be cut at the early flowering stage to obtain more nutritious silage. The process of ensiling comprises many steps that should be timed and controlled carefully; to ensure efficient ensiling with minimal losses.

Crops Suited for Ensiling, Stage of Harvesting and Moisture Content

The fodder crops which are rich in soluble carbohydrates such as maize, sorghum, oats, pearl millet and hybrid Napier are most suited for silage making. The quality of silage is determined by the soluble sugar content (8 to 10 %) and dry matter content in the fodder dry matter (30-45 %). All these factors influence the development of lactic acid and other organic acids, which act as preservative. Cereal crops should be cut at 50 per cent flowering stage for silage making. Crops like hybrid Napier grass should be harvested 45 to 50 days after previous cut. The moisture content in the harvested material should be around 60 to 65 per cent. If excess it has to be brought down to 60 to 65 per cent by shade drying or withering by air drying.

It is preferable to enhance the fermentation step to reduce the activity of harmful microorganisms and preserve the silage. Also, exposure of silage to air should be reduced during storage and unloading to sustain the silage quality. Very moist crops with less than 30 % dry matter will lead to nutrient loss and environmental pollution. Hence, they should be wilted to increase the dry matter content to about 35 per cent. If the crop is too dry fermentation will become very slow, fusion is incomplete and spoilage occur by yeasts and molds.

Silage Making

The device or container used to preserve silage is called silo. Permanent structures such as towers, trenches or bunkers that are made by bricks, cement or stainless steel are used as silo. They can also be pits dug in the ground that are coated with cow dung and clay or cement mortar. The types and size differ based on the green fodder availability and farmer's ability. The green fodder that is to be ensiled is packed in the silo either as it is or after fine chopping of about 1 to 2 cm size. Then it is well packed in such a way to prevent the entry of air. The packed material should reach 1 – 2 m above the ground level of the bunker. To make the silo air tight for anaerobic conditions, it should be sealed using any type of insulators like mud, plastic sheets, mud and dung mixture etc., after few days they get compacted leaving open space on the top. Cracks may be seen in case of mud plastering. These cracks should be immediately sealed. After a period of one and half to two months, the silage is ready for feeding of livestock. During this period, it is fermented. Due to the activity of enzymes and bacteria, organic acids like lactic acid, acetic acid, butyric acid, etc., and also ethyl alcohol are formed. The pH is brought down to 4.0. Lactic acid fermentation is important for good quality silage. Presence of more proteinaceous substance in the silage will lead to butyric acid fermentation which is not beneficial.

Nutritional Quality Improvement

The quality of silage can be enhanced by mixing grasses with legumes like cowpea at the concentration of 4:1 or by spraying urea solution at the time of ensiling. The green fodder is mixed with molasses and salt to improve the quality of the silage. Usually 20 kg molasses and 8 kg salt per ton of green fodder is recommended. Additives such as limestone (0.5 to 1.0 %), sodium meta bisulphite, organic acids like propionic and formic acids at 1% level and bacterial cultures like lactobacillus etc. are added to promote lactic acid fermentation and discourage the activity of other organisms.

Characteristics of Good Silage

Good quality silage is greenish yellow or golden yellow in color, bright and moist in appearance with characteristic pleasant aroma. While using the silage, the silo is opened to remove sufficient quantity of silage and immediately made airtight.

Once opened, the silage should be removed and fed daily till it is finished. In addition to that, other characteristics include:

1. Absence of mound growth.
2. Free flowing and non-sticky texture.
3. 3-4% increased palatability.
4. Increased nutritive value.
5. pH around 4.0-4.5.
6. Lactic acid proportionately more than the other acids.
7. Very low Butyric acid in the range of 0.2-0.5%.
8. Decreased nitrate and ammoniacal nitrogen level during ensilage. Generally, ammoniacal nitrogen level should not exceed 9-15 % of the total nitrogen.

Silage made from material with high dry matter content or dried material is called haylage and then prepared form waste material is called wastelage.

Hay Making

Preservation of forages in dry form is called hay making. It is stored forage that is characterized by low moisture content less than 15 %. This means it can be stored unharmed by fermentation and molds. Hay differs from straw or stover in that straw is a byproduct in the dried form while hay is the complete plant in the dried form cut before maturity. Fine stemmed grasses and legumes make good hay. They should be cut at the right stage and properly dried so that hay is leafy, pliable, green in color, free from molds, weeds and dust and has pleasant characteristic smell and aroma.

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Hay making is the most common and easy method of preserving seasonal excess of green fodder and the only method of preserving farm by-products. The principle involved in hay making is to reduce the water content of the herbage so that it can safely be stored in mass without undergoing fermentation or becoming moldy. Legume hay, non-legume hay and mixed hay are the major three types of common hays used in livestock feeding.

Crops Suited for Hay Making

Thin stemmed and more leafy grasses like oats are good for hay making. However, crops like Sorghum and maize are also converted into hay. Most grasses from pastures like *Cenchrus ciliaris, Dicanthium annulatum, Cyanodon dactylon* when properly cut and dried make good hay. Cultivated fodders like hybrid Napier, para grass, guinea grass is not suitable for hay making.

Methods of Hay Making

The common methods of hay making are field curing, mow curing and artificial drying.

Field Methods

Field method of drying in windrows or in swath is commonly practiced. In this method the harvested material occupies one third to half of the field. In windrows, drying is faster than in swath, because of the opening of the stomata in the lower layers.

The harvest has to be taken up after the dew has dried. It should be allowed for curing in the field itself, and turned every 4-5 hours. The moisture content will be reduced in the evening from 75% to 40% and it should be loose heaped in windrows. 1 to 2 turnings should be made the next day. The moisture will be reduced to 25% the next day afternoon provided the sunshine is not interrupted and it can be stored for longer period. The moisture content will be around 20% or less at the end of curing. In field method, around 70-75 sunshine hours is essential for drying.

Characteristics of Good Hay

A good hay is green in color. It is soft and palatable. It will have pleasant aroma and palatability. A good hay is free from dust, mound. The moisture content should not be more than 25 per cent.

Losses in Hay Making

During the process of hay making some nutrients are lost in the curing process. The following are the major losses in haymaking.

1. Nutrient losses due to late cutting.
2. Shattering of leaves and finer parts especially in legumes.
3. Losses in fermentation loss to about 6% of dry matter.
4. Oxidation by sun bleaching leads to loss of chlorophyll and carotene. Carotene content decreases from 150-200 ppm to 5-10 ppm by bleaching. Due to loss of carotene content, there is reduced aroma in the fodder.

5. Leaching leads to loss of protein, nitrogen free extract (NFE), minerals and vitamins, consequently crude fiber increases and digestibility decreases. Water entry in to the plant increases with increased drying. Rain leaching is greater when drying is almost complete compared to lesser-dried materials.

Conclusion

Due to lack of availability of roughages and crop residues the excess green fodder should be preserved for future use. Preservation of green fodder should be done without much loss of nutrients. Thus, conservation of green fodder in the form of silage making not only preserves the green fodder for longer period, it also improves the nutritive value and palatability of the green fodder. Thus, silage and hay making are two important methods of preservation of green fodder and to provide good quality fodder to livestock during lean periods.

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Rice Panicle Mites (*Steneotarsonemus Spinki* Smiley): Farmer's Grief

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Panicle rice mite is a pest of economic importance to field and green house crops of rice, which is a native to Asia. It feeds directly on rice grain and resulting in yield losses of 5-90 per cent. This mite has been a recognized pest of rice throughout the rice growing regions of Asia, since 1970s.

In India, spikelet sterility or grain discoloration was observed in 24 villages that were observed in the West and East Godavari district of Andhra Pradesh in the 1999 wet season. Affected glumes had brownish to black lemmata and palea and shriveled ovaries. Rice plants that had poorly exerted ear heads and necrotic leaf sheaths were found to have panicle rice mites between the stem and the leaf sheath.

Occurrence of Rice Panicle Mite

Steneotarsonemus spinki was first reported from Madagascar Island as *Steneotarsonemus madecassus* Gutierrez (Gutierrez, 1967) and Smiley (1967) reported the same mite from United States of America and identified it as *Steneotarsonemus spinki*.

Steneotarsonemus spinki required 17, 4 and 2.75 days to complete its development from egg to adult stage at 25° c, 28° c and 30° c, respectively. The females were facultative parthenogenetic. Virgin females through arrhenotokous parthenogenesis produced only male progeny that could fertilize their mother and produce both males and females.

Pest Association

In addition to the damage caused by their feeding, the panicle mite is often found in association with plant pathogens including phytopathogenic fungi, *Sarocladium oryzae* (Sawada), *Fusarium graminearum* Schwabe, *F. moniliforme* Sheldon, *Helminthosporium oryzae, Curvularia lunata* (Wakk.) Boed., *Alternaria padwickii* (Ganguly), as well as species in the genera *Pyricularia*, *Rhynchosporium* and *Rhizoctonia;* bacteria, *Burkholderia glumae* (Kurita and Tabei); and Spiroplasma, *Spiroplasma citri* Saglio, while the relationships between these pathogens and the mites is still not fully understood, there is speculation that the mites may serve as vector of one or more of these pathogens.

Identification Marks

Steneotarsonemus spinki are small mites (200-275 µm) with an overall morphology that is clearly typical of the Tarsonemidae. Their color ranges from translucent to pale white and they may exhibit areas of darker, yellowish pigmentation depending on life stage and/or feeding conditions. Males can be easily distinguished as they tend to be slightly smaller than females and possess highly modified hindlegs.

Economic Loss

This mite infests flag leaf sheath causing brown discoloration. Infestation of the mite on panicle causes chaffy grains and also discoloration of filled or ill-filled grains. Feeding of these mites on reproductive parts of flowers results in grain sterility.

Management

1. After harvesting, spread straw to burn before ploughing the field.
2. Use balanced dose of N-P-K Fertilizers
3. Rotation with bean or legume plants to break panicle mite life cycle.
4. Scout fields to know the dynamics of panicle rice mite populations to give effective control methods.
5. Leave the field fallow for two weeks after harvest.
6. Culturing predatory mites, *Phytoseiidae* effectively control the mite populations.
7. Use an insecticide cum acaricides spray such as Nissorun (hexythyazox), kinalux (quinalphos), kumulus (sulphur), comite (propargite) or Danitol-S 50 EC (fenpropathrin). Before spraying, flood the field to make mites move up the plant.

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Estimation of Water Use Efficiency in Crop Plants

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Introduction

Improving water use efficiency (WUE) or enhancing agricultural water productivity is a critical response to growing water scarcity, including the need to leave enough water in rivers and lakes to sustain ecosystems and to meet the growing demands of cities and industries. Water use efficiency (Y/ET) is the final results of a whole suite of plant and environmental approaches working over the existence of a crop to decide Y and ET. Consequently, biomass manufacturing according to unit ET, has been used notably as an intervening time degree of water use efficiency. ET contains non-efficient evaporation(E) of water from the soil floor and efficient transpiration (T) of soil-saved water with the aid of using the plant. Evaporation of loose water from leaf surfaces provides to non-efficient evaporation. The basic equation describing ET distinguishes efficient and non-efficient evaporation is (ET = E + T). In evaluation to ratios of water use efficiency primarily based on ET, the ratios W/T and Y/T do now no longer contain E and so serve to awareness interest on physiological components of water use efficiency.

Evaporation and Evapotranspiration

Seasonal evaporation from plant groups nearly usually exceeds precipitation, so that supplementary water is wanted to attain the complete expression of a crop's genetic potential for yield. In making use of such water to high-quality effect, questions rise as to how crop water loss through evapotranspiration is high-quality estimated, and whether there are soil or plant standards that may be utilized in conjunction with meteorological facts to time table irrigation. An aggregate of things drives evaporation from a loose water floor, specifically sun radiation, wind speed, turbulence and humidity (typically expressed as atmospheric vapour stress deficit, or VPD). Crop vegetation are difficulty to the equal aggregate of driving variables. Their evapotranspiration (ET) consists of soil evaporation + plant transpiration. For gift purposes, ET may be seemed as synonymous with crop water use, and is typically expressed as mm d–1.

Derivation of ET then turns into a crucial issue and may be inferred from direct size of close by evaporation or utility of an aggregate equation that gives an estimate of real ET primarily based totally on climate variables and crop attributes or utility of micro-meteorological strategies along with the Bowen ratio and eddy covariance. The best estimate of real ET for a given crop (ET crop) is predicated on direct size of evaporation from a category A pan (Epan), and alertness of an empirical pan coefficient (Kpc) suitable to that crop, where: ET crop = E pan x K pc. This empirical pan coefficient, Kpc, is derived with the aid of using evaluating measurements of Epan with both direct measurements of water loss from vegetation in weighing lysimeters, or modifications in soil moisture content. Kpc typically stages among 0.2 and 1.3, however does range consistent with species, cover development, soil conditions, topography and atmospheric moisture.

Potential, Reference and Actual Evaporation

In guides on estimation of evaporation, the phrases ability evaporation (or evapotranspiration) and reference evaporation are used. The period ability evaporation becomes at the beginning used to deliver the idea of evaporation that could arise from plant surfaces with none obstacle of water availability or restrict with inside the vapor switch pathway. However, due to canopy architecture, leaf traits and stomatal behavior, unique species evaporate water at unique rates, although all different elements are the same. To estimate the real charge of evaporation (Ea) from a crop or different crop vegetation type, the each day reference crop evaporation value (Er) is modified via way of means of an empirical crop coefficient (Kc): Ea = Er x Kc. Crop coefficients are derived via way of means of measuring Ea, normally with precision weighing lysimeters, and finding the ratio Ea/Er for every increase degree. They range with crop species, degree of phasic development (frequently stronger via way of means of leaf area) and soil water availability.

Direct Measurement of Water Uses by Plants by Lysimeters

Weighing lysimeters include a massive block of soil (from 1 m3 to four hundred m3 of soil) encased in a skinny steel sleeve and base, sitting on a massive precision stability. The stability is positioned underneath the block of soil, every so often several meters beneath the encircling floor so that the pinnacle of the block of soil in the steel sleeve is aligned with the encircling soil floor. Care is needed to keep an undisturbed soil shape in the sleeve and flowers developing at the block of soil need to be as the consultant of the surrounding flowers as possible. This is simple to attain with plants because seed may be sown with inside the lysimeter simply as without problems as with inside the surrounding soil. Measurements on local groups normally contain re-status quo of flowers. High-pleasant lysimeters can locate losses of about 0.01 mm of water, with time decision of an hour or less. Because the flowers in the lysimeter is surrounded through flowers of the equal composition and shape its miles uncovered to a sensible microclimate. Consequently, estimates of water use the use of lysimeters provide a higher degree of prices of water use with inside the field than the ones decided the use of remoted plants.

Soils and Plant-Available Water

Soil contains silica and clay debris in a porous matrix. Depending on packing, and consequently the density of the matrix, there might be a variable void space. Soil with a bulk density of 1.3 (mass in line with unit volume) has approximately a 50% void volume. Water can flow into this void volume, in large part dis-putting any fuelling it contains. If water fills the void volume, the soil is then saturated. Soil water held among field potential and wilting factor defined as being plant-to be had on bodily grounds (Ψ soil is much less bad than Ψ root) isn't always necessarily extractable with the aid of using roots due to spatial separation among soil garage sites and soaking up surfaces on roots. Moreover, now no longer all the water with inside the plant-to be had variety is similar to be had to vegetation. With irrigated crops developing in deep, properly-fertilised, gentle soils leaf extension starts evolved to declines soon as 70–80% of nominally to be had water has been evaporated. During soil drying, vegetation showcases some of the responses. Probably the maximum essential but least properly studied is root increase. Drying in topsoil layers is accompanied with the aid of using growing increase of roots into deeper, wetter layers. Often this increased increase and the water received is sufficient to triumph over the first detectable symptoms and symptoms of coming near water deficit. However, if transpiration call for can't be satisfied with the aid of using root extension, shoot increase is quickly affected. Roots usually develop in voids which gift the least resistance to extension increase. Independent soils, roots are clumped with inside the cracks and large pores round soiled. By and large, roots do now no longer unfold in a homogeneous style thru the soil. Moreover, water inside peds actions simplest slowly to outer surfaces to make touch with roots. Consequently, lots of this water isn't always to be had to vegetation at a rate good way to maintain them from experiencing water deficit. Due to those bodily and organic limitations, crop vegetation typically enjoys drought pressure evenlike though sub-soil water content material appears good enough for persisted increase.

Conclusions

During the remaining 50 years, the unique idea of 'water-use performance' has been substantially improved to include 'crop productiveness or price in line with a drop of water'. In its broadest experience, it pertains to the internet socio-financial and environmental blessings performed via using water in agriculture. The extra generally used the idea of 'water productiveness' and its size at numerous scales is a sturdy degree of the capacity of agricultural structures to convert water into food. Increasing water productiveness is particularly critical in which water is scarce as compared with different sources worried in manufacturing. While water productiveness will increase with growth in water deliver up to a positive point, water deliver additionally improves fertilizer-use performance by growing the provision of implemented nutrients. The complexities of measurements of bodily or financial water productiveness growth because the domain of hobby actions from crop-plant to area, farm, gadget, basin, area and countrywide stage. A critical truth to realize is that the water enters to the area or an agricultural gadget isn't always similar to the water used or depleted for crop manufacturing because the water this is taken into the gadget, however not consumed, is to be had downstream and therefore excluded from the estimation. Besides the traditional methods, using remote-sensing satellite tv for pc information and crop modelling has helped comprehensively map the versions in the basin- or regional-stage water productiveness and perceive the capacity regions for suitable interventions. Development of crop sorts with a better harvest index for the duration of the Green Revolution generation turned into the maximum a hit method to enhance land and water productiveness, however, also will increase have slowed down.

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Ultra-Sensitive and High-Throughput Crispr - A New Rays for Covid-19 Diagnosis

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Introduction

The demand of Crispr technology making a new era to molecular biology, which has been increasingly directed at fighting diseases against genetic ones. However, in recent day it's been tackled to fight infectious diseases, including the new ongoing global pandemic of coronavirus disease. FDA-authorized use of CRISPR technology, have made history with the very first and rapid identification of the virus that causes COVID-19. Rahul Dhanda, co-founder, president and CEO of Sherlock Biosciences said that they are dedicated to providing this initial wave of testing kits to physicians, laboratory experts and researchers worldwide to permit them to assist frontline workers leading the charge against this pandemic". According to the company Sherlock Biosciences the kit has been programming the CRISPR machinery in such a way that it has the ability to return results in about an hour with greater specificity.

Keyword: COVID-19, CRISPR, Mass Testing, Biosensor.

Need of Biosensors for COVID-19 Mass Testing

Most of the clinical laboratories following the molecular diagnostic assays based on quantitative reverse transcription polymerase chain reaction. However, to overpower the testing capacity and paved the path for development of quick point-of-care tests and the acceptance of isothermal DNA amplification method is very much essential for COVID-19 pandemic. Therefore, advanced digital systems are needed to overcome the constraint of antigenic and serological rapid tests and to enhance the performance at the expense of speed and the need for large equipment. The new emerging technologies, CRISPR gene-editing tools make molecular diagnostics with high sensitivity and specificity and the easy use of lateral-flow assays. DNA sequencing and sample pooling strategies are also pointed to bring out the full facility of the available biosensor technologies and accelerate mass testing (Santiago, 2020).

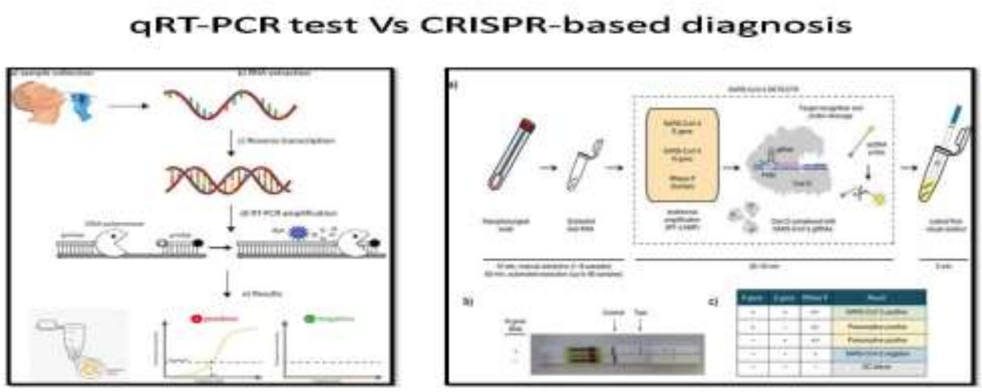

Fig- Showing the difference between qRT-PCR and CRISPR –based Diagnosis with respect to time consumption (Santiago, 2020)

CRISPR Based Diagnosis of COVID-19

In a race of proper diagnosis and tests to detect infectious diseases especially COVID-19, CRISPR-based diagnostics tool plays a vital role as a molecular diagnostic tool which is cheaper and faster than others. For the accurate detection of COVID-19, Mammoth Biosciences and Sherlock Biosciences are using CRISPR based diagnostics as a molecular diagnostic tool, rather than as an editing tool. By using the CRISPR technology developed from Jennifer Doudna's laboratory, Mammoth has created a DNA endonuclease-targeted CRISPR trans reporter (DETECTR) platform to detect multiple coronavirus strains. Feng Zhang and colleagues at the Broad Institute also have developed specific high-sensitivity enzymatic reporter unlocking (SHERLOCK). Now a day, many teams inside and outside of many research institutes is working on the usage of CRISPR for more effective tests. For Covid-19 test, a private company 'Mammoth Biosciences' has developed a test tool which reduces the result time from several hours to only 30 minutes. Another laboratory 'Sherlock Biosciences' has also produced a protocol which is giving a positive signal on a simple test strip like a pregnancy test.

Sherlock and Inspector

The SHERLOCK is stands for Specific High-sensitivity Enzymatic Reporter unLOCKing method. Based on this method, the kit works by programming a CRISPR molecule to detect the presence of a specific genetic signature of SARS-CoV-2 in nasal swab, nasopharyngeal swab, oropharyngeal swab or bronchoalveolar lavage (BAL) specimen. The testing frameworks work by utilizing CRISPR nucleases, programmed to find a defined gene sequence. SHERLOCK uses the proteins Cas13 to cleave and degradation of neighboring ssRNA and activates a fluorescent reporter, while DETECTR uses ssDNA and Cas12a.To find the sequence of interest, the nuclease activates a cleavage capability, which produces a fluorescence signal after cleaving a reporter DNA strand present in the sample. The sequence has been found by the confirmation of the fluorescence signal. Once the signature is found, the CRISPR enzyme is activated and releases a detectable signal. If the virus's genetic material is found, a CRISPR enzyme generates a fluorescent glow. To create an instrument-free, handheld test, the company 'Sherlock Biosciences' is also developing its INSPECTR™ platform which is similar to that of an at-home pregnancy test –that utilizes Sherlock Biosciences' Synthetic Biology platform to provide rapid detection of a genetic match of the SARS-CoV-2 virus.

Pac-Man Tool

To cure the coronavirus disease 2019 (COVID-19) pandemic, induced by the SARS-CoV-2 virus, has ignited the need for antiviral approaches which can aim emerging viruses with no effective vaccines or pharmaceuticals. To deteriorate RNA from SARS-CoV-2 sequences and live influenza A virus (IAV) in human lung epithelial cells effectively recently CRISPR-Cas13-based strategy, PAC-MAN (prophylactic antiviral CRISPR in human cells) tool designed for viral inhibition (Abbott et al., 2020). The mechanism of this techniques screened CRISPR RNAs (crRNAs) targeting conserved viral infected area and recognized functional crRNAs targeting SARS-CoV-2. Advancement of this approach efficiently lowered H1N1 IAV load in epithelial cells respiratory system. A group of only six crRNAs can target more than 90% of all coronaviruses, which was revealed by bioinformatics analysis. With the improvement of a protected and efficient system for respiratory tract delivery, PAC-MAN has the ability to become a significant pan-coronavirus inhibition strategy.

Conclusions

CRISPR-based diagnosis represents a prime example where mixed technologies can lead, combining high specificity and sensitivity with efficient and low-cost biosensors. Direct quantification of viral RNA with CRISPR, without the need for DNA amplification, would reduce the sample-to-answer time significantly.

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Bio-Fumigation for Nematode Management

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Biofumigation

Biofumigation is defined as a process that occurs when volatile compounds with pesticidal properties are released during decomposition of plant materials or animal products. Cruciferous plants belonging to Brassica spp. contain glucosinolate compounds. A number of toxic and volatile products (e.g. thiocyanate, isothiocyanate) are known to be released from these compounds during biodegradation. The gas is produced when plant cells are damaged by crushing or chopping and compounds come into contact with an enzyme called myrosinase in the presence of water and produces D-glucose, isothiocyanate (bio- fumigant) and nitrite.

Plants Used for Bio-Fumigation Process

1. Leaves of Brocoli, cabbage, cauliflower, Radisha, Nemat Argula and caliente mustard.
2. Brocoli and cabbage leaves.
3. *Brassica oleracea*, *B.rapa , B. napus* are the important species of barassica.
4. Caliente mustard blends to tolerate 19. 4 ° F so it is used in late summer and early spring cover crops.
5. Nemat Argula can tolerate colder temperature and glucosinates activity in leaves and roots, the root can contribute glucosinates.
6. Caliente Mustards have been bred specifically for bio-fumigation and green manuring.

Importance of Brassicas

1. Brassicas produce glucosinolates, which can be converted to chemicals with biofumigant activity.
2. In addition to providing some disease control, growing and incorporating the Brassica improves soil structure, assists in weeding, reduces soil erosion and provides organic matter to the organic producer for controlling diseases and pests.
3. Bio fumigant reduced the nematode population of *Meloidogyne. javanica, Heterodera. schachtii, Criconema. xenoplax, Xiphinema* spp.
3. Brassica type hydrolysis and produces the high concentration of volatile Iso- thiocyanate. (Dutta et al., 2019).

Steps Involved in Bio-Fumigation Process

1. The bio-fumigant should be distributed uniformly, the field should be watered, if possible, by sprinkling, until the soil is saturated and cover the soil surface tightly with a transparent plastic film for at least 2 weeks.

2. This is done to retain the volatiles produced from the biodegradation of the organic matter.

3. The film is removed 3-4 weeks after and the soil slightly removed in order to permit the gases to escape from soil. Planting of the desired crop can be done 24 hours later.

4. Crushed cabbage leaves (Brassica oleracea) were incorporated into the soil at different rates (2.5, 5 and 10g per pot), 10 days before transplanting. The crushed leaves at the rate of 5g per pot were mixed with the soil at different interval times (at transplanting, 5 and 10 days before transplanting) for controlling root knot nematode, *M. incognita*.

5. A dose of 50 t / ha is recommended. When nematodes or fungi are very serious, 100 t / ha should be applied and a dose that can be reduced by choosing a cultivation technique such as application in furrows.

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Conclusions

The above methods were used for control the nematodes problems in the field conditions. It can improve the farmers income and yield of the crop.

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Pathogenesis Related Proteins

Article ID: 31538

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Crop plants are under continuous exposure of abiotic and biotic stresses, causing major losses every year. Overall, global production target of 2050 for food crop under the rising population is threatened by the disease-causing agents. The climate change has additive effect on the disease scenario. The discovery of control measures is based on the knowledge and complete understanding of plant diseases. Plants evolve a possible number of defense mechanism to tackle the pathogens where the pathogenesis related (PR) proteins are the potent members. PR proteins are the group of pathogens induced molecules which act in signaling of defense responses. The PR proteins were first time reported from the leaves of tobacco plants having hypersensitive response against the tobacco mosaic virus. They are playing key role in plant immune system mainly for systemic acquired resistance. They act as molecular markers, diagnostically characterized for defense signaling response pathways. They are classified on the basis of their molecular structure and the activities of enzymes into 17 families. Such kind of immunity develops in response PR proteins induce resistance by mean of elicitor-receptor interaction. The elicitor involving synthetic compounds of fungicides and heavy metals of abiotic substances, biologically originated lipids, polysaccharides, proteins and oligosaccharides. Various PR proteins are PR1 proteins (having antifungal and antioomycete property), PR2 proteins (having β-1,3-glucanases activity), PR3 proteins (chitinases activity), PR4 proteins (antifungal activity), PR6 proteins (proteinase inhibition activity), defensins, lysozymes, thionins, osmotin-like proteins, thaumatine-like proteins, cysteine-rich proteins, chitosanases, lipoxygenases, proteinases, glycine-rich proteins, and peroxidases. The PR proteins responds against both biotic and abiotic stresses to provide resistance, hence considered as most potential targets for the development of tolerant varieties. The technology of genetic engineering is most importantly recommended tool using antimicrobial PR genes for developing disease resistant transgenic crop cultivars.

Antifungal Activity

Fungal pathogens are the most effective agents in causing significantly higher agricultural losses in crop plants. Fungal pathogens cause damage by producing cellulases, cutinases, pectinases and proteases to hydrolyse the hard cell wall. PR proteins are one of the excellent targets in agriculture for developing resistance due to their broad spectrum and long-lasting response. PR genes having basal level of transcriptional expression becomes elevated after the fungal infection in the infected part and the whole plant by acquiring systemic acquired resistance. The PR proteins such as PR2, PR3, PR4, PR5 and PR12 act on the fungal cell wall to hydrolyse them.

Antibacterial Activity

PR proteins are the potent weapons to combat against the bacterial pathogen in the bacterial resistant plants. The antibacterial properties of PR proteins such as PR14 (Lipid-transfer protein), PR13 (thionins), PR12 (defensins) and PR10 (Ribonuclease-like proteins) reported from the in-vitro studies. The lipid transfer protein (PR14) showed combined resistant against bacteria and fungi in transgenic rice plants. PR10 are showing antibacterial activity against a number of bacterial species such as *Agrobacterium tumefaciens, A. radiobacter, Pseudomonas syringae, P. aureofaciens* and *Serratia marcescens*.

Anti-Viral Activity

Viruses are the obligatory biotrophic pathogens that hijack the host machinery and suppressing immune responses to affect the health of plants. PR proteins acts as virus repressor and build up in the non-infected organs to blocks the subsequent infection. PR9 protein (peroxidase) is known as potent PR family member bearing antiviral property. PR2a and PR3 having strong antiviral property against Tobacco mosaic virus in

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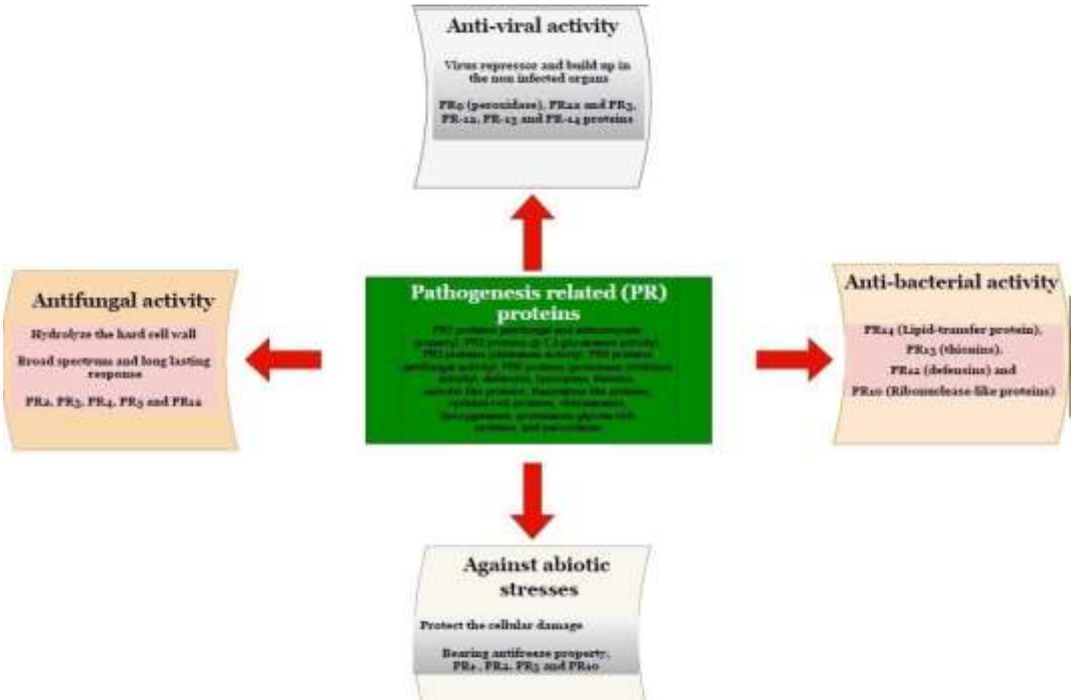
addition to antifungal activity. The Capsicum annuum PR10 protein is displaying ribonucleolytic activity against the TMV. PR-12, PR-13 and PR-14 proteins inhibit the cell-viral fusion and targeting virus envelope to cause pores and leads to viral pathogen lysis. Moreover, the over-expression of PR1b protein in transgenic tobacco plant showed enhanced resistance to TMV.

Against Abiotic Stresses

The exact mode of abiotic stress tolerance by PR proteins is not fully understood, however, the expression of PR genes modulated under abiotic stress. The mRNAs of PR1 (SAR marker gene) shown their higher expression in pepper plant under abiotic stress. The PR2 and PR3 proteins protect the cellular damage under cold condition and also bearing antifreeze property. Similarly, the level of mRNAs of PR4 gene increased under cold, wound and salinity stress. Higher expression of PR10 gene in maize has been observed under the multiple abiotic stresses. PR genes ware reported to be significantly higher under abiotic and biotic stress in *Brassica juncea*. PR genes expression is induced by the activation of transcriptional factors such as drought-induced protein 19, dehydration-responsive element binding proteins and cup-shaped cotyledon.

Conclusions

The research organizations of modern agriculture are working on the stress tolerance with the high pace using PR proteins. The activation property of against multiple stresses gains attraction from the most of the researchers. The transgenic already proven the potential to choose the PR genes and which is fitted day to day with the novel and innovative approaches to add the improved agronomic traits.



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The Burying Beetles; As Well-Known Nutrient Recyclers

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Introduction

The body of a dead animal is a rich, ephemeral and unpredictable source of nutrients for microbial decomposers and detritivore insects. While microorganisms and insects can be considered the main agents of decomposition. Among the insects diptera and coleoptera play an important role in corpse eating. Burying beetles are members of the coleopteran family Silphidae (the carrion beetles) of the genus *Nicrophorus*. Burying beetles are true to their name as they bury the carcasses of small vertebrates such as birds and rodents as a food source for their larvae. Most of these beetles are black with red markings on the elytra (forewings). The tips on the antennae of the beetle are club-like orange colour equipped with chemoreceptors capable of detecting a dead animal from a long distance. In rapid flight, often and abruptly changing direction, the sextons roam through forest and meadow until the wind carries the odour of carrion to them. Immediately the flight will be reduced, the source of odour will be flown around in narrow circles, and finally the beetle will land on it or in close proximity. Burying beetles have an important role as nutrient recyclers in ecosystems and forensic pathologists like to find some species in corpses because they are bio-indicators of time of death, but it is behavioural and evolutionary ecologists that care most about burying beetles.

		
Adult	**Larvae**	**Both adults and larvae foraging on carcass**

Fig.1. The burying beetles; (1) Adult, (2) Larvae and (3) Both adults and larvae foraging on carcass.

Life Cycle of Burying Beetle

Once the rounded carcass with a smooth surface rests in a crypt with strong walls (the performances necessary to reach this state take in total 12-48 hours), the female commences with egg laying while the male continues occasionally with the above-mentioned activities. The eggs of burying beetles are contrary to the common assumption and they not laid on or inside the carcass, but in the soil. Without exception it has been observed in more than 100 cases the eggs of the included species in little earth cavities that show a notable layout. At the end of the embryo development that lasts 5 days, the larvae of the burying beetles hatch. The newly hatched little larvae are white, mobile creatures that move deftly and restlessly with raised antennae, with the help of their six legs and the anal segment that functions as additional pusher. Most of them break through the soil layer that separates the egg chamber from the mother tunnel, follow the path smoothed by the female, and reach in this way in relatively short time the crypt to which they may have been lured by the odor of the carrion and the female. Some individuals also try to reach the food storage on the shortest way directly through the earth, to which they are also enabled. Every little stone is an obstacle to advancement and needs to be circumvented, until the animal falls into the subterranean cavity, once it has broken through the wall of the crypt, immediately it climbs up the carrion ball to its highest point and there reaches in the krater with its siblings, who have been led by the same instinct to the identical location. After 10-11 days the larva moves away from the carcass and pupate. Pupal duration varies from 20-21 days. In most of the nicrophorini, the adult burying beetles live for only 12 months.

Relationship of Beetles with Their Progeny

Just as burying beetles are not very choosy about their own food; they make do with every carrion for the provision for their brood. Nonetheless, the size places a limit both towards the upper and the lower end. Pieces too large cannot be handled by the beetles during burying, while too small ones do not offer sufficient amount of food for the numerous gluttonous larvae. Unable to detach parts of larger carcasses, the beetles have to primarily rely on the carcasses of small vertebrates when caring for their progeny. When a sexually mature burying beetle has found a carcass, it reacts initially in a very specific way; the dead body is climbed, the mandibles sink here and there loosely into the carcass while the maxillae are set into shaking, the antennae into vibrating movements. At least twice the beetle walks in almost perpendicular directions over the carcass. Then, the animal slips under the little body whose light motion indicate the beetle's activity; it lifts the body slightly off the ground. When a beetle has found a carcass that after inspection has been considered suitable, the burying activity will commence. At the beginning the beetle will scratch out some earth from under the carcass. The burying beetle will proceed in a way that it will move with its front legs little soil particles behind it, which the second pair of legs will hand over to the last pair. From there, the strong hind legs kick out the mass from under the carcass. By often repeating this, the little earth wall is created, but which will not go around the dead body like a ring but only partly. Then the beetles move the carcass, it is possible that the animals reach a greater depth in the wild. A carcass buried by *N. humator* is found on average at a depth of 7.4 cm.

Transformation of the Carcass and Building of the Crypt

Rounding of the carcass and the formation of the crypt (brood chamber) are highly linked and result from one and the same activity. For hours together the beetle marches around the buried prey in all possible directions. The feet on the carcass and the back towards the surrounding soil, it pushes the prey constantly away from itself by stretching the highly bent legs. Due to the counter pressure by the soil that offers a rather inflexible resistance both to the back of the beetle and to the opposing side of the carcass, the carcass is strongly compressed and obtains, since the pushes are repeated constantly from all sides, a spherical form as long as the stiff elements of the skeleton do not counteract this. The waste like hairs or feathers accumulates at the bottom of the cavity and is pressed by the sexton against the walls of the brood chamber such that it covers the ground of the crypt like a carpet. This can be observed most perfectly on carcasses that have been buried in soft peat earth that has been freed of all obstacles. In contrast, under the conditions most frequent in the wild, one usually encounters in the crypt only traces of hairs or feathers that the carcass has mainly already lost during its passage through the hard soil.

Protection from Infectious Microbes

When brood ball is buried, there will be intense competition begins among bacterial and fungal decomposers for the resources contained in its body tissue. Numerous studies have also reported that brood balls show little evidence of microbial decay and associated odour (Suzuki, 2001). There are a high number of opportunistic soil-dwelling microorganisms that come in contact with the carcass after it has been buried, and carrion beetles transport a high number of bacterial and fungal species between carrion sources (Berdela et al., 1994). Parental beetles maintain the brood ball by continually covering it with anal and oral secretions suggest that these secretions are antimicrobial (Scott, 1998).

Conclusions

The use of vertebrate carrion is an indispensable part of a burying beetle’s life. But unlike other silphids, which use carrion primarily as an adult food source or somewhere to lay eggs, *Nicrophorus* beetles bury the carcasses. They play a key role in increasing the survivability of offspring’s and reduced the bacterial and fungal infection to carcass by avoiding selection of old corpse and oral secretion of gut microbiota. Anal and oral secretion of antibacterial and fungistatic compound that is lysozymes and by secreting secondary metabolites which are having antimicrobial and insect repellent property. The resources they use for breeding - small vertebrate carcasses - are clearly imperative in shaping burying beetle life-histories. Carrion is a resource with high nutritional value, making it attractive to a variety of scavengers not just burying beetles. Burial of the carrion underground reduces competition, but this doesn't itself explain why they have such complex care. However, small vertebrate carcasses are defendable, non-renewable resources that are also rare and difficult to find. Strong competition over such a resource may have provided the necessary conditions to kick start the evolution of parental care by providing incentive for parents to stick around and guard the brood. Once parents began to associate with their offspring, this would set the stage for the co-evolution of parent-offspring behaviors - behaviors that boost communication between parents and their offspring-which would be favored by natural selection if these behaviors increase reproductive success. Such co-evolution may lead to rapid diversification and complexity of parental care traits.

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Using Scientific Process for Valuable Seed Production of Cabbage

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Cabbage

Cabbage (*Brassica oleracea var. Capitata* L.) is grown for its head which is formed by the development of densely overlapped leaves around the growing point. Cabbage occupies the land for only a single growing season when grown for its vegetative part (head) but requires two seasons for seed production. In the first season, crop remains in the vegetative phase characterized by the formation of heads whereas the reproductive phase is completed in the second season only after getting the necessary stimuli of low temperature of 4.4°C-10°C for about 60 days to break the dormancy of the heads.

Climatic Requirements

It is harder than cauliflower in respect of frost and cold tolerance. The optimum temperature for seed germination is 12°C-15°C. Transition of vegetative phase to the reproductive phase takes place only after the exposure to low temperature.

Seed Production

For seed multiplication of cabbage, the following three methods can be followed depending on the suitability, type of seed and stage of multiplication.

1. Seed to seed method.
2. Head to seed method.
3. Late planting.

Seed to Seed (In Situ) Method

For foundation and certified seed production, seed to seed method is commonly followed by using high quality breeders' seed. Plants are allowed to grow, over-winter and produce seed in their original position where they were first planted as seedling. This method is again divided into 3 sub-methods.

1. Head intact method: This is the most common method in commercial seed raising of cabbage. The plants are allowed to over winter at the place of original planting as seedling. Head formation is completed by mid-December. The field is kept clean by removing old, dry and diseased outer-leaves and earthing up is done to support the heavy weight of the heads.

With the rise in temperature in the first fortnight of March, the developing flower-stalk exerts an internal pressure and the head starts bursting. Head may burst from any side to allow the flower-stalk to come out. The heads bursting from lateral sides may result in an injury to the terminal part of the inflorescence stalk. With the suppression of apical dominance, the growth of lateral buds/branches is stimulated and the branches instead of growing upright become decumbent.

These are liable to be broken while performing field operations such as weeding, spraying and strong winds at the full load of mature pods. To facilitate the flower-stalk to emerge easily, uniformly and to grow straight up with the terminal point intact, two vertical they start bulging or giving dome-shaped appearance. A care is taken not to injure the central growing point. Cross cuts may be given twice or thrice in the varieties having very compact heads.

2. Stump method: The fully mature heads are decapitated just below the base with a sharp knife keeping the stem with outer whorls of leaves intact. Removal of heads should only be done after ascertaining true to typeness of mature heads. The stumps thus left throw flowering shoots from the axillary buds during spring. This method may be useful when the selection of heads is based on internal characters like core size particularly in research. The stump of plants selected on the basis of head characteristics can be left either in situ or replanted at another place.

3. Stump method with central core intact: Instead of removing the whole heads they are chopped off on all sides with downwards perpendicular cuts in such a way that the central core is not damaged. The flowering shoots arise from the terminal and axillary buds.

Head-To-Seed Method

This method is mostly followed for nucleus seed production. True-to-type compact heads are selected, uprooted and replanted in a separate plot during November-December. Before replanting, the outer leaves are removed and plants are set in the field in such a way that the whole stem below the head is buried in the ground with the head resting just above the surface of soil which prevents tilting of plants due to weight of the heads. The soil around the base of the plant is made firm by pressing and leveled uniformly. There should be no depression otherwise water will stagnate and may injure the root system. The loosely set plants get tilted immediately after irrigation. Selection of true-to-type heads is possible only in the compact stage. Hence, selection in the loose headed stage from seed quality point of view is risky unless there is certainty of the highest quality of the seed stock used.

Modified Method: This method is followed in areas like Kinnaur (Himachal Pradesh) where there is a heavy snowfall during winter and the land remains covered with snow for a fairly long time. In such areas planting time is adjusted in such a way that full maturity of the heads occurs just before the onset of winter season and is generally done in May-June.

If the planting is done earlier the heads may begin to split and are not fit for storage in the trenches. In the delayed planting, the head may not be compact and fully mature which cannot be stored properly because loosely folded leaves are more prone to desiccation than the tightly overlapped leaves which increase the staying capacity of the heads. The compact true-to-type heads are selected, uprooted and stored in trenches for overwintering after removing the outer whorls of leaves.

In this method trenches of size 300 cm long, 90 cm wide and 75 cm deep are made being convenient for storage. Heads are stored in a single layer in slanting position and roots are buried 5-7 cm deep in the soil. The trenches are covered with wooden planks (may be kept flat or in wedge position) and about 15 cm layer of earth is spread over them and on both sides of trenches small holes are made for ventilation. Due to extremely low temperature, the heads get vernalized in the trenches.

At low temperature, the heads remain dormant and the growth of disease organisms is discouraged. As soon as the danger of frost is over, the heads are taken out from the trenches and are replanted in well prepared field during March-April. Cross cut (3 cm deep) is given to the heads before they start bursting. Flowering takes place in June-July and the seed is ready for harvesting in August-September. This method is advocated for nucleus seed raising under insect proof conditions in the screen chambers. It is also suitable for breeders' seed production. Head-to-seed method provides better scope for inspection of heads (stalk length) after removal of outer leaves, head size, shape and color and rouging.

Late Planting

Although this method is a modification of in situ method and is followed only under specific circumstances. It can only be followed in early types which when planted late bold directly in spring after overwintering in the field without forming any typical heads. In the late maturing cabbages seed production is not possible because when these are planted late, the immediate onset of winter will prevent the plants from making sufficient vegetative growth necessary for perceiving the low temperature effect required to initiate bolting and flowering. These plants remain in vegetative stage even after the winter is over and start making further growth with the rise of temperature in March.

Heading in these plants occurs in May-June. In this method, seed yield is very high but the quality of seed produced may not be up to the stock seed used to raise the crop must be of the highest quality otherwise it is quite risky and the subsequent crop raised from this seed is bound to produce plants of inferior quality. The other advantage is that it shortens the period of seed production in early cultivars because in other methods of seed raising, the plants have to be maintained and cared for, for almost a year, which may involve extra expenses.

1. Manures and Fertilizers: It is a shallow rooted crop and removes large amounts of nutrients which go in the formation of heads. The requirements of nutrients for a seed crop of cabbage are more compared to a crop meant for vegetable purpose because the seed crop remains in the field for about two times more than the vegetable crop.

For the best results 200-250q/ha FYM should be incorporated in the soil 30 days before transplanting. First dressing of nitrogen is generally done at planting along with the whole dose of phosphorus and potash. The second dressing is done at 25-35 days later at the end of the initial growth stage and the third just before heading when the outer leaves are developing.

2. Sowing and Transplantation: The optimum time for sowing of seed in the nursery and transplanting of early cultivars are end of July to first week of August and end of August to first week of September.

3. Seed Treatment: Hot water treatment of seeds for 50°C for 30 min is done to combat different pathogens followed by treating with fungicides.

4. Seed rate: Seed rate of good stock varies from 600g/ha for mid or late cultivars to 750g/ha for early cultivars.

5. Spacing:

Varieties	Spacing between	
	Rows (cm)	Plants(cm)
Early	45	45
Mid	60	45
Late	60	45 or 60

6. Irrigation: The critical stages for water requirement during seed production are:

a. Head initiation and development.
b. Flowering.
c. Seed setting.
d. Seed development.

From March to June at bolting to maturity stages irrigation requirement is increased, due to rising temperature.

7. Intercultural and weeding operation: Two earthing up are essential to support the plants. Firstly, at the time of removal of outer and old leaves and secondly at the time of bolting. Rouging is done atlest three times at different stages to remove the off types. First rouging is done at full vegetative stage, second at the time of heading and third at the time of bolting and pre-flowering stage.

8. Harvesting: It should be done in 2-3 lots to avoid shattering loss. When about 70% of pods on a branch have changed to yellowish brown color and seed turns brown it is cut whole with a sharp sickle.

9. Curing, Threshing and Seed Grading: Curing is done to reduce the shattering loss. After 4-5 days the cut heaps are turned upside down to cure for another 4-5 days. Seeds separated from chaff by sieve and died to safe moisture level (7%).

10. Seed Yield: 350 kg/ha for early and 250 kg for late.

11. Isolation: For Foundation Seed -1600m and Certified seed- 1000m 300m for Breeder seed

12. Seed Standards:

Factors	Standards for each class	
	Foundation	Certified
1	**2**	**3**
Pure seed (maximum)	98.0 per cent	98.0 per cent
Inert matter (minimum)	2.0 per cent	2.0 per cent
Other crop seeds(maximum)	5/kg	10/kg
Weeds seeds (maximum)	5/kg	10/kg
Germination(minimum)	65 per cent	65 per cent
Moisture (maximum)	7.0 per cent	7.0 per cent
For vapour proof containers maximum)	5.0 per cent	5.0 per cent

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Pesticides Threats on Honeybee Colony

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Honey bees are the key pollinators of agricultural and horticultural crops but these pollinators are very sensitive by general environmental factor like pollution. A pesticide also causes ecological threats against these pollinators. When different chemicals are applied to the crops, they are affecting the pests of the crops but also harm the beneficial insects. This harmful effect may create the ecological imbalance between the insects and their host (Amsalu, 2012). Older worker bees forage outside the hive for pollen and nectar and thus are susceptible to contact exposure to pesticides during foraging as well as dietary exposure during collection or ingestion of pollen and nectar. Workers also serve as a vector for bringing contaminants back to the hive. All the young and middle-aged workers, queen and drone can have secondary exposure to pesticides through contaminated food brought back to the hive (Fischer and Moriarty 2011). Colony Collapse Disorder (CCD) is unlike other ailments that have affected honeybees because worker bees simply disappear rapidly, never returning to the hive where the queen still lives with a small cluster of bees amidst pollen and honey stores in the presence of immature bees (brood). Many indications point to CCD being induced by pesticides, especially neonicotinoid insecticides, as well as, nutritional deficits and environmental stresses. Ongoing research into the cause of CCD at Penn State University has identified more than 120 different pesticides contaminating hive samples from 23 states. Pesticides are likely to be a part of the CCD equation and a precautionary approach must be taken. Solutions to the loss of bees are clearly within our reach if we engage our communities and governmental bodies. We know how-to live-in harmony with the ecosystem through the adoption of sustainable practices that simply do not allow toxic pesticide use. Because our survival depends on healthy pollinators, we must do everything in our power to solve this problem.

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Blast and Brown Spot Diseases of Rice and their Management

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Introduction

Rice is the basic food crop and being a tropical plant, it flourishes comfortably in hot and humid climate. Rice is mainly grown in rain fed areas that receive heavy annual rainfall. That is why it is fundamentally a kharif crop in India. Rice is the staple food of eastern and southern parts of India. Now disease damage to rice can greatly reduce yield. They are mainly caused by fungus, bacteria or viruses. Rice blast and brown spot disease are more saviors in Vidarbha region. Planting a resistant variety is the simplest and often, the most cost-effective management for diseases.

Blast: *Pyricularia oryzae* (*Syn: P. grisea*) (Sexual stage: *Magnaporthe grisea*).

Symptoms

The fungus attacks the crop at all stages of crop growth. Symptoms appear on leaves, nodes, rachis, and glumes. On the leaves, the lesions appear as small bluish green flecks, which enlarge under moist weather to form the characteristic spindle shaped spots with grey centre and dark brown margin (Leaf blast). The spots coalesce as the disease progresses and large areas of the leaves dry up and wither. Spots also appear on sheath. Severely infected nursery and field appear as burnt. Black lesions appear on nodes girdling them. The affected nodes may break up and all the plant parts above the infected nodes may die (nodal blast). During flower emergence, the fungus attacks the peduncle and the lesion turns to brownish-black which is referred to as rotten neck / neck rot / panicle blast (neck blast). In early neck infection, grain filling does not occur while in late infection, partial grain filling occurs. Small brown to black spots may also be observed on glumes of the heavily infected panicles. The pathogen causes yield losses ranging from 30-61 per cent depending upon the stages of infection.

Pathogen

The mycelium is hyaline to olivaceous and septate. Conidia are produced in clusters on long septate, olivaceous conidiophores. Conidia are pyriform to ellipsoid, attached at the broader base by a hilum. Conidia are hyaline to pale olive green, usually 3 celled. The perfect state of the fungus is *M. grisea* producing perithecia. The ascospores are hyaline, fusiform, 4 celled and slightly curved.

Favourable Conditions

Intermittent drizzles, cloudy weather, more of rainy days, longer duration of dew high relative humidity (93-99 per cent). Low night temperature (between 15-20˚C or less than 26˚C). Availability of collateral hosts and excess dose of nitrogen. Forecast for rice blast can be made on the basis of minimum night temperature range of 20-26˚C in association with a high relative humidity of 90 per cent and above lasting for a period of a week or more during any of the three susceptible phases of crop growth, viz., seedling stage, post transplanting tillering stage and neck emergence stage. In Japan, the first leaf blast forecasting model was developed named as BLAST. Later several other models have also been developed namely, PYRICULARIA, PYRIVIEW, BLASTAM, EPIBLA and PBLAST.

Disease Cycle

The disease spreads primarily through airborne conidia since spores of the fungus present throughout the year. Mycelium and conidia in the infected straw and seeds are major sources of inoculum. Irrigation water may carry the conidia to different fields. The fungus also survives on collateral hosts viz., *Panicum repens, Digitaria marginata, Brachiaria mutica, Leersia hexandra and Echinochloa crusgalli*. Conidia and Conidiophore of *P. grisea* Spores land on leaves, germinate, penetrate the leaf, and cause a lesion 4 days later; more spores are produced in as little as 6 days. Infections from spores arriving from a distance are termed primary infections. Primary infections generally result in a few widely scattered spots on leaves. Spores arising from the primary infections are capable of causing many more infections. This cycling is called secondary spread. Secondary spread is responsible for the severe epidemics of blast in fields and localized areas.

Management

1. Grow resistant to moderately resistant varieties CO47, IR 20, ADT36, ADT39, ASD 18 and IR64. Avoid cultivation of highly susceptible varieties viz., IR50 and TKM6 in disease favourable season.
2. Remove and destroy the weed hosts in the field bunds and channels.
3. Treat the seeds with Captan or Thiram or Carbendazim or Tricyclazole at 2 g/kg. or Pseudomonas fluorescens @ 10g/kg of seed. Spray the nursery with carbendazim 500mg/L or tricyclazole 300mg/L.
4. Spray the main field with Edifenphos 500 ml or Carbendazim 500 g or Tricyclazole 500 g or Iprobenphos (IBP) 500 ml /ha.

Brown Spot: *Helminthosporium oryzae (Syn: Drechslera oryzae; Bipolaris oryzae)* (Sexual stage: *Cochliobolus miyabeanus*)

Symptoms

The fungus attacks the crop from seedling to milky stage in main field. Symptoms appear as minute spots on the coleoptile, leaf blade, leaf sheath, and glume, being most prominent on the leaf blade and glumes. The spots become cylindrical or oval, dark brown with yellow halo later becoming circular.

Several spots coalesce and the leaf dries up. The seedlings die and affected nurseries can be often recognized from a distance by scorched appearance. Dark brown or black spots also appear on glumes leading to grain discoloration. It causes failure of seed germination, seedling mortality and reduces the grain quality and weight.

Pathogen

Bipolaris oryzae produces brown septate mycelium. Conidiophores arise singly or in small groups. They are geniculate, brown in colour. Conidia are usually curved with a bulged centre and tapered ends. They are pale to golden brown in colour and are 6-14 septate. The perfect stage of the fungus is *C. miyabeanus*.

It produces perithecia with asci containing 6-15 septate, filamentous or long cylindrical, hyaline to pale olive green ascospores. The fungus produces terpenoid phytotoxins called ophiobolin A (or Cochliobolin A), ophiobolin B (or cochliobolin B) and ophiobolin I. Ophiobolin A is most toxic. These breakdowns the protein fragment of cell wall resulting in partial disruption of integrity of cell.

Favourable Conditions

Temperature of 25-30˚C with relative humidity above 80 per cent are highly favourable. Excess of nitrogen aggravates the disease severity.

Disease Cycle

Infected seeds and stubbles are the most common source of primary infection. The conidia present on infected grain and mycelium in the infected tissue are viable for 2 to 3 years. Airborne conidia infect the plants both in nursery and in main field.

The fungus also survives on collateral hosts like *Leersia hexandra* and *Echinochloa colonum*. The brown spot fungus is normally present in areas with a long history of rice culture. Airborne spores that are capable of causing infection are produced in infested debris and older lesions.

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Conclusion

Temperature of 25-30˚C, intermittent drizzles, cloudy weather, more of rainy days, longer duration of dew high relative humidity (93-99 per cent). are highly favourable, Availability of collateral hosts and excess dose of nitrogen show the high disease intensity.

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Rice blast Disease

Shriveled Culms

Drooped Panicle

Brown Spot of Rice

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Phenomics in Plant Breeding

Article ID: 31543

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Introduction

The most precious things are not jade and pearl but it's the agriculture and its products which are the powerful tool to end extreme poverty, boost prosperity and feed the hunger lives. Persistent food and feed supply, shortage of resources, changing climate and energy use are number of the challenges we face in our dependence on agriculture. Rising human population urges global researchers to improve the crop productivity to satisfy the increasing demand for food supply. Genetic improvements in crop performance remain the key role in improving crop productivity and it will be achieved by exploiting plant genotyping and phenotyping technologies. The development of innovative bio-technological and next-generation sequencing (NGS) tools has led to the build-up of massive data on genomics; nevertheless, data on phenotype and functions is yet to be fully annotated. To take advantage of the wealth of large-scale genomic data sets, it is essential to characterize the crop performance quantitatively and link it to the genomic data. Reliable, automatic, multifunctional, and high-throughput phenotypic technologies are increasingly considered important tools for rapid advancement of genetic gain in breeding programs. With the rapid development in high-throughput phenotyping technologies, research in this area is entering a new era called 'phenomics.'

Phenomics is the systematic measurement and analysis of qualitative and quantitative traits, including clinical, biochemical and imaging methodologies, for the refinement and characterization of a phenotype. It requires deep phenotyping and phenomics analysis to assure the thorough collection of phenotypic data and evaluation of patterns & relationships between genotype-phenotype associations and also between individuals with related phenotypes.

In recent years, new high throughput phenotyping tools and techniques like non-invasive imaging, spectroscopy, image analysis, robotics and high-performance computing for phenotyping technology has been widely adopted across the agri-food industry to reinforce automation and promote efficiency with application starting from product quality assessment to sorting and packaging. High-throughput phenomics studies also offer strategies to screen largescale populations for a specific phenotype. The utilization of high-throughput phenotyping systems and non-destructive imaging is widely considered as a key technology allowing scientists and breeders to develop crops with the ability to perform well under diverse environments (kumar et. al., 2015). Phenomics technologies fastened the evaluation of plant performance under field condition and facilitates a more dynamic and whole-of-lifecycle non-destructive assays.

Need of Phonemics in Plant Breeding

Phenomics is occupying the field of plant breeding with several advantages over the conventional methods for collecting data on phenotypes as it will reduce time, labour, and cost involved. The main objective in plant breeding is to identify plants with improved trait and the science of phenomics speeds up phenotyping by using automated high-tech sensors, robotics, imaging systems and computing power. Presently, phenomics is mainly concern for monitoring crops for fertilizer requirement and weed detection. Further, advance detection of pathogens and pest's population holds great promise to revolutionize precision agriculture. HTPP can also enable evaluation of traits that are otherwise invisible to the naked eye or are correlated with the trait of interest. This broadens the genetic variation in the breeding material as germplasm with such traits could then be retained in the breeding programs. To receive the complete advantage of the available genomic information, plant phenomics, which integrates technologies like photonics biology, computers, and robotics, will permit the functional characterization of genes. Depending on the trait under observation, phenomics techniques can be used to characterize large number of lines/ individual plants accurately in a short time period. The high speed of phenomics based plant phenotyping accelerate the process of selecting plant varieties or germplasms that perform better within the field under drought, salinity, or high temperature stress condition or crops with high photosynthetic efficiency or those which can perform better under higher levels of atmospheric carbon dioxide. The considerable power of unmanned aerial systems (UAS) or drone-based phenotyping as a high-throughput alternative to visual assessments for the complex phonological trait of lodging, which significantly impacts yield and quality in many crops including wheat.

Pathogen

The mycelium is hyaline to olivaceous and septate. Conidia are produced in clusters on long septate, olivaceous conidiophores. Conidia are pyriform to ellipsoid, attached at the broader base by a hilum. Conidia are hyaline to pale olive green, usually 3 celled. The perfect state of the fungus is *M. grisea* producing perithecia. The ascospores are hyaline, fusiform, 4 celled and slightly curved.

Forward and Reverse Plant Phenomics

Forward phenomics uses phenotyping tools to 'sieve' collections of germplasm for valuable traits. The sieve or screen could be high-throughput to screen thousands of plants in pots running along a conveyor belt and travelling through a room containing automated imaging systems such as infra-red or 3D cameras. The pots are labelled with barcodes or radio tags, so that the system can identify which pots contain plants with interesting traits. Further, screens will have to include abiotic or biotic stress challenges and must be reproducible and of physiological relevance. The selected plants can then be grown up to provide seed for further analysis and breeding. This results identification of the 'best of the best' germplasm line or plant variety. Reverse phenomics is used where the promising genotypes having desirable trait(s) is already known. Now through reverse phenomics, traits shown to be of useful to reveal mechanistic understanding are dissected in details and subsequently the identified mechanisms are exploited in new approaches. This can involve reduction of a physiological trait to biochemical or biophysical processes and ultimately a gene or genes. For example, in case of drought tolerance, researchers try to work out the mechanisms underlying the drought tolerance and find out the gene or genes that are responsible for it. These genes are screened in germplasm or the gene can be bred into new varieties (kumar et. al., 2015).

Phenotyping Platform

Automation and robotics, new sensors and imaging technologies (hardware and software) have provided an opportunity for high throughput plant phenotyping platforms (HTPPs) development. Such high-throughput phenotyping platforms are characterized by automation, high-throughput, and high precision, which greatly improve plant data collection efficiency and accuracy, in order to enhance the efficiency of crop breeding.

Table 1: List of digital technologies and platform equipment's for crop phenotyping.

Phonemics tool	Species	Trait studied	Reference
RGB Imaging (Unmanned Ground Vehicle)	Sugarbeet	Cercospora leaf spot	Jay et. al., 2020
RGB, Thermal imaging and chlorophyll fluorescence imaging	Arabidopsis	Heat stress induced changes	Gao et. al., 2020
LiDAR: 3D voxel index and 3D profile index	Wheat	Above ground biomass and crop growth rate	Deery et. al., 2020
X- ray computed Tomography	Rice	Grain traits	Hu et. al., 2020
Fluorescence imaging	Grape	Grape berry color	Underhill et al., 2020
MVS-Pheno	Maize	Shoot architecture	Wu et. al., 2020

(multiview stereo)			
Rhizovision hardwere platform and imager	Soybean and wheat	Crown root phenotyping	Seethepalli et. al., 2020
unmanned aerial systems (UAS) or drone-based phenotyping	Wheat	Genetic dissection of lodging	Singh et. al., 2010
3D laser scanning, Multi-View Stereo Image Acquisition (MVS) and 3D digitizer	Maize	Multi growth stages	Wang et. al., 2018

Application of Phenomics in Agricultural Research

Phenomics approaches make it accessible to find the determinants of productivity, to identify plant resistance mechanisms to biotic and abiotic stressors, and to accomplish crop scheduling on agricultural lands. High throughput phenotyping tools have a great potential to capture soil resources and do the whole plant phenotyping to measure root and shoot traits simultaneously. The use of phenomics technologies in agricultural and biocenoses allows for most competent ecological monitoring and unravelling global hitches in the field of environmental safety.

Phenotyping Bottleneck

Phenomics tools and techs developed for large-scale phenotyping are accessible only to small group of species with comparable growth habit and climatic requirements. Since, novel and automated phenotyping approaches are hardware dependent such as viz., robotics, imaging devices and computing infrastructure, the cost of phenotyping is very high and are not accepted by many countries. Its challenging to phenotype the agriculturally important traits such as grain yield, abiotic stress tolerance, and nutritional quality as they demand the replicated trials across multiple locations over a couple of seasons (Kumar et. al., 2015). Some phenomics tools require destructive harvesting at fixed time intervals or at a particular phenological stage and are slow and costly. Main emphasis of phenomics is to understand the phenotypic differences, but technologies fail to analyse the relation of phenotypes to function even if quantitative genetics is employed (York, 2018). High constructional, operational and maintenance expenses of HTPPs puts restriction to install these technologies by most of the academic and research institutions.

Conclusion and Future Prospectus

Phenomics has swiftly emerged in the past decades and created many opportunities addressing the various demands, in which phenotyping is desired. With present downsides associated with phenomics in plant breeding and farming, there is much effort have to be done to enhance capacity, implement the new technologies seamlessly into the workflow of users in breeding and academia, develop proper access opportunities, and establish data management systems that allow data exchange and information gain across installations, locations, and experiments. This needs to be done in analogous with continued implementation of innovative technologies. There is a need to resolve the challenges associated with generation and reportage of precise phenotyping data for proper understanding of the obtained results and reproducibility. Should also establish the national and international collaborations to offer funding facilities and also share knowledge which will helps to achieve investment in large-scale infrastructures and data analysis. In precision agriculture, added challenges are automation and hasty procedure, even real-time, which are necessary for timely and appropriate intervention in fields or greenhouses. As new satellites are regularly launched, satellites with high-resolution and lower GSD will benefit the plant breeding and farming sectors.

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Soil Erosion: A Major Constraint to Crop Production

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Introduction

Erosion is a difficult issue for beneficial, agricultural land and for water quality concerns (Garba and Dalhatu, 2015). Soil erosion is a continuous process and procedure that happens when the effect of water or wind confines and expels soil particles, making soil apart. Soil decay and low water quality are being occurred due to the disintegration and surface overflow. Soil particles can be moved by wind or water into streams and different streams. Silt is a result of land disintegration and erosion and gets largely from sheet and rivulet disintegration from upland territories and less significantly from cyclic disintegration movement in ravines and seepage ways. The effect of soil erosion on water quality gets critical, especially as soil surface spillover. Accordingly, the best method to limit residue creation is the adjustment of the dregs source by controlling erosion. Soil erosion is the separation and development of soil particles from the purpose of start through the activity of water or wind. Along these lines, limiting the effect of water or wind powers is the principle objective for erosion control.

Water Erosion

The across the board event of water erosion joined with the seriousness of on location and off-site impacts have made water erosion the focal point of soil preservation endeavours (Blanco-Canqui and Lal 2010a; Ketema and Dwarakish (2019). There are generally four forms of water erosion. These are sheet, rill, gully and bank erosion. The rate and size of soil erosion by water is constrained by the accompanying elements:

1. Rainfall and Runoff: The more noteworthy the force and length of a rainstorm, higher is the disintegration potential. The effect of raindrops on the dirt surface can separate soil totals and scatter the total material. Decrease in infiltration because of soil compaction, crusting or freezing expands the overflow. Overflow from agrarian land is most prominent during spring months when the soil is regularly soaked, snow is softening and vegetative spread is insignificant.

2. Soil Erodibility: Soil erodibility is a gauge of the capacity of soils to oppose disintegration and erosion, in light of the physical qualities of each soil. Previous disintegration additionally affects a soil's erodibility. Many uncovered subsurface because of low organic matter and poor structure will result increase in soil erosion.

3. Cultivation and Vegetation: The potential for soil disintegration increments if the soil has no or next to no vegetative front of plants and additionally crop residues. Vegetation and residues of cover crop helps preventing soil from raindrop impact and splash, which helps in decelerating the runoff movement and infiltration rate increases. The disintegration lessening viability of plant and residues depend upon sort, degree and amount of spread. Vegetation and residues mixes that cover the surface and impede the falling drops of rain at and near to surface are effective in soil erosion control (e.g., woodlands, grasslands).

4. Culturing Practices: The potential for soil disintegration by water is influenced by culturing practices and intercultural operations , type, depth and time of ploughing. Generally, the less the unsettling influence of vegetation or residue spread at or close to the surface, the more successful the culturing practice in diminishing water disintegration. Least till or no-till are powerful in lessening soil disintegration by water.

Causes of Water Erosion

The ramifications of soil erosion by water reach out past the evacuation of significant topsoil layer. Crop emergence, development and yield are straightforwardly influenced by the loss of common supplements and applied manures. A great impact is visible on seeds and plants because of topsoil removal. During spring defrost conditions organic matter, applied manure, pesticide and crop residue being lightweight is easily blown off the field. Soil quality, structure, strength and surface can be influenced by the loss of soil. The off-site effects of soil disintegration by water are not generally as obvious as the on-location impacts. Disintegrated soil, accumulated on slope, restrains or postpones the development of seeds, covers little seedlings and requires replanting in the influenced territories. Likewise, residue can aggregate on down-slope properties and add to street destruction. Sediment that arrives at streams or conduits can quicken bank disintegration, block stream and seepage channels, fill in repositories, harm fish natural surroundings and debase downstream water quality.

Wind Erosion

Wind erosion occurs mainly in sandy and natural or refuse soils. Under the severe conditions it can cause significant destruction of soil and property. Soil particles move in three ways, depending on soil particle size and wind strength – suspension, siltation and surface creep (Blanco-Canqui and Lal 2010b). The following factors control rate and magnitude of soil eroded by wind:

1. Soil Erodibility: Exceptionally fine soil particles are conveyed high into the air by the breeze and translocate far away distances (suspension). Fine-to-medium size soil particles are lifted a short separation into the air and drop back to the soil surface, harming crops and dislodging more soil (saltation). Larger-sized soil particles that are too enormous to be in any way lifted off the ground are ousted by the wind and move along the soil (surface creep). The scraped area that outcome from windblown particles separates stable surface totals and further expands the soil erodibility.

2. Surface Roughness: Soil surfaces roughness contribute in offering resistance or protection from the wind. However, ridges, which are not cultivated, can dry out more rapidly the blowing of wind, bringing about more free, dry soil accessible to blow.

3. Climate: The speed and rate of the wind have an immediate relationship to the degree of soil disintegration. Accumulation of soil on the leeward side of boundaries, for example, fence columns, trees or structures, or snow spread that has brown coloured shading during winter are indicators of wind erosion.

4. Unsheltered Distance: Absence of windbreaks (trees, bushes, crop residue etc.) helps in translocation of soil particles with high rate of wind thus, leading to abrasion and soil erosion. Ridges and hilltops, which are bare, are generally uncovered and susceptible to erosion.

5. Vegetative Cover: The absence of vegetative spread in specific areas brings about broad wind led soil disintegration. Free, dry, uncovered soil is the most prone; in any case, crops that produce low degrees of residues (e.g., soybeans and vegetable yields) may not give enough obstruction.

Causes of Wind Erosion

Wind disintegration harms crops through sandblasting of youthful seedlings or transplants, internment of plants or seed, and seed exposure. Yields are demolished, bringing about exorbitant postponements and making reseeding essential. Plants harmed by sandblasting are vulnerable against the section of ailment with a subsequent abatement in yield, loss of quality and market value. Also, wind erosion can lead to unfavourable working conditions, preventing ideal field exercises. Drifting of top soil decreases the fertility which leads to decrease in crop productivity and production. With continuous drifting of soil zone textural class of soil changes gradually. Loss of fine sand, silt, clay and organic particles from sandy soils serves to bring down the moisture-holding limit of the soil.

Tillage Erosion

Tillage erosion is the redistribution of soil through the activity of tillage and gravity. It brings about the dynamic down-slope development of soil, causing extreme soil misfortune on upper-slope positions and aggregation in lower-slope. This type of disintegration is a significant conveyance instrument for water runoff. Cultivation activities move soil to exposed territories of a field where surface water overflows concentrates. In addition, subsoil gets exposed to water and wind erosion. In comparison, to water and wind erosion most of the soil is eroded by adopting various tillage operations in-situ (Blanco-Canqui and Lal 2010c). There are several factors, which determine the extent of tillage erosion. These are direction, speed and depth of tillage, number of passes of tillage operation etc.

Causes of Tillage Erosion

It affects yield and development of crop. Vegetation on shoulder slopes and glades is moderate and hindered because of poor soil structure and loss of crop residue and is more prone to stressful conditions. Alteration in the soil structure and surface can be accelerated the erodibility of the soil and further increased by water and wind. In some extreme conditions, tillage erosion may lead to sub surface erosion too. Sub-soil that has been moved from upper-slope to lower slope can cover the fertile top soil layer in the lower-slope areas, further affecting growth and yield.

Conclusion

The top fertile layer of soil loss is there with disintegration/erosion. As soil dissolves, it loses supplements, nutrients, obstructs streams with earth, and in the long run transforms the zone into a desert. Despite the fact that disintegration happens normally, human exercises can exacerbate it much. Erosion can turn an area into barren land, which was once fertile. Disintegration can be controlled effectively on a building site when the correct methods, tools, and strategies are utilized at the perfect time. The most common and powerful approach to protect soil from disintegration is by planting vegetation. Understanding soil erosion in the agricultural field is an essential step toward developing effective soil conservation strategies. It is obviously demonstrated that agricultural activities and mulching are the best and proposed techniques to be used. For production of enough food to feed splurging population for present and future generation there is lot of pressure on soil and to maintain its fertility along and reverse the degraded soils into quality and healthy one, as it is a limited source. For maintaining, protecting improvement of the soil's productivity and environment, we require high-level commitment in all sectors of society. By substantially decreasing soil loss, conservation practices will conserve the soil's fertility and allow the land to sustain higher crop yields that will help in increasing economy.

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Integrated Nutrient Management: Its Strategies and Contribution to Agricultural Sustainability

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Introduction

The main challenges facing agriculture planners and farming decision makers in the coming few years 'lies in vision world without hunger and zero poverty intensified by raising standards of living of rural regions, where the majority of poor people live and their full dependence on agriculture for living to fulfil their food demands Wheller and Braun, (2013). The key to eliminate the current suffering lies in the creation of a strategic plan that enhances prosperous farming and enables farmers themselves to achieve agricultural growth, reduce poverty, and sustain high returns. With the view of an increase in land scarcity and water shortage, most of the agriculture plans depend on the use of chemical fertilizers and the production of new high-yielding crop varieties. Yet, both components are much expensive, will lead to higher pressure and more responsibilities for the financial investments and consequently will lead to an increase in the total costs. Over the years due to intensification of Agriculture coupled with higher productivity, wide spread deficiency of nutrient in cropping up. This means those nutrients taken out of the soils are not being replenished. Since ancient times, farmers have known that soil health can be restored by applying organic manure; accordingly, they used to apply farmyard manure regularly and directly after crop harvest. Consequently, the custom of using organic manures after harvesting has been coupled with restoration of soil health and improvement of physical, chemical, and biological properties of soil, particularly in marginal soils, which are already suffering from low organic matter and low native nutrient content, low productivity, and limitations and unavailability of essential nutrients Adeoye et al., (2011). Recently escalated calls emerged invited farmers and agriculture specialists to change their awareness towards substituting a part of inorganic fertilizers by cheaper, more sustainable, higher nutrient use of efficient and eco-friendly nutrients, which are originated from natural resources (Compost), under the bold title of using integrated nutrient management.

Definition of INM

Integrated nutrient management (INM) is one of the agronomic practices aiming at the usage of the harmonious properties of both organic and inorganic sources of fertilizers by making a combination that can be used for decreasing the enormous use of chemical fertilizers and accreting a balance between fertilizer inputs and crop nutrient requirement options, which can maintain the soil fertility, restore the soil health and continuous supply of plant with nutrient requirements to obtain an optimum level of yield production, maximize the profitability and subsequently reduce the environmental pollution and provide a sustainable production system Selim and Al-Owied, (2017).

Components of INM

Integrated nutrient management (INM) is a scheme that refers to a safest way to dispose off crop residues and produce high-quality compost by a balanced and integrated use of both sources of fertilizers together in combinations (organic and inorganic fertilizers) for maintaining soil fertility and providing plants with an optimum level of nutrients required over all of cycle life to sustain the yield productivity. The key component of INM system includes the following items:

1. Considerable attention must be focused on all possible nutrient sources that can be used as a tool of nutrient sources in planning nutrient input programs for optimizing nutrient-use efficiency and high yield production.

2. The form sand quantities of soil nutrient contents in the root zone, which is known as soil balance and its availability to cover crop requirements (spatially and temporally).

3. Minimizing nutrient losses, especially in the intensive agriculture system.

4. Taking all factors affecting the plant/nutrient relationship into consideration to achieve high yield production, which is the main objective and the major gain of the application of integrated nutrient management, water use efficiency, grain superiority, high economic return, and sustainability.

Advantages of INM

INM a good nutrient management package is a way to attain ideal growth and yield levels for most crops at different agroecological zones, with or without minimum risk in the environment eco-friendly strategy Zhang et al., (2012). Thus, it can also be described as a system involving a series of the following benefits:
1. Systems can improve the soil nutrient natives and increase the solubility and availability of fertilizers to be used.
2. Use the harmonious behavior of nutrient supplies and making them match with the crop requirements.
3. Offer the nutritional balance to the crops and lessen the aggressive effects resulting from the opposite impact between nutrient fractions and nutrient imbalance.
4. Advance and sustain the physiochemical and biological functions of soil properties.
5. Reduce the rate of soil degeneration, water, and ecosystem by enhancing carbon confiscation and decreasing nutrient losses to ground and surface water forms and/or to environment pollution.
6. Minimize higher total costs of production and raise the farmer's returns (increasing profitability).
7. Improve the resistance to both biotic and abiotic stresses.
8. An effective method of agricultural practices to ensure healthy food, covering population food demands alongside with many soil and environmental impacts, especially in countries with rapid growth in population.
9. Additional benefits can also be gained; it does not only save the total costs at the satisfactory level with an increase in cro production but also can be easily practiced by farmers; therefore, it is considered one of the most promising techniques in line with the future needs.
10. INM can have positive effects on the susceptibility or plan resistance against many types of biotic and abiotic stresses.
11. Following INM will enable to explore a larger volume of soil in order to access water and nutrients; additionally, improved root development enables the plant to absorb water from deeper soil layers and then reflects an increase in the ability of crops toward drought resistance.
12. Changes in awareness of farmers toward the climate changes from season to season, which have greater ecological impacts in order to produce safe food rather than achieving higher yield aiming at attaining higher profit.

Factors Affecting on Sustainable Agricultural Production

There are several factors of sustainability of agricultural production system which are offered by INM. These are highlighted and enlisted as follows:
1. INM in relation to macro- and micronutrients.
2. INM in relation to environmental concern and food requirements.
3. INM in relation to soil structure and water use.
4. INM in relation to plant growth and crop yield.
5. INM in relation to succeeding crops.

Conclusion

Achieving higher yield per unit area and more crops per drop are the main challenges facing researchers, agricultural specialists, and farmers worldwide and also is the main option of solving highly critical problems of alleviation poverty. In this domain, fewer response to the recommended dose of chemical fertilizers and low response of some fields to fertilizer application are the main constraints and bottlenecks not only for low production but also deteriorates the soil health. Integrated nutrient management is a tool which can offer good options and economic choice to supply plants with a sufficient amount of most macro- and micro nutrients and also can reduce the dose of chemical fertilizers, create favourable soil physiochemical conditions and healthy environment, eliminate the constraints, safeguard the soil nutrient balance in the long run, generate an optimum level for sustaining the desired crop productivity, and lastly find safe methods to get rid of agriculture wastes. In addition it can be gained, a part of the applied organic manure is left with a high amount of crop residue after harvesting to the succeeding crop and these materials will be quickly decomposing and turn to high quality compost, which can improve soil properties and share in building soil organic matter, which is the main option of protecting soil from erosion.

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Pheromone: Info-Chemicals in Intraspecific Insects

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Introduction

Insects are massive clients of chemical signals and cues, which play diverse and fundamental mode of information transfer both within and between species. Indeed, it is likely that no other group of animals make such sophisticated use of chemical signalling in their biology. Chemical regulating insect behaviour are collectively known as “Semiochemicals”, derived from greek word “semeon” for signal. Semiochemicals may be classified into Pheromones (intraspecific semiochemicals i.e. communication within the same species) and Allelochemicals (interspecific semiochemicals i.e. communication within the different species). Semiochmicals are potential tools in pest management and they play an important role in insect behaviour such as search for food, sexual partners and egg laying sites, defensive activities, adverse environmental conditions and natural enemies.

Pheromone

Pheromones are those semiochemicals which mediate interactions between members of the same species and it is a mixture of chemicals released by an organism in the environment. These are volatile in nature and aid communication among insects. Pheromones are exocrine in origin hence, they were called ectohormones. Based on the response elicited pheromones can be classified into compounds that produce an immediate behavioural change following reception are referred to as “releaser” pheromone. Releaser pheromones may be further subdivided based on their biological activity into Sex pheromones, Aggregation pheromones, Alarm pheromones and Trail pheromones. In contrast, the chemical signals that stimulate a physiological change where the effects are not immediate are referred to as “primer” pheromone (e.g.) Caste determination and reproduction in social insects like ants, bees, wasps, and termites are mediated by primer pheromones. These pheromones are not of much practical value in IPM.

1. Sex pheromones: An intraspecific pheromone which is volatile in nature serving as long distance signals, emitted by receptive individuals to attract suitable mates. Female sex pheromones are usually received by olfactory sensillae on male antennae and males moth activated by the pheromone and flies upwind, following the odour corridor of the females. Majorly female produce sex pheromone in order to attract conspecific males except in cotton bollweevil, *Anthonomus grandis*, cabbage looper, *Trichoplusia ni* and Mediterranean fruit fly, *Ceratitis capitata*, red palm weevil, banana corn weevil where males produce sex pheromone.

Properties	Female sex pheromone	Male sex pheromone
Range	Acts at a long range. Attracts males from long distance	Acts at a short distance
Role of other stimuli	Play less role	Visual and auditory stimuli play major role
Action elicited in the other sex	Attracts and excites males to copulate	Lowers female’s resistance to mating
Importance in IPM	More important	Less important

The mechanism involved in release of the pheromone in a short range is mainly passive evaporation of the pheromone from and exposed gland surface. It is seen in pyralid moths that it curls the abdomen up above the body to allow maximum exposure of the everted gland and to facilitate pheromone emission they vibrate their wings.

For long distance attraction of mates Lepidoptera are extensively studied where the female pheromone glands are ectodermal origin, and found in close association with the cuticle (Wigglesworth, 1972). For example, the pheromone glands of female bagworm *Tryridopteryx ephemeraefirmis*, are found on the thorax.

Sex pheromone are usually emitted at a specific time of day or night and there is evidence that calling behaviour is governed by an endogenous circadian rhythm that may persist for several days under continuous darkness in *Pseudaletia unipuncta* (Turgeon and McNeil, 1982). Over short distances non-volatile sex pheromone plays a significant role. These compounds protect insects from desiccation which are typically a subset of the cuticular lipids.

2. Anti-aphrodisiac pheromone: This pheromone is transferred to female by males of some insect species during mating which reduces the attractiveness of mated females to other courting males. It is reported in Drosophila fruit flies and plant bug, Lygus Hesperus. The presence of anti- aphrodisiac pheromone benefits both sexes where the mated females suffers less from further mating by other males and delaying remating reduces sperm competition, assuring higher probability of male paternity.

3. Aggregation pheromone: It is produced by adults of one or both sexes and mediates the behaviour of both sexes. These pheromones induce aggregation and congregation of insects for protection, reproduction and feeding or combinations thereof and also provide effective defence. Aggregation pheromone can be used in insect pest control by including insect to aggregate and attack wrong host plant.

Females of bark beetle, *Dendroctonus* frontalis produce aggregation pheromones eliciting mass attack on host tree which attract both sexes so that the host's defences are overwhelmed and beetles can successfully colonize the tree. Males of phloem beetle, Ips confuses incorporate their pheromone in faecal matter which attract both male and female to the infested tree.

Aggregation pheromone play a critical role in the life cycle of one of the world's most devastating insect pest, the dessert locust, *Schistocerca gregaria* which is produced by different developmental stages influencing densities and rate of sexual maturation and oviposition behaviour. Aggregation pheromones of Coconut Rhinocerous beetle and red palm weevil are used for monitoring or mass trapping the pests in India.

4. Marking pheromones: Females of herbivorous and entomophagous species use marking hormone as oviposition deterrent to reduce intraspecific larval competition. This pheromone is extensively studied in tephritid fruit flies. The pollinating Hymenopterans mark flowers with repellent signal after nectar feeding which reduces the foraging at a depleted source of nectar. In case of Bumble bee marking pheromone helps in locating flowers with high quality resources with an attractant found in tarsi.

5. Trail pheromones: The trail pheromones are used to find mates and also used as a road map for finding food. In case of social insects, this pheromone also maintains the social integration of the colony. Different sources of trail pheromone in ant are on the abdomen, including the poison, Dufour's, Pavan's and post pygidial glands, as well as the hindgut and glands on the legs (Billen, 1986; Holldobler and Wilson, 1990). It helps in locating suitable food resource in foraging ant by depositing chemical signal by dragging the abdomen on the substance while returning to the nest (Billen, 2006). In termite trail pheromone are produced from sterna gland

6. Alarm pheromone: Alarm pheromones are released in response to danger and are primarily an antipredator device, a warning to member of the same species about the presence or attack of an enemy (mostly a predator). The warning elicits different behaviour including increased levels of alertness, adoption of aggressive postures, and recruitment to the source of pheromone or conversely movement away from the signal. This pheromone is common in eusocial species like bees, wasps and termites.

It has been reported in hemipteran, isopteran and hymenoptera and is released by organs such as mandibular, anal, Dufours and poison gland in ants, cephalic glands in termites, sting apparatus and mandibular glands of worker bees and cornicles or siphunculi in aphids. Chemicals nature of the alarm pheromones are terpenes (aphid) an aldehyde (hemiptran) and formic acid (ant). Alarm pheromone can be used in IPM for controlling aphid. β Farnescene (EBF) has been identified as alarm pheromone of aphids, *Aphis gossypii*. When alarm pheromone of aphid is spray on plant, the aphids try to escape, fall down from the plant and get killed.

Conclusion

Semiochemicals is an alternative tool to synthetic insecticide approaches in Integrated pest Management (IPM) strategies. Pheromone is an important and promising tool for IPM program which involves in different strategies of pest management like monitoring, mass trapping, mating disruption, attract-and-kill and push-pull strategies. It can be applied single or in an integrated way with other strategies of management for monitoring and controlling various insect pests. So, it can be concluded that Pheromone is an eco-friendly and sustainable approach for pest management.

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Whey Proteins

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Introduction

Proteins are organic compound made of amino acids arranged in a linear chain and folded globular form. They are also known as polypeptides. Proteins can be classified according to their Structure, enzymes, receptor action and functions. Proteins can be obtained from various sources such as milk, meat, egg, soy, wheat, etc. Milk has two proteins: casein and whey protein. Whey protein is more soluble than casein and also has a higher quality rating. Whey is highly bioavailable and boasts having the highest biological value (BV) of any protein source. Therefore, a whey product is an excellent choice for those looking for a protein product that can be readily used by the body to build mass. Whey protein is defined as the "proteins not associated with the casein micelle or other milk particles such as membrane structures and somatic and microbial cells".

Whey Protein Composition

Whey milk contains less than 1% proteins comprising mainly β-lactoglobulin (β-LG), α-lactalbumin (α-LA), bovine serum albumin (BSA), immunoglobulins and proteose peptone, as well as several minor proteins including lactoferrin, lactollin glycoproteins, lactoperoxidase and transferrin. Whey proteins remain soluble at pH 4.6 and 20°C after the removal of caseins from milk.

Types of Whey

Types of Whey: Two primary types of whey are available as whey protein sources Acidic whey and sweet whey. Acid whey is produced by the generation or direct addition of acid and results in the precipitation of caseins. Sweet whey comes from rennet coagulated cheese when caseins are removed.

Advances in processing technologies have enabled the purification and separation of whey proteins which are sold as concentrate (WPC) or isolate (WPI) containing 35–80% and >90% proteins, respectively. The production of WPC begins with a step where centrifugation removes small cheese and casein particles followed by ultrafiltration, a physicochemical separation technique in which a pressurized solution flows over a porous membrane, allows the selective separation of whey proteins from lactose, salts, and water under mild conditions of temperature and pH. The protein purity can be increased by applying Dial filtration by continuously adding water to the ultra-filtration retentive stream. Finally, spray drying is used to yield a product with greater than 95% total solids. On the other hand, ion exchange fractionation processes are used for the manufacture of WPI. Whey proteins have a net positive charge at pH values lower than their isoelectric point (pH 5.2) and behave as cations that can be absorbed on cation exchangers. At pH values above their isoelectric point, whey protein has a net negative charge and behave as anions that can be absorbed on anion exchangers. Once proteins are absorbed onto the resins, a change in the pH of the mobile phase is used to detach them, followed by ultrafiltration, dial filtration, and drying. WPIs are characterized by high protein and low lactose and lipid concentration.

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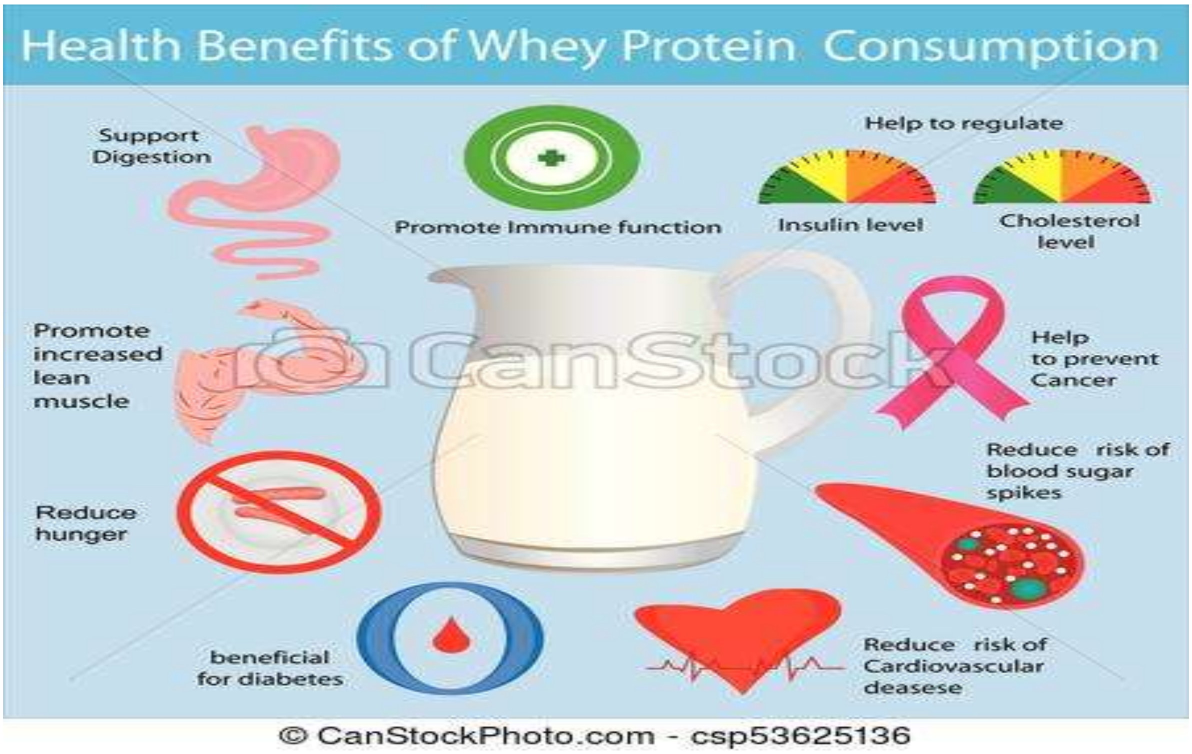
Benefits of Whey Protein

Whey protein contains the maximum concentration (23– 25%) of branched-chain amino acids (BCAAs) of any single protein source. This BCAA content is very important to athletes because BCAAs are an integral part of muscle metabolism and are the first amino acids of muscle sacrificed during intense exercise. Whey also has the ability to enhance endogenous GSH production. GSH is the body's most powerful naturally occurring antioxidant and also plays a role in immune system support.

Whey protein contains quadrapeptides, which have been shown to have opioid effects that is another powerful functional property that may help decrease the sensation of muscle soreness following intense weight training. Due to its excellent amino acid profile, solubility and digestibility, whey has a very high BV. BV is a measure of how well a protein is utilized by the body. One of the more interesting functional properties of whey protein is its ability to help stimulate IGF4 production. Whey has been shown to reduce cholesterol by inhibiting low-density lipoprotein (LDL) production. Whey protein has antibacterial, anti-viral activity; also, it reduces liver damage, improves immune system function, digestive function, and blood pressure, and reduces gastric mucosal injury.



Applications of Whey Protein

1. Muscle building: Protein supplements are being used every day by both old and young people. Most of these people are avid exercisers who work out and tear their muscles apart on a daily basis. Whey is also a fast-acting protein, which means that it is absorbed quickly into the bloodstream. It is widely believed that drinking a protein shake that contains whey shortly after a training session can speed up muscle recovery by making the essential and BCAAs readily available to the muscles.

2. Weight management: Whey protein can play an important role in weight management. Specific factors in whey protein like leucine are being investigated for their ability to promote weight loss by increasing satiety, influencing glucose homeostasis, and maintaining lean body mass and promoting fat loss.

3. Kidney Diseases: Whey has extremely high Protein Efficiency Ratio which is important in conditions like renal failure where protein intake must be limited and it is most prudent to consume the highest quality proteins (like WPI and egg white proteins) rather than lower-quality proteins (like red meat and dairy) that produce more problematic metabolic waste by-products and residues.

4. In Males: For promoting weight loss, increasing the muscle mass, healthy aging and athletes and body builders, whey protein is the most easily and quickly absorbed protein available. It helps build muscle by stimulating maximum protein synthesis.

5. In Females: The second most abundant component in whey protein is a-LA, which is one of the main whey proteins in human breast milk. They are not allergic to dairy proteins. For tatting women protein is essential for proper fetal and infant development, particularly brain development, and helps prevent gestational diabetes.

6. In Children: Whey protein helps stabilize children's blood sugar and increases the production of feel-good brain chemicals that help increase mental clarity and focus. It also provides the protein essential for growing bodies, particularly brain.

7. In Adults and Elderly People: As a person get older, his/her body becomes less efficient in absorbing protein. Whey protein is the most easily absorbed protein available. It can reverse the aging process and rebuild the immune system. It can ensure that you are rarely, if ever, sick, and that you will begin to look and feel years younger.

Conclusion

Whey protein is a pure, natural, high-quality protein from milk. It is a rich source of all of the essential amino acids needed on a daily basis by the body. In its purest form, as WPI, it contains little to no fat, lactose, or cholesterol. Whey protein has one of the highest PDCAAS (a measure of protein bioavailability) and is more rapidly digested than other proteins such as casein. Whey is available in three major forms, i.e. WPCs, WPIs or WPHs. Whey may also support a healthy response to stress and help maintain healthy levels of the brain's neurotransmitters. There are some great benefits of the whey protein on HIV infected person. It is beneficial in conditions like hepatitis, blood pressure, chronic fatigue, kidney diseases, for weight loss, and for an increase in the immune power.

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Tank Silt: Crop Yield Booster

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Introduction

In India, 580,000 tanks of various sizes are located across the country, of which 150,000 tanks are spread in the semi-arid region of Deccan plateau. Among all state, Maharashtra have highest numbers (42 per cent) of irrigation dams. The main use of tank systems in agriculture is to increase groundwater level, provide drinking water for livestock, and irrigation for crops. Tanks also become a good source of silt which is use as fertilizer, amendment and constructing materials. Tank silt use will enhance and protect soil quality and improve soil as well as crop production.

Benefits of Tank Silt in Agriculture

1. Ground water level and water availability: Desiltation of the tanks was recharging the groundwater tables and increased water availability in the tanks due to increase of storage capacity.

2. Soil physical properties: Tank silt application will improve soil texture, water holding capacity and bulk density. Water holding capacity of light texture soil can increase with use of tank silt and also change the texture of light soil. Bulk density of soil will increase with the tank silt.

3. Crop yield: Farmers reported that silt application increased crop production by 50 percent and also reduced the use of fertilisers thus reducing fertilizer cost by 50 percent. The crops also looked green and healthy. Cotton, maize, soybean was show good response to tank silt.

4. Soil fertility: Tank silt analysis report showed that it contained high amount of organic carbon, Macro nutrient and micro nutrient require for plant to complete its life cycle. With use of tank silt, soil fertility will increase. Improvement in clay content will not only retain higher moisture but will also reduce the losses of nutrients through leaching because of improved cation exchange capacity (CEC).

5. Fertilizer use: In many crops, fertilizer use was fertilizer cost was reduced due to the use of tank silt. In Cotton and soybean, cost of fertilizer was reduced by 8 and percent respectively where as in Sorghum and Bengal gram, it cost reduced by 15 percent and 6 percent respectively. In the case of perennial crops like sugarcane, it saving percent was reach to 31.

Issues Coming with Tank Silt Use?

1. Lack of support of government support towards tank silt application
2. At lower level, unwanted interference of the Revenue staff was more for taking silt from the tanks for agriculture purpose.
3. The authority does not take considering benefits of tank silt.
4. Farmers are not aware with the procedure to obtain tank silt.
5. Transportation cost and the cost of spreading silt become a problem to farmer.

Effect of Tank Silt on Crop Yield

Use of tank silt in agriculture is an indigenous practice rarely followed in our country which can improve soil fertility. Grain yield of maize with use of tank silt was increased by 200 – 600 kg ha^{-1} compare to without use tank silt. In cotton, tank silt was increased yield up to 1000 Kg ha-1 (Osman, 2007). Maximum benefits were observed in chilli and turmeric with application of tank silt. Grain yield of many crops were increases with the application of tank silt may be due to increase of water productivity and fertility of soil (Sharma et al., 2015).

Conclusion

Tank silt can use in agriculture as fertilizer and amendment. It contained enough amount of essential nutrient which has improved crop production. Tank silt also contained huge amount of silt and clay particle which change inactive soil in to active form by improving physical, chemical and biological function of soil that mainly contributing to crop yield.

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Reinvigorating Food Sector Amid Covid-19 Pandemic

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Covid-19 pandemic has transmuted our world and it has aggravated the situation of entire sectors of society. Food sector is also vulnerable and its situation has been substantially exacerbated due to covid-19 pandemic. In India, lockdown was imposed on 24 April 2020 during which food supply chain was enervated due to several reasons such as shortage of raw materials as well as labours, restriction on transportation and supply networks. Moreover, Indian food retail market was facing demand side shock due to trepidation among consumers which engendered panic buying. The aim of this article is to provide insight about problems in front of food sector in India amid of covid-19 as well as appraisal of strategies not only to catalyse its recovery but also to ensure its betterment in post-pandemic period.

Understanding the Problem

1. From demand side perspective: In India, during lockdown sharp hike in demand of Fast-Moving Consumer Goods products were observed by Indian retail sector resulted in demand side shock which can be ascribed with panic-buying inflamed with hoarding behaviours by consumers. When government imposed various rules, many consumers started stockpiling of food supplies and other essentials in anticipation of movement restrictions and fear of disruptions to food distribution systems due to which supermarkets and grocery shops especially in urban areas experienced 75% hike in store visit.

Covid-19 crisis not just created distress among consumers but also upended consumer preferences. Many consumers started preferring home-cooked food instead of foods from restaurants due to which situation of restaurant and catering industry has been significantly exacerbated.

The problem of panic-buying by consumers is ephemeral and not much significant but in long run the demand centric food supply chain can be affected due to several reasons such as fall in income and tectonic shift in consumer preferences, For example, we can expect consumers to become more price sensitive and the demand for income elastic products to decline more sharply as consumers demur to buy more expensive items. As retail market is consumer centric this may influence contractual relationships with suppliers. In the event of a severe economic downturn and decline in demand, retailers may squeeze supply chains for cost efficiencies. As these are typically low-margin businesses, this shall create challenges for many food processors and suppliers. Small food retailers with less bargaining power relative to the larger food retail chains may also face challenges.

2. From supply side perspective: Covid-19 pandemic has significantly aggravated the situation of food businesses globally in different ways. In India, Majority of food processing sector is still unorganized, According to Ministry of Labour and Employment, Government of India, A sector is called as unorganized when an enterprise owned by individuals or self-employed workers and engaged in the production or sale of goods or providing service of any kind whatsoever, and where the enterprise employs workers, the number of such workers is less than ten.

As compared to organized food processing sector, unorganized food processing has been largely affected due to the covid-19 pandemic. Presently, main challenge in front of unorganized sector is supply chain disruption which can be ascribed to shortage of manpower, transportation and poor distribution systems. As small food processing units are more labour intensive as compared to big food processing companies so shortage of manpower have rendered them more vulnerable to this disruption as compared to large food processing companies. However, if we focus on most of the food processing giants, currently they are not looking to make profits, but are rather looking for a way to stay afloat and provide for their stakeholders.

From industrial-economic point of view, the liquidity in the food retail businesses is dependent on sales of goods and collection of profit, liquidity is important as it keeps the companies afloat. In case of food industry fixed capital expenditures are constant and high. Disruption of supply chain has disturbed liquidity inflow which has threatens the existence of many small-scale food businesses. Moreover, in order to cut down expenses, many food businesses are implementing strategies such as salary cuts and reducing number of employees which has engendered problem of unemployment.

Strategies to Resilience

There is one famous saying that "when there is a problem, there is a solution." & problem of covid-19 is no exception to it. As Charles Kettering, a renowned American inventor said "a problem well stated is a problem half solved". The root of current crisis can be attributed to inefficacious supply chain also present consumer mindset need to be taken into consideration. So, there is strong need to ameliorate current situation by developing and implementing more sustainable solutions. So, there is need to institute some strategies as follows.

1. Revamping supply chain management: Better amenability of food supply chain can be a key factor in resiliency. For example, Future Group which is one of the leading retail chains in India exhibit their own logistics and procurement units. This allows them to achieve better control and coordination on their sourcing in the face of constraints.

More efforts need to put in-order to enhance resilience through strategic inventory management plans and flexible procurement strategies will be important. Secondly, manufacturers should implement strategic inventory management plans and flexible procurement strategies. On individual enterprise level, risk management plans should include contingency planning to deal with labour shortages or disruptions to transportation and supply networks.

2. Be consumer centric: Food businesses need to understand consumer behaviour and should enhance flexibility in marketing by diversifying the customer base and use effective ways to reach consumers such as by e-commerce platforms.

3. Use of technology: Technology can be a wonderful solution on current crisis. Development and use of modern technologies to improve and ensure hygiene and safe food processing which will mitigate the risk of covid-19 transmission. Contactless delivery and e-commerce can be perfect epitome of technology.

4. Facilities and training for staff: Workers are important in value chain and their proper management can be a boon in order to achieve efficiency and growth. Strategies such as Increasing flexibility of labour sourcing and timing, including facilitating the movement such as facility of transport for workers to processing plant and safety of workers by implementing good hygiene practices, good manufacturing practices and training of staff under programs such as Food Safety Training and Certification (FoSTaC) which will help to improve food safety culture throughout the food chain thereby assuaging consumers' trust.

Conclusion

Food sector is one of the most important sectors in Indian economy. So, understanding unprecedented shocks to the food system pertaining to covid-19 circumstances such as disruption of food supply chain pertaining to labour intensive segments and changing consumer behaviour amid pandemic is need of an hour. For future, manufacturers especially Small and Medium Enterprises (SMEs) and other elements in food supply chain such as raw material suppliers, distributors and retailers should revamp existing strategies in order to provide sustainability to food system right from farm to fork. Even though government has started unlock phase still it will take at least 6 months for food SMEs to recover substantially, if not to the pre-pandemic levels, but at least modestly close to it. Also, there is crucial need that government should bolster food processing industry for catalysing its recovery by instituting stimulus packages or effective stratagem to revitalize it.

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'Hydrogel' – A Micro Water Reservoir in Agriculture

Article ID: 31550

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Introduction

Water is major input in agriculture which determines the yield. Scarcity of irrigation water due to monsoons vagaries, seasonal temperature fluctuations and prolonged drought conditions has led to reduced crop yields all over the world especially in arid and semi-arid regions. India experiences seasonal drought every year during summer months and water scarcity problems exist in the midland and highland regions even in the years of normal rainfall. In the changing climate scenario of unpredictable monsoon and related factors, water availability for farming is becoming a major threat for the farmers.

Hydrogel is a new type of water absorbing macro molecular polymer material which has a water uptake potential as high as 100,000% of its own weight in a short period of time. The gel mitigates the risk of growing crops when water availability drops.

What is Hydrogel?

Hydrogels are hydrophilic or colloidal gel in which water acts as the dispersion medium. The softness, elasticity, swelling, absorbent nature, flexibility and the capacity to store water are some of the important properties of hydrogels. These polymers can be produced synthetically and also obtained naturally. A semi-synthetic polymer called "Pusa Hydrogel" was developed by Indian Agriculture Research Institute (IARI), New Delhi to meet the requirements of water productivity in agriculture. It has a three - dimensional structure which are bonded physically or chemically through polymer networks entrapping water in intermolecular space. The increment in water absorption capacity of the soil is due to the hydrophilic groups attached to the polymer backbone whereas their resistance to dissolution is due to the cross-links between the network chains. The synthetic hydrogel has replaced natural hydrogel due to enhanced absorption capacity of water, stability, and hydrophobic or hydrophilic nature. Hydrogel can be mixed with soil when seeds are sown in field. The gel has the capacity to absorb water and expands to 300 times of its original size. It sticks to the roots of the plants and when the soil moisture falls, the gel sheds water to nourish the crop. It increases the plant yield by 10-25 per cent.

How it Works?

The hydrophilic groups such as acrylamide, acrylic acid and carboxylic acid of the polymer chain is responsible for the water absorption mechanism of the hydrogel. When the polymers are placed in water, the water molecules enter by the process of osmosis, and H+ ions react and come out as positive ions. This process leaves negative ions along the length of the polymer chain. Then the hydrogel will have several negative charges down its length, these negative charges repel each other, and forces he polymer chain to unwind and open up. They also attract water molecules and bind them through hydrogen bonding. When the surroundings are dry, it dispenses up to 95% of the stored water depending on the dryness of the surroundings and will start to rehydrate and repeat the process of storing water when exposed to water again. This works for 2-5 years and it is biodegradable in nature as it decomposes in the soil.

The swelling capacity and gel modulus depend greatly on the quantity and type of cross links used. Poly acrylates polymers are nontoxic, non-irritating and non-corrosive in nature and tested to be biodegradable with a degradation rate of 10-15% per year.

ISSN: 2581 - 8317

Types of Hydrogel

In agriculture, three types of hydrogel are usually used. They are:

1. Starch graft copolymers.
2. Cross - linked polyacrylates.
3. Cross - linked poly acrylamides and acrylamide-acrylate copolymers.

These are also known as super absorbent polymers (SAP), absorbent gels, super soakers, super slurpers, water gel etc. SAP used in agriculture are made from acrylic acids and a cross linking agent like potassium by solution or suspension polymerization. The polymer produced is called poly acrylate. Potassium poly acrylate is the major element used in hydrogel technology and marketed as hydrogel for agriculture. Its capability for longer periods of water retention and high efficiency in soil with no toxicity issues makes it more attracting among the users.

Application Methods

Hydrogels can be applied in two ways:

1. As soil conditioners to stabilize the surface of soils and to inhibit crust formation and improve water holding capacity.
2. To improve the poor structure at greater depths by aggregation and to enhance the plant growth.

Dry Method to Subsoil

Dry polymer such as PVA is applied to subsoil by mixing with sandy soil into the depths of about 15-25 cm and then subjecting to wetting prior to cultivation. Improvement in structure, increased water penetration and retention capacity are observed in line with the swelling of polymer/as a result of swelling of polymer and hence decreases runoff and erosion losses. This method is applied for long term intensions since the polymer must absorb water prior to becoming beneficial, and it cannot be recommended for immediate sowing.

Wet Method to Top Soil

The polymer solution is sprayed onto initially wetted topsoil, followed by drying to create a water- stable aggregate that resist erosion. This method is particularly well adapted to sowing immediately afterwards and can also be adopted to reduce water consumption in irrigation systems where soils having poor ability to retain moisture. These wet polymer methods can also decrease soil erosion by being applied to top soil or driveways of irrigation.

Role of Hydrogel in Agriculture

Hydrogel can be used to provide a better growing environment for the crops.

It will enhance the growth of plants under adverse conditions and provide favourable microclimate for plant development. They are used in agriculture to obtain higher yield and to improve the quality of plants in a shorter time span using less space at a lower cost. It has got wide applications in agriculture as soil conditioners, planting and transplanting gels, seed coatings for controlled germination, soil aerators and soil sterilizing agents.

It can also be used in various stages of development stages viz., germination, growth, flowering and fruit formation. Their successful application in agriculture includes more rational plant containers, films for soil sterilization and as coverings and sheeting's for protective structures.

It works based on an anti-drought mechanism and reduces the water requirement of plants. Typically, a farmer who irrigates his field once in every four days for high value crops, can extend the irrigation to once in every eight days by the use of hydrogel, thereby saving 40-70 per cent of water. It also reduces fertiliser application, as it binds the fertiliser to the root thereby reduces leaching of fertilisers. The gel also helps the crop to store water for a dry spell and aids farmers to cope with the changing climatic situation. Application of hydrogel improves soil moisture contents under different sowing techniques as compared to soil without hydrogel. (Rehman et al., 2011).

Super absorbent hydrogels are used as water saving materials for the renewal of dry and desert environment.

Advantages of Using Hydrogel in Agriculture

1. Cut down irrigation water consumption.
2. Enhance fertilizer retention in soil.
3. Lower death rate of plants and improve plant growth.
4. Improve physical properties of the soils and restores biota.
5. Promote seed germination and rate of seedling emergence.
6. Improve root growth and plant density.
7. They relieve the plants from moisture stress and make them to with stand prolonged moisture stress.
8. Reduces the nursery establishment period.
9. Reduce irrigation frequencies and fertilization requirements of crops with improved input efficiency.

Conclusion

Hydrogel, a micro water reservoir in agriculture is emerging as a promising method to mitigate problems like water crisis, drought and sandy porous top soils. It is an ideal water conservation technology to curb the predominant problems of water scarcity in agriculture while limiting environmental losses like ground water contamination and soil degradation by moisture loss.

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Alternative Sweeteners Production from Sugarcane in Bihar – A Review

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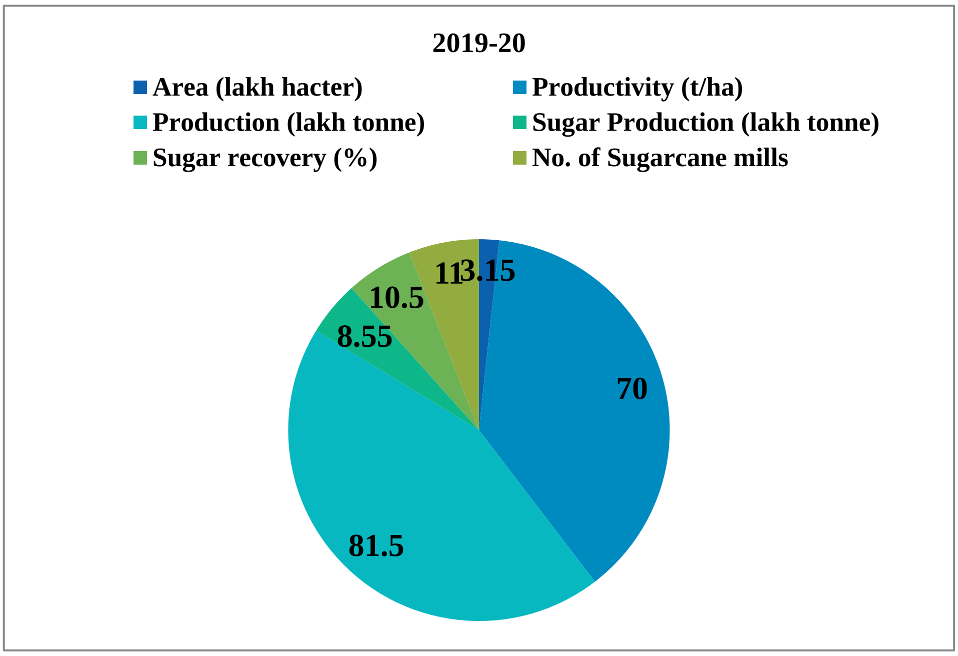
In present scenario the Bihar Agriculture as a whole is undergoing several transformative changes. Growing population, changing lifestyles, expanding urbanization and accelerating climate changes are creating new challenges for Bihar agricultural research and development. Sugarcane occupies an important position in agrarian economy of Bihar. Bihar is an agriculture dominating state and its economy mainly depends on agriculture. About 77% of the population primarily engaged in Agriculture which contributes about 35% to the state domestic product. The area under sugarcane during 2019-20 is soared up to 3.15 lakh hectares and during 2018-19 state produced 182.85 lakh tonnes of cane with an average productivity of 60.15 tonnes/hectare (Deptt. of Cane development Govt. of Bihar) as indicated in fig. 1. During current crop season more than 8.40 lakh tonnes of sugar was produced by sugar mills of the state. The sugar production in Bihar likely to be increased to a record of 8.55 lakh tonnes in 2019-20 from 3.85 lakh tonnes in the year 2010-11 (Bihar Govt. Statistics).

Despite rapid urbanization and growth in industrial and service sectors, progress of the rural economy remains central for overall socio-economic development owing to its forward and backward linkages. The liberalizing economy has brought about enhanced market and technological opportunities, thereby pushing for greater interface between the sub- economic sectors. A reallocation of factors of production from agriculture to more productive non-farm sectors would bring about the required transformation in rural-based economies (Chand, Srivastava and Singh 2017). In this regard, jaggery sector assumes importance for providing the "agriculture-industry" linkage by not only absorbing surplus labour from agriculture, but also spiralling economic activity to boost rural incomes. The provisioning of subsidy, other incentives and training to farmers towards adoption of improved variety of seeds have facilitated the increase in production.



Production and productivity (estimated) of sugarcane in Bihar (2019-20)

About 60-70% of sugarcane produced is supplied to sugar factories for preparation of sugar while around 10-15% is used for preparation of jaggery. The cane map of Bihar is shown in fig. 2 indicates the situation of sugar mills in Bihar. The estimates by the National Commission of Agriculture (1976) show that per capita requirement of sweeteners would increase to 40 kg per head per annum by 2030 A.D. in India. The rising demand for sweeteners has brought focus on jaggery, an important cottage industry in economies such as Bihar for their implications on employment and income. As a traditional non-centrifugal sugar, jaggery is produced in small units using local machinery in rural areas. In Bihar, like in most parts of India, jaggery is produced conventionally through the process of heating purified cane juice by employing about 10 semi-skilled workers. In past, Bihar had 33 sugar factories located at almost every corners of Bihar and was contributing 20-25% sugar production of the country. At present, its contribution has declined to 2-2.5%.

Sugarcane is grown in an area of 12,450 ha in 13 non-mill districts of Bihar *viz. Madhubani, Saharsha, Madhepura, Banka, Dharbhanga, Jamui, Purnea, Begusarai, Bhagalpur, Vaishali, Nawada, Lakhisarai and Munger.* The area coverage of non-sugar factory districts of Bihar is given in table 1. The canes produced in these areas are not utilized for manufacturing of sugar but largely for the manufacture of jaggery. Traditional methods of jaggery making have become non profitable business due to the production of low quality jaggery which fetches low prices. More so, this cottage industry remained neglected due to cane crushing inefficiency, juice clarification, inefficiencies in heating and open pan boiling system, meagre financial and policy support to jaggery units, lack of technological intervention in juice extraction, open pan furnace inefficiency, jaggery moulding and packaging, quality control and hygiene issues, lack of skill , non-adoption of R&D interventions due to paucity of infrastructure, development fund, improper jaggery market and extension support.

Nutritive Value of Organically Processed Jaggery and Sugar

The analysis of organic jaggery (Table-2) indicated that it is a bank of vitamins and minerals. It is rich in calcium, phosphorus and iron. The jaggery made by using natural clarificant is delicious golden in colour and prominent source of energy. Because having high vitamin C, vitamin A and other minerals, it can act as a vehicle to fight iron and vitamin deficiency. In contrast, the composition of sugar clearly indicated that sugar is only source of energy (398.0 Kcal) with sucrose content of 99.5%, without any additional contribution of vitamins and minerals. The above data clearly indicated that nutritive value of sugar is negligible and so it is inferior for healthy life. The nutritive and medicinal value of Jaggery has been also reported by Tiwari et. al. (2014). It provides glucose to the body, which is started as glycogen & burned by the muscles when they require energy. It helps to hydrate the body quickly and speed up the recovery process after jaundice. Jaggery has some antioxidant which helps in purifying the blood & curing problems. People suffer from cough, constipation and water retention problems can also overcome these problems. The jaggery made by plant clarificant becomes more nutritionally rich. The daily use of jaggery increase human life span and its regular consumption reduces the incidence of diabetes (Kumar, 1999; Singh, 1998).

Table 2. Constituents of jaggery and sugar in 100 g

Sl. No.	Particular	Jaggery	Sugar
1.	Sucrose (%)	75.5	99.5
2.	Water (gm)	3.80	-
3.	Protein (gm)	0.40	-
4.	Fat (gm)	0.10	-
5.	Carbohydrate (gm)	95.0	-
6.	Total mineral (gm)	0.60	-
7.	Calcium (mg)	80.20	-
8.	Phosphorus (mg)	40.20	-
9.	Iron (mg)	11.40	-
10.	Thymine (mg)	0.02	-
11.	Riboflavin (mg)	0.05	-

12.	Vitamin C (mg)	0.50	-
13.	Carotene (Vitamin A) (µgm)	168.0	-
14.	Energy (Kcal)	383.0	398.0

Source: Sinha et al. (2015)

In Bihar most of the sugar factories are located in north western part only while other part of the state is lacking sugar industries and thus Jaggery Production is the only option for strengthening rural economy through cane cultivation and Jaggery production.

Jaggery is marketed in different shapes, colour and texture. There are three forms viz. solid, liquid and granular form of jaggery. Most of the jaggery (80%) is prepared in solid form and the remaining (20%) is prepared in liquid or granular form. Jaggery may be light golden, golden, dark golden, light brown or brown in colour. In India, the production of jaggery ranges between five million tonnes to seven million tonnes creating employment opportunities to the millions of people in rural areas. It is estimated that two third of the sweetener requirement in rural areas is met by jaggery. The jaggery industry in the country has thus, been continued to be an industry of great importance and relevance.

Jaggery Status in Bihar

The districts of Madhepura, Bhagalpur, Banka, Gopalganj, Darbhanga, West Champaran, and Madhubani are the major jaggery producing parts in Bihar. Estimated figures of jaggery production in Bihar for the period 2010-11 to 2016-17 are presented in table 3.

Table 3. Status of Jaggery production in Bihar:

Year	Sugarcane production	Weight of sugarcane utilized for jaggery production	Jaggery Production
2010-11	13.41	1.61	0.13
2011-12	17.75	2.13	0.17
2012-13	22.22	2.67	0.21
2013-14	17.94	2.15	0.17
2014-15	21.12	2.53	0.20
2015-16	18.18	2.18	0.17
2016-17	18.24	2.19	0.18

Note: Assumed that 12 per cent of sugarcane is utilized for jaggery production; Recovery percentage for jaggery as 8 per cent

Source: Indian Sugar, 2019

Jaggery Production Technology

For jaggery production matured cane with high sucrose content and low colloidal impurities is selected. Softness, low mineral content and light-coloured varieties are other parameters for consideration. Efforts should be made to crush the cane within 24 hours after harvest to prevent inversion of sucrose. De-trashed cane variety suitable for jaggery making is crushed in horizontal or vertical crushers. Horizontal crushers yield higher juice recovery in comparison to vertical crushers. Crushed juice is allowed to settle before passing through multistage filtration. Heavy impurities get settled at the tank bottom due to gravity. Thus, obtained decanted juice free from dispersed foreign matter is heated on bagasse fired open pans. Three pan furnaces utilize the waste heat of flue gases for preheating of raw cane juice. It is more suitable for continuous production of jaggery. Boiling and concentration of juice takes place in the pans. In order to remove colloidal impurities, use of clarificants from vegetable sources, deola, okra, phalsa, caster, groundnut, soybean etc., are recommended to maintain food value and keeping quality of jaggery. Deola is most commonly used for jaggery

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making. The juice is concentrated in pan till it reaches the striking temperature of 114-1180C. At this point, molten jaggery is transferred to cooling wooden pan before final transfer of moulds. Moulds can be of different shapes and sizes. Conditioning is done to attain jaggery moisture within range of 5-7% for storage purpose. For ease of handling and packaging, and increased market value, cubical moulding frames for 10 or 20 g jaggery are preferred. Moisture content in jaggery should not exceed above 6% and should be kept at a relative humidity of 43-61% for good keeping quality of jaggery (Chockalingam, 1985).

The operations involved in jaggery manufacturing process from sugarcane as follows:

1. Sugarcane Planting → Maturity → Harvesting.
2. Crushing → Settling Filtering.
3. Concentration (Boiling) → Cooling → Moulding.
4. Packaging → Storage → Marketing.

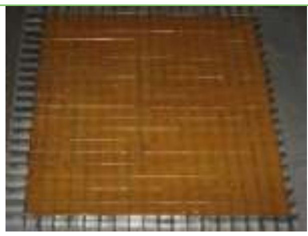
Process Flow Diagram

Cane Production

Harvesting and Detrashing

Crushing and Filtration

Concentration in open pan using vegetative clarificants



Transfer to cooling pan for mixing and cooling Cubical moulding of jaggery

Conclusion

Bihar is, undoubtedly one of the major producers of sugarcane in the country and nearly 50 per cent is used for production of sugar. The growing awareness of the harmful effects of consumption of refined sugar have brought a need to focus on alternative nutritive sweeteners such as jaggery. The palatability and high nutritive content in jaggery make it the most sought-after sweetener. The medicinal properties and high energy content present in jaggery have enabled it to be used in herbal medicines. In this context, Bihar holds a lot of potential in the production of jaggery in rural areas both for consumption and meeting the export demands. As an unorganised sector, it is one of the important rural-based cottage industries providing alternative sources of income. Jaggery is processed using traditional manufacturing processes in traditional units by small farmers using sugarcane as a primary raw material. Jaggery accounted for about 1.95 per cent of the total value of output from agriculture and allied activities in Bihar during 2013-14. Since most jaggery producing enterprises are small, a cooperative arrangement which would organize the producers and offer ways to arrive at reasonable solutions for processing, packaging and marketing of jaggery would be beneficial.

The quality jaggery produced will be sold out at higher price in wholesale market. Hence, by adopting the technology, the farmer can enhance their income by selling the value jaggery at Rs.100-120/kg instead of Rs.60/kg (price of traditionally made jaggery). The socio-economic impact of jaggery cottage may be ruled out because of its contribution in rural development. It is a cottage industry managed by semi-skilled workers and its modern techniques will definitely provide benefits to farmers for quantum jump in their income significantly. It will improve the product quality, hygiene, and market access to reap economic benefits of premium jaggery product in market. Possibilities for diversification of jaggery with other value-added products processing such as pelted and wafer cattle feeds making with molasses can be explored.

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Sensors in Agriculture

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Introduction

Computer controlled devices is a device that accepts physical inputs from external source and pair this information with computer-controlled instruction to perform specific functions.

Crop management depends on having the right information to make necessary decisions. To improve crop management, a number of sensors and instruments can be used to gather information. A computer control system uses the information to make regular adjustments to equipment settings to optimize growing conditions.

Monitoring the growing conditions is essential. Even without automated control of the production system, it is not possible to make the right decisions about the crop without having the right information. Temperature and relative humidity (and/or vapour pressure deficit) need be monitored in every greenhouse. Light levels should be checked at least periodically to make sure covering materials are performing adequately, but ideally light levels need to be checked on a regular basis in order to know the optimal temperature regime for the crop. The electrical conductivity and pH of both the feed and drain solutions should be monitored in every hydroponic system.

A sensor is defined as a device that stimulates and responds in a unique manner. Seniors embedded the components in robots which perform complex task in the field of Agriculture.

Sensors in Agriculture

1. Agriculture sensors are used in smart agriculture farming.
2. Sensors give data to the farmers, that helps to monitor crops and the conditions related to environment.
3. Agricultural industry uses sensors, which are embedded in robots, drones and weather station.
4. Mobile apps controls sensors for specific applications.
5. Sensor are controlled with Wi-Fi devices or by cellular towers with mobile app.

List of Agriculture Sensors

Agriculture Sensors	Functional description
Location Sensors	Determines the latitude, longitude and altitude of any position within specified area, GPS satellites is used for this purpose.
Optical Sensors	To measure the properties of the soil, sensors uses light. Optical Sensors are installed on satellites, drones or robots to determine clay, organic matter and moisture contents of the soil.
Electro-Chemical Sensors	Sensors helps together chemical data of the soils by detecting specific ions in the soil. Provides information related to form of pH and soil nutrient levels.
Mechanical Sensors	Soil compaction or mechanical resistance are measure by mechanical sensors.
Dielectric Soil Moisture Sensors	To measure moisture levels, the dielectric soil moisture sensors is used.

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Air Flow Sensors	Air flow sensors are used to calculate the air permeability. They are used in fixed point or in mobile mode.

Advantages of Agriculture Sensors

1. Sensors helps to meet the increasing demand of food by maximizing yields with the help of minimum resources such as water, fertilizers and seeds.
2. Simple for usage, easy to install and cheaper.
3. Sensors are used for global warming and polluting the environment
4. Wireless chip in sensors helps to control remotely.

Disadvantages of Agriculture Sensors

1. In developing countries internet connectivity is not available in all parts of rural areas as Smart farming and IoT technology requires internet.
2. The infrastructure requirements such as traffic systems, smart grids, and cellular towers are not available in all the areas.

Conclusion

The uses of Agriculture Sensors are used in agricultural weather stations, sensors which gives information such as soil temperature at various depths, air temperature, rainfall, leaf wetness, chlorophyll, wind direction, solar radiation, relative humidity and atmospheric pressure. Agro based industries develop equipment's with the sensors. Farming applications such as leaf wetness and measuring trunk diameter also uses sensors. Sensors are used in agriculture drones for spraying insecticides and pesticides. Agriculture Sensors are used in solar based pumps which are operated by mobile phones and which reduces cost to electricity. Sensors are used in E-fences which saves crops from animals such as elephants.

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Attaining Self-Sufficiency in Pulses Production in India

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For the majority of the low-income households in India, besides being rich in essential minerals, vitamins and fibers, a major source of dietary protein is Pulses. Apart from serving as a cost-effective and nutritionally balanced rich source of protein, pulses form an important constituent of the food basket, for people. But, during the past decade, the production of pulses has lagged far behind the consumption needs. The increasing demand and fall in domestic output have resulted in a sharp rise in the prices of pulses. Realizing the problem of the sharply rising costly imports coupled with stagnant pulses production and the high strategic importance of pulses in food and nutritional security of the poor peoples in India, the call of the hour is to strategize boosted and sustained domestic production of pulses to attain self-sufficiency, especially at the household level, in the shortest period of time. India ought to become self-sufficient in pulses and attain the projected production of 34 million tonnes by 2030. Before addressing the issues or drafting the strategies ahead for attaining self-sufficiency in pulses production one must know major gaps being left prior and take them as stepping stones for achieving the goals. The perusal of the majority of the literature available and analysis of data clearly indicates the contradicting output on several vital components is not up to the mark. Say for instance distribution of quality seed and its flow from the breeder's plot to the farmer's field. Most of the researchers claim satisfactory production of breeder seeds and other classes of quality seed productions for the farmer's welfare. But the statics of its origin from the research field to farmer's field is far more elusive. Also, huge yield gaps that of potential yield and realized yield aggravates the scenario more towards low yield and productivity. Pulses being more susceptible to high incidences of pests and diseases, including blue bull menace, face more losses. These losses are not only confined to farmer's field but post-harvest losses also make the whole picture grim. Another dimension to lower yield of pulses is the half-heartedly adoption of complete packages of practices viz. improved varieties, IPM, IPNS, water management, conservation cultivation, mechanization etc. in a holistic way.

In India of the majority of poor and smallholder farmer's pulses are a strategically integral part of the food, nutrition and income security. To meet the domestic demand of the country, the import of pulses is not a feasible option since the pulses international market is too thin also doing so not only will burden the economy but is against the spirit of the Right-to-Food Bill.

Moving from deficiency to sufficiency can be achieved by a number of ways as pulse crops are grown in the country with their specific adaptation ranges. All it needs is an approach based on agro-ecological and socioeconomic capabilities that are differentiated and disaggregated in nature. Certain remarkable efforts like depending on soil moisture and water availability, include introducing a short duration pulse crop, viz. mungbean or urdbean or cowpea or horsegram, in vast rice-wheat and other fallows areas of the country. Selected pulse crops will save water without sacrificing demonstrated come that needs to be demonstrated at farmers' fields so that the farmers opt for diversification out of the rice-wheat system. In the target areas, in close collaboration with farmers, scale-up and scale-out the technologies and also testing of proven wholesome packages of technologies be carried out wholeheartedly for the desired impact.

Extremely sluggish total factor productivity (TFP) may be attributed to the 'extension problem', or to the failure of the farmers to use the new technology, or even to the shortcoming in the technology itself. Ascertain location-specific causes of the gaps and low factor productivity, and then by restructured state land use boards promote specific land and water use decisions to realize the yield and income potential. A cadre of dedicated pulses extension workers could be of great help and use to get the technologies moving and to ensure access of farmers to the technologies congruent with the research, development and transfer of agricultural technology. By application of public-private partnership seed production and distribution systems could be strengthened. Through farm mechanization promote mechanization in pulse production on a large scale which will reduce the cost of cultivation.

Natural resources viz: soil, water and biodiversity are shrinking fast. Pulses are important from both the angles to save and conserve the resources and to enhance their uses efficiency. To satisfy these objectives, pulses-based conservation agriculture is to be promoted. Use of pulses in alternative forms as catch, inter, companion or cover crop, and the unique and the most important role of pulses in nitrogen economy, carbon enrichment, climate resilience and wide adaptability is a win-win situation both for nature and mankind. To combat widespread nutrient deficiency of secondary and micronutrients viz., sulphur, zinc, boron and molybdenum in soils, adoption of the Soil Health Card be done and efforts should be made so as under integrated nutrient management these elements be included.

For accelerating pulses production assured and remunerative markets are essential. To achieve this, connectivity of the farm to the market be done physically and economically. At farm level increase their availability of food processing industries like Mini dal mills which could give more than 75 percent recovery. For increasing their use and adoption by farmers subside should be given. All these in a way reduce the post-harvest losses and improve the storability – both adding to the farmers' income. Farmers could get full value for their produce so in this direction Integration of pulses markets through ICT should be done along with promoting E-trade.

Keeping in mind the needs of the majority smallholders the future development of pulses shall be driven by technology and innovations. Application of frontier technologies with mainstay on achieving productivity break-through and facilitating mechanization through restructuring plant types and exploring new cropping patterns. Broaden the genetic base by using existing germplasm for pre-breeding. Search for new genes in wild as well as in other crop species be intensified so as to achieve a breakthrough in pulses yield as well as to enhance their resilience to climate change and other stresses. Application of novel technologies like transgenics, genomics and genome editing can result in increasing genetic gains. Through the development of super-nodulating plant types enhanced biological nitrogen fixation could be achieved thereby optimizing host and symbiont genotype combination. For increasing cropping intensity use of photo-thermal insensitivity and breeding short duration pulse varieties be encouraged. To minimize storage losses, strengthen research on storage structures and conditions. The focus be concentrated on increasing the nutritional value of pulses through bio-fortification and strategic value addition and strengthening research on value-added products.

It can be summarized that India is the largest producer of pulses in the world. But the demand has increasingly outstripped the supply. For meeting and fulfilling the demand imports of pulses has to be necessitated. The picture becomes grimmer when the economy of the country is burdened with the burgeoning costing over US dollar one billion annually. The call of the hour is that India ought to become self-sufficient in pulses. India is having a rich tradition of conservation, and with growing inputs from the Government, scientists and NGOs, should provide leadership in developing appropriate methodologies and strategies for enhancing indigenous pulse production so as to attaining self-sufficiency by the end of the decade.

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Properties of Quality Rice to be Improved for Consumer's Demand

Article ID: 31554

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Summary of Article

Rice is one of the very important food crops in term of energy, nutrition and aromatic rice is very delicious. Quality rice depends upon its biochemical, physical and cooking quality. Many rice varieties having high yield and nutritious but their cooking qualities are so poor so that its consumption is not suitable which leads to decline in consumer's demand. Now breeders are more focusing on improving the biochemical, physical and cooking quality.

Introduction

Rice is one of the major staple food crops of Asian subcontinent which feed around more half of population of world (Singh et. al., 2003). It is energy and nutritious crop which is consume by the poorer section population as it is available with very cheap price. Major care has been taken in the present condition to increase the yield to feed the rapid growing population. Apart from yield we should care about the physical and chemical property of the rice which will increase the quality of the rice. Consumption of nutritious food is the right of every human being so we must take care about the nutritional value of the rice. Physical property of rice helps the farmers for various farm operations like planting, harvesting, drying, storing, milling, and processing of rice, (Kunze and Wratten, 1985). Physical properties are also helpful for the varietal identification of rice during seed certification. Biochemical properties help to identify its cooking quality and eating quality.

Physical Properties of Rice

1. Grain Dimension: It includes grain dimensions, weight, uniformity, color, density, texture, broken rice. Based on the Length and breadth ratio, Ramiah committee (1964) categorized the rice into five types:

a. Long slender.
b. Short slender.
c. Medium slender.
d. Long bold.
e. Short bold.

In India slender type of grain is of high consumer demand. Grain length and shape is of polygenic and highly heritability. Grain dimensions are helpful for areas of processing, drying, handling equipment, breeding, marketing and grading.

Scale	Length (mm)	Size category	Scale	L/B ratio	Shape category
1	>7.50	Extra long	1	>3.0	Slender
2	6.61 to 7.5	Long	2	2.1 to 3.0	Medium
3	5.51 to 6.6	Medium	3	1.1 to 2.0	Bold
4	5.5 or less	Short	4	<1.1	Round

2. Colour: Anthocyanin present in the rice bran imparts colour to the rice. Different rice available based on colour is red rice, brown rice, black rice, white rice/ milled rice. Green rice is also available in which chlorophyll found in its endosperm. All coloured rice is rich in nutrition and very useful medicinal properties, which are very demanding in the present situation.

3. Density: Density of rice varies from 1.327 to 1.375 g/cm3 for rough rice (medium grain), from 1.365 to 1.381 g/cm3 for rough rice (long grain) and from 1.442 to 1.379 g/cm3 for brown rice (long grain). Bulk density raise with increased moisture content for rough rice (medium and long grain) but observed very little variation for the brown rice. It is also helpful for the degree of hull filling and storage of rice.

4. Hulling: Removal of husk is called hulling. Removal of rice bran is called milling. Total rice is the total grains and pieces recovered after milling. Head rice is the whole grains and grain pieces that are at least 3/4th in grain size. Milling recovery varies from 70.4 to 79.2% and head rice varies from 23.8 to 74.5%. This trait is under the polygenic control and low heritability. Hulling and milling help in detecting the grain recovery and check the quality of rice during grading.

5. Endosperm Type: It appears like transparent or opaque. Opaque trait is due to a loose packing of starch grain and it disappear after cooking and no problem with palatability. It is polygenic and with low heritability. Waxy endosperm is controlled by a single gene and produces opaque and glutinous endosperm. Glutinous endosperm grains stick each other on cooking. Non-waxy endosperm is preferred in India.

Biochemical Property

1. Starch: Rice contains about 90% of its dry matter. Rice starch of two types:

a. Non glutinous (non-waxy).
b. Glutinous (waxy).

In glutinous type only amylopectin branched chains present but non glutinous type starch is in the straight form and mixture of amylose (1/4 part) and amylopectin (3/4 part). In non-glutinous type endosperm is of translucent but in glutinous type it is of opaque or waxy hard. Quality traits of rice are controlled by both major and minor QTLs, environmental factors and nitrogen concentration of soil. Through study indicates that AC, GC, paste viscosity parameters and gel texture are affected by the waxy locus (Wx) and few minor genes. Wx codes for granule-bound starch synthase-I (GBSSI) which is located on the chromosome 6. Ratio between amylose and amylopectin of endosperm determines by granule-bound starch synthase-I (GBSSI).

2. Amylose: Amylose content in rice varies from 15 to 35%. Amylase content determines the stickiness of the cooked rice. Large molecular weight and highly branched Amylopectin also found in rice. Amylose contains α -1-4-glycosidic linkages between D-Glucose units to form straight chain while Amylopectin contains both α -1-4-glycosidic linkages and the branched chains linkage of α -1-6- glycosidic linkages (Nakamura et. al.). Synthesis of amylopectin depends on the starch branching enzymes (SBE) which helps in the insertion of branched chain α -1-6- glycosidic linkages to α-polyglucans in the endosperm starch.

Cooking Quality

It depends on the following factors:

1. Grain elongation: It is ratio of grain length after cooking to the grain length in uncooked state. Higher the elongation more demand is the rice.

2. Volume expansion: Volume ratio of cooked rice to uncooked rice. Higher the volume expansion more the rice will be soft and floppy which leads to more consumer demand.

3. Water uptake: It is the volume of water required to cook 100gm of rice in a definite period of time. Non waxy type shows greater water uptake and suitable for consumption.

4. Gel consistency (GC): It is length covered by the rice gel in a test tube. It is classified into 1. Soft (80mm) 2. Medium soft (61-80mm) 3. Medium (41-60mm) 4. Medium hard (36-40mm) 5. Hard (<35mm). Gel consistency shows a negative correlation with amylose content. The harder the gel consistency more is the amylose content. Always soft gel rice is preferable over the hard gel as soft gel rice remain soft even upon cooling. As upon cooling hard gel consistency rice becomes very hard which will be not consumable.

5. Aroma: Scented rice is always preferable over the non-scented rice.

6. Amylose content: It determines the stickiness of the rice.

Sl. No.	Endosperm type	Amylose content (%)	Significance
1	Waxy	<2%	Very sticky and not easy to consume
2	Low	20	Sticky
3	Intermediate	21-25	Non sticky and soft on cooking
4	High	>25	Non sticky and hard upon cooling

In general, Indian rice is high amylose content, upon cooking grains become dry and fluffy, but become hard on cooling.

7. Gelatinization Temperature (GT): It is temperature in which starch grain swell irreversibly upon boiling. It varies from 56 to 790C. It has a positive correlation with hardness of the starch granules. It is also directly proportional to amount of water and time required for cooking.

8. Alkali Digestion Value (ADV): Gelatinizing temperature can be assayed as the extent of disintegration of milled rice treated with 1.7% KOH at 300c for 23 hr. it scored as:

a. Low.
b. Low to intermediate.
c. Intermediate.
d. High.

Higher the Alkali digestion value, lower will be the gelatinizing temperature and vice versa. In general, high ADV rice prefer over low ADV rice due to low GT.

Alkali digestion value			Gelatinization Value	
Scale	Features	Inference	GT(°C)	Inference
1	Kernel not affected	Low	75-79	High
2	Kernel swollen	Low	75-79	High
2.5	Kernel swollen, collar incomplete or narrow	Low to intermediate	70-79	Intermediate to High
3	Kernel swollen, collar incomplete and narrow	Low to intermediate	70-79	Intermediate to High
4	Kernel swollen, collar complete or wide	Intermediate	70-74	Intermediate
5	Kernel split or segmented collar complete and narrow	Intermediate	70-74	Intermediate
6	Kernel dispersed, merged with collar	High	55-69	Low
7	Kernel completely dispersed	High	55-69	Low

ADV controls by alk locus which is present in the chromosome 6 and the alky gene encodes for starch synthase IIa (SSIIa) which determines the GT. ADV depends on the amylopectin molecules. Higher will be the amylopectin lesser will be the ADV.

Conclusion

Rice is the staple food of half of the world population. It is majorly an energy providing crop. Not only energy it also rich source of various nutrient and minerals. So, it has no doubt that rice is a complete diet for rice consuming section of the world. Apart from energy and nutrition care should be taken on the quality of rice. So, it is very much essential to increase the physical, biochemical and cooking quality of rice.

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Impact of Climate Change on Sustainable Rice (*Oryza sativa* L.) Production

Article ID: 31555

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Summary

Global warming is the biggest challenge for today world, in which gradual raise in the temperature in the overall temperature of the earth's atmosphere generally attributed to the greenhouse effect caused by increased levels of carbon dioxide (CO_2), methane (CH_4), CFCs, and other pollutants. (NASA., 2005). However, climate change subjected to change in temperature, disturb the rainfall pattern and rise in sea level as well as also impact on the field crop production and its productivity like rice, wheat, maize, sugarcane etc. It leads to decrease various growth parameter, physiological function, yield attributes and yield of the rice crop (*Oryza sativa* L.). Apart from this it declines the quality parameter of the crop and also bioavailability of nutrients to a great extent (Chaturvedi et al., 2017 and Wang et al., 2013). For sustaining the rice yield effective management practices are needed from start of seed selection to harvest. To mitigate this problem biotic and abiotic stress tolerant cultivars of rice should be adopted for getting optimum productivity.

Introduction

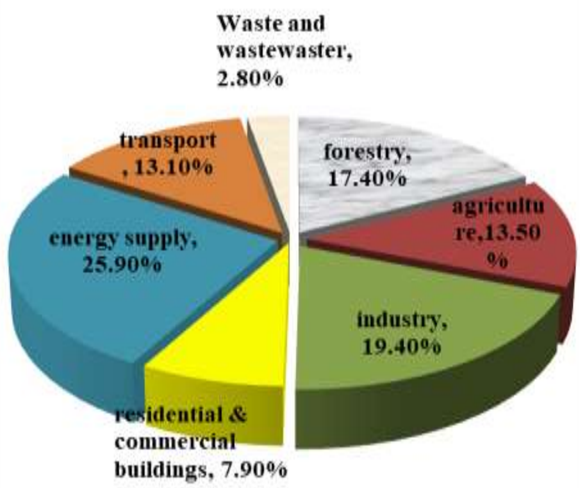

Fig1. Contribution from different sectors in GHGs

*Source: IPCC 2011, National communication on climate change 2012.

Since the earth came into existence, it has experienced the change in climatic conditions several times but the present scenario of climate change is very intensified and occurring with a greater pace and impacting the food production and other related issue to a greater extent. There are the different sectors that lead to increased greenhouse gas emission via., the burning fossil fuels, automobiles, various industries sector, forestry, heavy use of machinery etc (Fig. 1). The different agriculture sectors like enteric fermentation, and livestock, rice cultivation, soil, manure managements and crop residues that contribute in the greenhouse gas emission (GHGS) are 59%, 23%, 12%, 5% and 1% respectively (Fig. 2). Unsustainable use of resources limiting them for future generations and also put challenge for the food security of ever-increasing population. Rice is a staple food for almost 50% of global population and lifeline for the Asian population. The changing climatic conditions may decline sustainable productivity of rice crop by 14% in south Asia by 2050 and demand led inflation of rice may hike the prices by 12-15 % worldwide till 2050. Climate change may lead to decline in various growth parameters including LAI, total biomass accumulation, etc and finally adversely affecting the yield parameters may decrease the production.

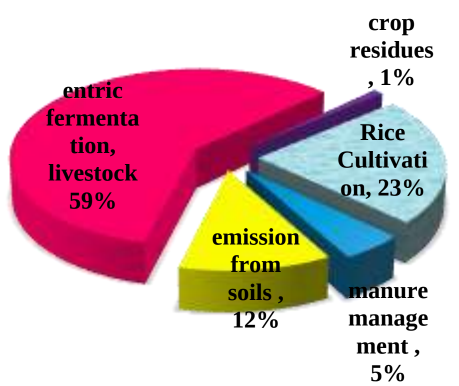

Fig2. Contribution from different agricultural sectors in GHGs

*Source: IPCC 2011, National communication on climate change 2012.

A projection indicate 2°c increase in temperature above normal will cause curtail in crop duration, grains/ear, grain yield and straw yield by 3.3%, 12.4%, 8.4%, 6.4%, respectively. Chaturvedi et al., 2017 and Wang et al., 2013 revealed that the quality parameters including amylase%, protein%, chalkiness%, head rice recovery, bioavailability of nutrients may decline to a great extent. Relative change may occur in pest dynamics. Heong et al., (2005) observed that Some of the pests and diseases will be affected positively and some negatively. To sustain rice yields, efficient management practices are needed from start of seed selection to harvest. Among such practices the most efficient ones are *Azolla* cultivation, organic rice cultivation, aerobic rice, system of rice intensification, deep water floating rice for submerged conditions. *Azolla* dual cropping has significant effect on reducing CH4 production from rice field (Bharati et al., 2015). SRI is helpful in efficient utilization of resources under resource scarce conditions (Geethalakshmi., 2016). Besides these, biotic and abiotic stress tolerant verities are required with infrastructure development and efficient extension services at farmer's level.

Conclusion

Climate change declines growth parameters, yield attributes, physiological process and yield of crop as well as also deteriorates the quality parameters of rice crop. Hence there is a need to adopt a holistic approach to mitigate the impact of climate change and sustain the crop production and productivity with sustained environment. Farmer should prefer biotic and abiotic stress tolerance variety that compatible with prevailed climates.

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Azolla – A Wonder Fern

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Introduction

Azolla is a freshwater fern and is one of the fastest growing plants on the earth; however, it does not need any soil to grow. *Azolla* is otherwise called as mosquito fern, duckweed fern, fairy moss, water fern etc. *Azolla* is a genus comprising seven aquatic fern species in *Salviniaceae* family. It has symbiotic relationship with a cyanobacterium called Anabaena.

Ecology

Azolla reproduces quickly. The biomass of *Azolla* doubles in 1.9 days or more, which rely upon environmental conditions, and the yield is 8–10 tonnes fresh matter/ha in rice fields. Yield of *Azolla* is 37.8 t fresh weight/ha (2.78 t DM/ha dry weight) for *Azolla pinnata* in India.

It is commonly growing on the standing water and behind farm dams. *Azolla* floats on the surface of water by means of numerous, closely overlapping, small scale-like leaves, with the roots hanging in the water.

Uses of Azolla

1. Nitrogen fixation: They form a symbiotic relationship with Cyanobacterium *Anabaena azollae*, which fixes atmospheric nitrogen. Contrasting with other plants, the symbiotic microorganism in *Azolla* is transferred from one generation to the next directly. The nitrogen-fixing capability of *Azolla* has led it being widely used as a biofertilizer.

2. Component of integrated farming system: *Azolla* can be used fruitfully as a part of Integrated Farming System (IFS) such as rice-fish-azolla, rice-duck-azolla, rice-duck-fish-azolla or pig-fish-azolla systems etc.

3. Provides great amount of organic carbon: *Azolla* can grow at immense speed and doubles its biomass in 2 to 3 days. The rotting *Azolla* plant releases organic carbon and nitrogen to the rice plants, providing up to nine tonnes of protein per hectare per year.

4. Weed control: *Azolla* can quickly multiply to cover the water and there by suppressing weeds by avoiding sunlight exposure to weed plants.

5. Ornamental value: *Azolla* cannot withstand longer winters with prolonged freezing, so is often grown as an ornamental plant at high latitudes where it cannot establish itself firmly enough to become a weed.

Food

Azolla has also been recommended as food material for human consumption. Since *Azolla* is rich in proteins, essential amino acids, vitamins and minerals it is considered as nutritional supplement.

Feed

Azolla is increasingly being used for sustainable livestock feed production. Feeding *Azolla* to dairy cattle, rabbits, pigs, ducks, and chickens, increases milk production, weight of the animal and egg production of layers, as compared to other regular feed. *Azolla* has 19-30% protein content which is higher than most green forage crops and aquatic macrophytes, and an essential amino acid (lysine) favorable for animal nutrition.

Larvicide / Mosquito control

The *Azolla* plant grows like a thick mat on the water surface and making it more difficult for the mosquito larvae to reach the surface to breathe and thereby effectively choking the larvae.

Reduction of Greenhouse Effect (Paleoclimatology)

Massive patches of *Azolla* growing on the freshwater surface of the Arctic Ocean co carbon dioxide from the atmosphere for the global greenhouse effect to decline, eventually causing the formation of Ice sheets in Antarctica and the current "icehouse period" which we are still in. This theory has been termed the *Azolla* event. (Institute of Environmental Biology, Utrecht University).

Bioremediation

Azolla can remove chromium, nickel, copper, zinc and lead from polluted aquatic environment. It can remove lead from solutions containing 1–1000 ppm. *Azolla* can accumulate excessive amounts of radionuclides, dyes, pesticides, etc. from the environment.

Other Environmental Benefits

Other benefits of *Azolla* include the reclamation of saline soils and the production of biogas and bioenergy.

Even though *Azolla* has as many beneficial characters, following areas need to be concentrated to make this technology more viable.

1. Development of *Azolla* strains for upland rice.
2. Extreme low temperature and high temperature (> 35°C) tolerant strain development.
3. Technology to use *Azolla* as dry inoculums.
4. Creating market facilities for *Azolla.*
5. Value addition in *Azolla.*

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Management of Organic Matter in Soil for Enhancing Hydro-Physical Characteristics and Productivity of Crops

Article ID: 31557

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Abstract

Organic matter plays a vital role in influencing soil physical and chemical properties far out of proportion to the small quantities present in the soil. The most obvious effects of organic matter on soil properties are related to physical, chemical, biological and hydro-physical properties which directly and / or indirectly influence water retention and release characteristics of any soil. Organic matter acts as a reservoir of chemical elements which are essential for plant growth. Major part of soil N, P and S occur in organic combination and only a small fraction occurs in inorganic forms at any one point of time. Organic matter upon decomposition release essential plant nutrients, many hormones and antibiotics and also enhances solubility of fixed forms of nutrients by producing organic acids. The overall objective of managing the soil organic matter is to conserve soil and water, improve and stabilize soil hydro-physico-chemical properties and achieve high yields. For this, addition of even only small amount of crop residues (4 to 5 t/ha/year on dry matter basis) is sufficient under most agricultural conditions. Addition of well decomposed forms e.g. farmyard manure, compost etc. give quick results. An attempt has been made in present paper to review the importance of organic matter in enhancing the water retention capacity of soil and crop productivity on a sustainable basis.

Introduction

In spite of good efforts made by various agencies to expand irrigated area, almost 50% of the cropped area continues to be rain-fed. Therefore, for the above referred reasons it becomes very essential to conserve available water resource and utilize it efficiently for crop productivity enhancement. For this purpose, cost effective simple measures are required to be adopted and popularized amongst farming community. In India, age old practices of addition of farmyard manure, green manure, compost, and residues have been in use for the purpose but for obvious reasons renewed emphasis are required to conserve soil profile stored moisture by the use of organic matter for realizing enhanced sustainable productivity of crops.

Indian soils are poor in organic matter content. Because of low organic matter levels and long periods of dryness, the biological activity is generally low. There is also evidence that the organic matter present in dry lands / rain-fed soils is chemically and biologically less stable because of less biological turnover of organic matter (Anderson,1987). This leads to faster depletion of whatever little organic matter present in soil. Decline of organic matter content clears the way to deterioration in soil physical and chemical environment. High thermal regimes, poor management practices and non-replenishment of depleted organic matter further accelerates the loss of soil fertility and thus crop productivity of most crops particularly under semiarid tropic conditions.

What is Organic Matter?

All organic substances in the soil, living or dead, fresh or decomposed, simple or complex compounds, are part of soil organic matter. This includes plant roots, residues of plants and animals in all stages of decomposition, humus, microbes, and any other organic compounds. Animals that live in soil or excluded from this definition and it would probably the best to exclude also living roots. Living bacteria, fungi and other microbes are included for simple reason that it is essentially impossible to separate these from the rest of organic matter in the soil. For all practical purposes soil organic matter can best be classified into residues and humus. The residues included dead part of plants and animals and animal excreta. A simple and better estimate of soil organic matter may be obtained by estimating its organic carbon content. Organic matter is considered to be 1.724 times of organic carbon content. The humus is the dark coloured soil organic matter that has fairly definite chemical and physical properties and that is not subject to as rapid a rate of decomposition as the residues.

Composition of Humus

The proximate analysis of a typical humus reveals the composition as; (a) Ligninlike compounds = 45%, (b) Amino acids = 35%, (c) Carbohydrates = 11%, (d) Cellulose = 4%, (e) Hemicellulose = 7%, (f) Fat, wax, resins = 3%, and (g) Others = 6%. A typical elemental composition (per cent by weight) of humus occurring in mineral soils is as; (a) Carbon = 52 - 60%, (b) Oxygen = 32 – 38%, (c) Hydrogen = 3 – 4%, (d) Nitrogen = 4 – 5%, (e) Phosphorus = 0.4 – 0.6%, and (e) Sulphur = 0.4 – 0.6%.

Functions / Role of Organic Matter

Organic matter plays a vital role in influencing soil physical and chemical properties far out of proportion to the small quantities present in the soil. The most obvious effects of organic matter on soil properties are:

1. Effect on soil color: Brown to black.

2. Effect on soil physical properties:

a. Granulation and aggregation increases. Protects the aggregates from destruction, makes soil more tractable, increases porosity and aeration, increases infiltration of water into soil and percolation. Reduces runoff and erosion hazards.
b. Plasticity, cohesion etc. decreases.
c. Water holding capacity increases.
d. Fresh organic matter supplies food for earthworms, ants and rodents which are beneficial soil.
e. Surface mulches lower the soil temperature in summer and keep soil warm in winter season.

3. Effect on chemical properties of soil: The influence of organic matter addition on soil properties is summarized as below:

a. Organic matter acts as a reservoir of chemical element which are essential for plant growth. Major part of soil N, P and S occur in organic combination and only a small fraction occurs in inorganic forms at any one point of time. Organic matter upon decomposition release essential plant nutrients, many hormones and antibiotics and also enhances solubility of fixed forms of nutrients by producing organic acids.
b. Cation exchange capacity of organic matter is 20-30 times as that of mineral colloids. Organic matter supplies carbon dioxide, nitrates, sulphates and organic acids to help dissolve materials and supplies other plant nutrients both directly and indirectly.
c. Organic matter accounts for 30 to 90 % of the adsorbing power of mineral soils.
d. Easily replaceable cations present.
e. N, P and S held in organic forms.
f. Extraction of elements from minerals by acid humus.
g. Organic matter serves as a source of energy for the growth of soil microorganisms e.g. N fixing organisms requires easily decomposable organic matter as their source of carbon, without which N fixation by Azotobacter and Clostridium would not be possible.

4. Effect on biological properties of soil: Organic matter supplies energy, carbon and minerals for microbes and thus helps in enhancing microbial population in the soil.

Potential Energy in Organic Matter

Organic matter is bestowed with considerable amount of potential energy. A major proportion of this potential energy is transferable to other latent forms or is liberated as heat. Application of about 5 t/ ha of FYM (about 1100 kg dry matter) would mean an addition of about 4500000 to 5500000 Kilocalories of latent energy. A soil containing 1 % organic matter carries 37500000 to 45000000 Kilocalories of potential energy per acre in the plough layer depth. This is equivalent to 5 to 6 tonnes of anthracite coal.

Conservation of Soil and Water

Vegetative cover over earth's surface protects soil and related resources. Some of the falling rains are caught by the crowns of the trees / arable crops foliage and very little harmless amount reach the ground. Vegetation also breaks the force of the rain drops reaching the soil surface and washing them away. Litter and humus provide additional barriers against the flow of surface water and aid the soil by increasing its porosity. Water readily enters into soil without accumulating on its surface. Thus, it is now scientifically established fact that organic matter helps in controlling soil erosion by conserving water. Recent studies on the impact of different vegetative barriers either in-situ grown or transported, effectively conserve rainfall and minimize the soil and nutrient losses from arable lands.

Management of Organic Matter

The overall objective of managing the soil organic matter is to conserve soil and water, improve and stabilize soil hydro-physico-chemical properties and achieve high yields. For this, addition of even only small amount of crop residues (4 to 5 t/ha/year on dry matter basis) is sufficient under most agricultural conditions. Addition of well decomposed forms e.g. farmyard manure, compost etc. give quick results.

The following are the ways by which organic matter may be managed as per feasibility and convenience for farmers:

1. Application of FYM / compost at the rate of 4 – 6t/ha every year.
2. Application of crop residues (stubbles, seed free weed biomass in-situ or transported) etc. as surface mulch and subsequently its incorporation in the soil.
3. Vegetative vertical mulch using crop stubbles.
4. Vegetative barriers or live vegetative bunding.

Bulky Manures

Bulky organic manures e.g. FYM, biogas spent slurry, NADEP preparations etc refer to the decomposed mixture of dung and urine of farm animals along with litter and leftover material from roughages of the fodder fed to cattle. A lot of information is available in literature regarding the impact of manures in conserving soil profile stored moisture, increasing water use efficiency and crop yields. Some examples of recent studies have been given in Tables 1 through 3.

Recycling of Crop Residues

It is known to everybody that after harvest of paddy and wheat crops, fields are put to fire and valuable straw, locally known as Parali or Narai are burnt, which create a lot of pollution. Such residues and other residues having no fodder values can be turned into valuable compost and recycled to fields. The NADEP Tankas can be constructed at farmer's fields to make compost. The NADEP Tankas are filled with crop residues in 3 layers, after each layer some soil and dung is sprayed and finally sealed with mud. After decomposition of straw in about 3 months' time 3 tons of well decomposed compost is prepared which can be applied to field for improving soil organic matter.

NADEP Compost Making *TANKA* (Size 12x5x3 ft.)

Table 1: Influence of crop residues and farmyard manure on seed yield of soybean and safflower, sustainability index and water use efficiency of crops (Average of 1983 – 89, Sharma,1992).

Treatments	Seed Yields(Kg/ha)		SYI for Yield		W.U.E. (Kg/ha. mm)	
	Soybean	Safflower	Soybean	Safflower	Soybean	Safflower
N0 P0	1117	781	0.39	0.19	2.52	3.46
N20/40-40	1697 (51.9)	1330 (72.3)	0.60	0.32	3.71	5.62
N10/20-20	1591 (42.4)	1121 (43.5)	0.55	0.26	3.47	4.94
FYM 6t/ha	1943 (74.0)	1788 (128.9)	0.70	0.43	4.24	7.07
FYM 6t/ha + N10/20-20	2044 (83.0)	1987 (154.4)	0.73	0.47	4.50	8.26
Residues 5t+ N10/20-20	1388 (24.3)	1177 (50.7.)	0.35	0.14	3.33	3.28
Note: SYI= Sustainable yield index, W.U.E. = Water use efficiency and Figures in parentheses are percent increase over control.						

Table 2: Seed yield of un-irrigated safflower grown after soybean as influenced by residual effect of FYM (Mean of 1983- 84 to 1987- 88) (Sharma and Gupta, 1993).

Treatments	Mean seed yield (kg/ha)		Water use efficiency (Kg/ha. mm)	
	Soybean	Safflower	Soybean	Safflower
N0 P0	1131	695	2.38	3.71
N20-40	1628 (+ 43.9%)	1132 (+ 62.9%)	3.32	5.79
N10-20	1517 (+ 34.1%)	955 (+ 37.4%)	3.08	5.03
6t/ha FYM alone in rainy season	1808 (+ 59.9%)	1539 (+ 121.4%)	3.66	7.19
6t/ha FYM + N10-20	1913 (+ 69.1%)	1692 (+ 143.5%)	3.86	8.70

Straw Mulching

Crop residues like sorghum cob husk, maize stalks, safflower straw, soybean straw or any other locally available material which has very little or no fodder value may be utilized for mulching purposes. Usually these can be applied at the rates of 5 – 6 t/ha. After emergence and establishment of crops, straw may be spread in between crop rows. Straw mulching checks soil water evaporation and weeds leading to increased water use efficiency of crops. Straw mulches are relatively more effective during drought spells in the rainy season. Experimental results depicted in Table 4 indicate that during post rainy season, short duration crops of gram and linseed responded remarkably well as compared to wheat and safflower to 6t/ha of sorghum cob husk used as surface mulch. After harvesting of crops, residues which are used as mulch may be incorporated in soil which upon decomposition would help in improving soil physicochemical properties and soil fertility.

Table 3: Water holding capacity and soil organic matter content changes due to application of farmyard manure (Average of 3 seasons.) (Sharma and Gupta, 1993).

Treatments	Organic Carbon (%)	Max. Water holding apacity (%)	Volume of water in top 15cm soil (Lac lit./ha)	Soil Swelling (%)
Control	0.26	70.00	14.000	15.57
N20-40	0.30	72.16	14.432 (+ 0.432)	16.25
FYM 6t/ha	0.70	81.62	16.324 (+ 2.324)	17.44
6t/ha FYM + N10-20	0.66	82.12	16.424(+2.424)	17.33
Note: One lac litres of water /ha = One irrigation of One cm water per hectare.				

Table 4: Influence of straw mulching on yield and water use efficiency of dryland crops at Indore (Sharma et. al.1985).

Parameters	Crops	No Mulch	Sorghum cob husk mulch(6t/ha)
Yield (Kg/ha)	Gram	1430	1800 (+25.9%)
	Linseed	905	1043 (+ 15.2%)

	Wheat	1730	1835 (+6.2%)
	Safflower	1755	1822 (+ 3.8%)
Water use efficiency (Kg/ha. mm)	Gram	6.5	9.4 (+ 44.6%)
	Linseed	3.9	4.6 (+ 17.9%)
	Wheat	6.6	7.5 (+ 13.6%)
	Safflower	6.8	7.6 (+ 13.8%)

Vertical Mulching

Vertical mulching is a recent innovation which is found to be helpful in in–situ conservation of water for increased yields. High intensity rainfall, low infiltration rate and greater slope produce tremendous amount of runoff with corresponding transporting ability.

In this technique trenches of 20 cm width, 60-90 cm depth and preferably spaced at 4 m distance and putting sorghum or maize stubbles in them gives increased production of rabi crops. Vertical mulch should be created prior to onset of monsoon to affect rain water conservation. Mulches are also applied in narrow slots (vertical mulching) instead of spreading on the soil surface.

Crop residues are pressed into narrow continuous slots of 5 to 10 cm width and 20 to 25 cm depth. The residue is filled up to 5 cm above the ground level. These slots with residues form a ridge across slope. They increase infiltration and thus reduce runoff.

Vegetative Bunds / Barriers

Vegetative barriers have been found useful in reducing runoff water and conserving soil and plant nutrients. These are also helpful in stabilizing the earthen bunds, particularly in black soil regions where the swell shrink nature of these soils causes severe damage to these bunds. For this purpose, various grasses available locally may be used. These grasses may be planted across the land slope either alone or along and on the graded bunds. Studies conducted at campus College of Agriculture, Indore (Ranade et.al., 1995) clearly revealed the impact of Vetiver and Cymbopogon planted alone or along with bunds on the conservation of rain water, soil and nutrients (Table 5).

Table 5: Seasonal runoff, soil loss and nitrogen loss as influenced by vegetative barriers on different land slopes (Ranade et. al. 1995).

Treatments	Slope %	Runoff (mm)	Soil loss (Kg/ha)	N loss (Kg/ha)
Check	2.0	115.7	986	23.85
	1.5	85.2	918	15.31
	1.0	87.9	614	10.67
Vetiver Grass	2.0	94.9	662	17.40
	1.5	69.1	453	13.12
	1.0	53.8	465	8.88
Bund + Cymbopogon	2.0	94.6	567	17.18
	1.5	69.4	509	11.48
	1.0	52.9	474	8.02

Green Biomass Mulching

Organic manures, green manuring, compost, FYM and incorporation of crop residues are very well known to improve hydro-physical, chemical and biological properties of soils Incorporation of these material which are initially applied as surface mulch and later on incorporated in soil, tend to build up soil fertility in long run. Another way of green biomass mulching is that either incorporation of weed insitu or application of weed biomass transported from elsewhere and spreading it in between crops rows. This will initially serve as mulch and lateron its incorporation in soil will addt organic matter in subsequent seasons.

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The Intimidating Pest - Pulse Beetle Management in Mungbean

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Introduction

Mungbean severs as an excellent source of high-quality protein with an ideal essential amino acid profile. Matured raw mungbean seeds of 100 g are highly nutritive with protein (22.53 g), carbohydrates (46.13 g), calcium (92.43 mg), magnesium (198 mg), phosphorus (353 mg), potassium (1117 mg), sodium (12 mg), zinc (2.67 mg) and vitamins. Mungbean is also principally important for its physiological functionalities viz., antitumor, antioxidant, antidiabetic and angiotensin I-converting enzyme (ACE) inhibitor activity. It is exponentially preferred over other pulses due to its better digestibility and less flatulence problem because of the minimal amount of raffinose, stachyose and verbascose content. The dried mungbean seeds can be consumed after cooking or as fresh sprouts or can be converted into flour and also be consumed in the form of products like soups, porridge, confections, curries, and alcoholic beverages.

Mungbean Production Constraints

Besides shortage in pulse production, yield reduction was also based on several strategies viz., poor agronomic practices of cultivating traditional landraces, biotic stresses in the field and in storage and climate change. The major constraints for mungbean production include the predominance of pest attack followed by the scarcity of water, salinity, lack of quality seed and the use of untreated seed. The yield reduction in mungbean is mainly, due to the occurrence of pests and diseases. The major biotic stresses of mungbean include pulse beetle, mungbean yellow mosaic virus, leaf crinkle virus, anthracnose, powdery mildew, cercospora leaf spot, gram pod borer and whitefly.

Pulse Beetle - A Major Threat to Mungbean in Storage

Pulse beetle (bruchids) come under the family Bruchidae that encompasses more than 1700 species. About 117 species of bruchids belonging to 11 genera have been recorded from India. The infestation of pulse beetle starts in the field and persists in storage causes 7–73% yield loss in mungbean. The storage losses are heavy and sometimes total loss of seed lot occurs within 3-6 months. Hence, the pulse beetle management can be attained through various approaches namely, cultural, botanical, physical and chemical methods.

Cultural Control

Proper harvesting by several pickings resulted in a reduction of 50-90% of infestation by pulse beetle. Planting of alternate wild host plant along with the crop reduced the level of infestation. Pulse beetle infestation spread from infested seeds in adjacent granaries to the ripening crop. Hence infested seeds should be completely disposed of before the planting season. Storing of seeds in granaries should be done immediately after harvest to minimize the infestation and for ensuring physical protection. Storage rooms should be maintained well by the removal of eggshells, dead grubs and infested grains before storage of new grains. Furthermore, the process like fumigation, disinfestation, white-washing and painting the walls, floors and ceilings of empty stores with insect repellent paints, such as coal tar need to be done in order to make the environment less attractive and unfavorable for the survival, dispersal, growth and reproduction of the pulse beetle.

Botanical Control

Plant extracts, powder, ash and oil from pepper, nishinda, eucalyptus, bankalmi, neem, safflower, sesame and bablah produced considerable oviposition inhibition, surface protectant, residual toxicity and direct toxicity effects on pulse beetle. Antharfa and *Jatropha curcas* also produced significantly higher per cent of parent adult mortality of pulse beetle.

Physical Control

Reduction in pulse beetle infestation attained by adopting simple physical controls such as: storing pulses unthreshed, where dry pod provides a physical barrier against oviposition by pulse beetle, sun drying, storing beans greater than 36°C, freezing and crushing eggs. The admixture of local dusts, smaller grains, wood ash or sand to stored legumes reduces the intergranular space and gradually reduces the available area for the pest generations to utilize, thereby causing auto sterilization of adults due to overcrowding, exhaustion of food, rise in local moisture and microbial overgrowth. Physical control also involves the treatment of the seeds and insects using physical agents, such as temperature, heat, moisture content and pressure. A combination of low pressure and high temperature is more effective in killing the eggs and grubs of pulse beetle.

Chemical Control

The insect pests including pulse beetle are mostly controlled by using pesticides belonging to four chemical groups – organochlorines, organophosphates, carbamates and pyrethroids. The insecticides namely, malathion, deltamethrin 2.8 EC @ 2.5 ppm, spinosad 45 SC @ 2 ppm, cypermethrin @ 4 ppm, diflubenzuron 25% WP @ 1.00 ppm produced good control over pulse beetle.

Conclusion

By adopting any of the above methods or in combinations of two or more methods can provide good management again pulse beetle. Therefore, we can able to minimize the storage loss of mungbean to greater extent.

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Biofortification of Food Crops: A Potential Way to Combat Malnutrition Condition in Humans

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Introduction

Malnutrition refers to a particular condition that results from eating a diet in which one or more nutrients are not enough. This type of diet causes health related problems. This condition is prevalent in various countries including India. Combating with this condition is foremost objective of the several countries. Malnutrition, in all its forms, includes under-nutrition (waste, stunting, underweight), inadequate vitamins or minerals, overweight or obesity and resulting diet-related noncommunicable diseases. At present, worldwide, around 1.9 billion adults are over-weighted, while 462 million are under-weighted. Around 47 million children under 5 years of age are wasted, 14.3 million are severely wasted and 144 million are stunted. Around 45% of deaths among children under 5 years of age are linked to under-nutrition. The developmental, economic, social, and medical impacts of the global burden of malnutrition are serious and lasting, for individuals and their families, eventually for communities and for countries.

Malnutrition

Malnutrition refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients. Micro-nutrient related malnutrition inadequacies in intake of vitamins and minerals often referred to as micro-nutrients, can also be grouped together. Micro-nutrients enable the body to produce enzymes, hormones, and other substances that are essential for proper growth and development. Iodine, vitamin A, and iron are the most important in global public health terms; their deficiency represents a major threat to the health and development of populations worldwide, particularly children and pregnant women in low-income countries. Micronutrient deficiencies, which is defined as a lack of essential vitamins and minerals required in small amounts by the body for proper growth and development. Micro-nutrient deficiencies can have devastating consequences. At least half of children worldwide younger than 5 years of age suffer from vitamin and mineral deficiencies (Bouis and Saltzman, 2017).

Some Essential Nutrients and their Functions

There are various micro and macro-nutrients which are required for proper functioning of the human body (Table 1). The role of six essential nutrients is outlined as follows:

1. Iron:

a. Iron is critical for motor and cognitive development. Children and pregnant women are especially vulnerable to the consequences of iron deficiency.

b. Iron is a leading cause of anemia which is defined as low hemoglobin concentration. Anemia affects 43% of children younger than 5 years of age and 38% of pregnant women globally.

2. Vitamin A:

a. Vitamin A supports healthy eyesight and immune system functions.

b. Globally, vitamin A deficiency affects an estimated 190 million preschool-age children.

3. Vitamin D:

a. Vitamin D builds healthy bones. Vitamin D deficiency causes bone diseases, including rickets in children and osteomalacia in adults.
b. Vitamin is required for muscle and nerve functions.

4. Iodine:

a. Iodine is required during pregnancy and infancy for the infant's healthy growth and cognitive development.
b. Globally an estimated 1.8 billion people have insufficient iodine intake.

5. Zinc:

a. Zinc promotes immune functions and helps people resist infectious diseases including diarrhea, pneumonia and malaria.
b. Providing zinc supplements reduces the incidence of premature birth, decreases childhood diarrhea and respiratory infections.

Table 1: Various micro and macro-nutrients which are required for proper functioning of the human body.

Micro minerals	Vitamins	Amino acid (essential)	Fatty acid (essential)	Macro-minerals
Iron	A (Retinol)	Histidine	Linoleic acid	Potassium
Zinc	D (Calciferol)	Isoleucine	Linolenic acid	Calcium
Copper	E (α-Tocopherol)	Leucine		Magnesium
Manganese	K (Phylloquinone)	Lysine		Sulphur
Iodine	C (Ascorbic acid)	Methionine		Phosphorus
Selenium	B1 (Thiamine)	Phenylalanine		Sodium
Molybdenum	B2 (Riboflavin)	Threonine		Chlorine
	B3 (Niacin)	Tryptophan		
	B5 (Pantothenic acid)	Valine		
	B6 (Pyridoxine)			
	B7 (Biotin)			
	B9 (Folic acid, folacin)			
	B2 (Cobalamin)			

Biofortification: A Way to Combat with Malnutrition

"Biofortification" or "biological fortification" refers to nutritionally enhanced food crops with increased bioavailability to the human population that are developed and grown using modern biotechnology techniques, conventional plant breeding, and/or agronomic practices.

Biofortification: Various Approaches

Producing nutritious and safe foods, sufficiently and sustainably, is the ultimate goal of biofortification. Biofortification of essential micronutrients into crop plants can be achieved through three main approaches, namely transgenic, conventional, and agronomic, involving the use of biotechnology, crop breeding, and fertilization strategies, respectively.

1. Agronomic biofortification: Microminerals such as Fe, Zn, Cu, Mn, I, Se, Mo, Co, and Ni are found in varying degrees in the edible portions of certain plants and are usually absorbed from the soil. Improvement of the soil micronutrient status by their application as fertilizers can contribute to decrease in micronutrient deficiency in humans (Cakmak, 2008). For instance, micronutrient biofortification through agronomical practices is an alternative strategy to reduce the iron and zinc deficiency in rice grain. Biofortification of rice plants by foliar spray of iron was found to be an effective way to promote iron concentration in rice grains (Fang et al., 2008).

Agronomic biofortification has been very efficiently utilized in wheat grain quality improvement. Inclusion of iron in foliar urea fertilizers has been positively correlated with high iron accumulation (Aciksoz et al., 2011). In maize, various zinc fertilizer treatments and foliar applications have been applied to obtain increased concentration of zinc in maize kernels (Alvarez et al., 2003).

2. Biofortification through conventional breeding: most trusted approach Biofortification through conventional breeding in the most accepted method of biofortification. It offers a sustainable, cost-effective alternative to transgenic- and agronomic-based strategies. Sufficient genotypic variation in the trait of interest is necessary for conventional breeding to be feasible. The CGIAR along with the International Center for Tropical Agriculture (CIAT) and the International Food Policy Research Institute have launched the HarvestPlus program to breed biofortified staple food crops (Bouis and Saltzman, 2017). Rice is greatly emphasized for micronutrient enhancement. The milled rice is poor source of minerals. Different old rice varieties with high iron and zinc content in grain have been screened and the higher mineral trait has been combined with improved agronomic traits by breeding methods. The world's first zinc enriched rice varieties developed by HarvestPlus were released in 2013 by the Bangladesh Rice Research Institute (BRRI dhan 62, BRRI dhan 72, and BRRI dhan 64), which is claimed to contain 20–22 ppm zinc in brown rice. Wide variation in grain iron and zinc concentrations has been observed in cultivated wheat and its closely related wild species that can be exploited for improvement of modern elite cultivars.

Another major food crop is maize, which is a cash crop grown for animal feed, industrial purposes (source of sugar, oil, starch, and ethanol) and for use for human consumption. Scientists have discovered varieties that have naturally high levels of provitamin *A. HarvestPlus* is using these lines to breed high-yielding varieties of biofortified maize with higher levels of provitamin A to combat vitamin A deficiency. The prospects of breeding for micronutrients and beta-carotene rich sorghum have been discussed by Reddy et al., (2005). Sorghum germplasm has shown large variability and genetic heritability for iron and zinc content. Biofortified iron rich sorghum lines (ICSR 14001, ICSH 14002) and hybrids (ICSA 661 × ICSR 196, ICSA 318 × ICSR 94, ICSA 336 × IS 3760) have been bred by ICRISAT and released in India. Pearl millet is the cheapest source of iron and zinc and large variation has been seen in its germplasm for these micronutrients. In India, biofortified (iron and zinc) pearl millet variety "Dhanashakti" and a hybrid ICMH 1201 (Shakti-1201) has been released by ICRISAT, HarvestPlus in 2014.

3. Biofortification through transgenic means—maximum explored and minimum utilized: Transgenic approaches can also be used for the simultaneous incorporation of genes involved in the enhancement of micro-nutrient concentration, their bio-availability, and reduction in the concentration of anti-nutrients which limit the bio-availability of nutrients in plants.

For instance:

a. Transgenic Rice *(Oryza sativa)*: Rice has been targeted to address the global challenge of undernutrition. Golden Rice was an important breakthrough in this direction as an effective source of provitamin A (beta-carotene) with a significant potential to reduce disease burden by expressing genes encoding PSY and carotene desaturase (Beyer et al., 2002).

b. Transgenic Wheat *(Triticum aestivum)*: Researchers have tried to address the challenges of most deficient nutrients like vitamin A, iron, and quality proteins through wheat. The provitamin A content of wheat has been enhanced by expressing bacterial PSY and carotene desaturase genes [CrtB, CrtI.]

Limitations Associated with Biofortification Approaches

1. Limitations associated with agronomic biofortification: Application of fertilizers fortified with micronutrients is the simplest method among all biofortification methods. But the success of agronomical biofortification is highly variable due to the differences in mineral mobility, mineral accumulation among plant species, soil compositions in the specific geographical location of each crop. Agronomic biofortification is less cost-effective and labor intensive as it demands continuous inputs, through the application of micronutrient to the soil or plant regularly.

2. Limitations associated with conventional breeding methods: The design of conventional plant breeding programs to improve micro-nutrient content has proved to be successful and is a sustainable and cost-effective solution in the long run; however, there are limitations with respect to the amount of genetic variability for the micro-nutrients in the plant gene pool and the time needed to generate cultivars with the desired trait(s). In some cases, this can be overcome by crossing to distant relatives and thus interiorising traits into commercial cultivars, but in many occasions, it would be impossible to breed for a specific trait using conventional means, and the timescale and effort involved may be quite unrealistic, e.g., improving Se concentration in wheat grains and improvement of oleic, linoleic, and linolenic fatty acid content in soybean.

Another limitation is that different countries have adopted different regulatory processes for the acceptance and commercialization of these transgenic crops. Regrettably, the current political and economic landscape is not receptive to this technology. Furthermore, these regulatory processes are very expensive and time consuming.

Let us take the example of Bt Brinjal. It has been initially developed by Mahyco, an Indian seed company. Unfortunately, it was not released in India because some of the scientists, farmers, and anti-GMO activists, raised concerns and a moratorium on its release was imposed, until further tests were conducted. However, four varieties of Bt Brinjal were given approval for commercial release in Bangladesh in 2013–2014. Although the research efforts devoted to the transgenic-based approach are quite higher compared with breeding based, its success rate in terms of cultivar release in very low due to time required from target trait and gene identification, modification, expression, and assessment of agronomical traits to understanding the possible effect on other life forms. For example, after 8 years project, the scientific details of the Golden rice were first published in Science in 2000, and since then different groups, including International Rice Research Institute scientists are working on it, but Golden Rice is still not ready for farmers due to issues with its yield. Its dissemination is also being held back due to inability to get approval from Governments (Beyer et al., 2002).

Conclusion

Malnutrition is the condition which we are dealing in every age group and the solution is demanded for all of them. Biofortification is one of the ways to combat because it took only modification and suitability. Space requirement is much less as compared to other means and availability of food could be raised and ultimately it can be reached to every corner of the world.

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Phytoremediation

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Summary

Environmental pollution has become a major problem across the globe, adversely affecting crop yields, soil fertility, and water quality. Among numerous remediation technologies available, phytoremediation represents an aesthetically agreeable, eco-friendly, and lucrative approach that use plants and their associated microorganisms to remove, degrade, or isolate toxic substances from the environment. Phytodegradation, phytostabilization, phytovolatilization, phytoextraction, phytofiltration, rhizodegradation, and phytodesalination are the different types of phytoremediation techniques that can be used to remove metals, radionuclides, pesticides, explosives, fuels, volatile and semi-volatile organic compounds from the environment.

Introduction

Environmental pollution, due to urbanization, industrialization, and changing agricultural practices, has become a major problem all over the world, adversely affecting crop yields, soil fertility, and water quality. Inorganic pollutants such as heavy metals (Cd, Cr, Pb, Ni, Zn, Se, Cu, Co), metalloids (As, Hg, Se), and radionuclides (U, Ra, Sr, Cs) and organic pollutants (hydrocarbons, trichloroethylene (TCE), herbicides, Methyl tertiary-butyl ether, and trinitrotoluene) are mainly responsible for the deterioration of the health of soil and water ecosystems (Pandey and Bajpai, 2019). Even low levels of these contaminants in the environment pose a great risk due to their potential accumulation at higher trophic levels, known as biomagnification. Among the remediation technologies, phytoremediation represents an aesthetically agreeable, eco-friendly, and lucrative approach.

Phytoremediation

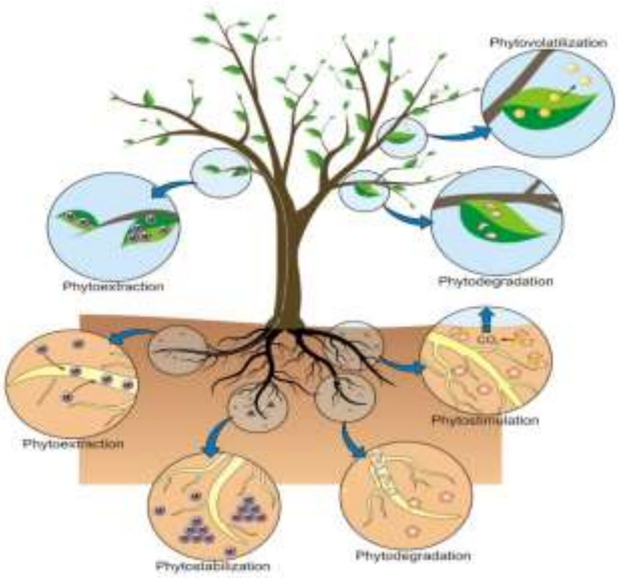

Figure 1. Diagrammatic representation of phytoremediation techniques (Source: Favas et al. 2014)

Phytoremediation is a bioremediation process (the use of organisms to clean up contaminated soil) that uses various types of plants to remove, transfer, stabilize, and/or destroy contaminants in the soil and groundwater. It is the use of plants (trees, shrubs, grasses, and aquatic plants) and their associated microorganisms to remove, degrade, or isolate toxic substances from the environment. The word "phytoremediation" has been derived from the Greek word "*phyton*" meaning "plant", and Latin word "*remedium*" which means "to remedy" (Phillips, 2019). Substances that may be subjected to phytoremediation include metals (Pb, Zn, Cd, Cu, Ni, Hg), metalloids (As, Sb), inorganic compounds (NO_3^-, NH_4^+, PO_4^{3-}), radioactive elements (U, Cs, Sr), petroleum hydrocarbons (BTEX), pesticides and herbicides (atrazine, bentazone, chlorinated and nitroaromatic compounds), explosives (TNT, DNT), chlorinated solvents (TCE, PCE) and industrial organic wastes (PCPs, PAHs), etc. Phytoremediation is an alternative to engineering procedures that are usually more destructive to the soil (Greipsson, 2011).

Phytoremediation Techniques

Depending on the chemical nature and properties of the contaminant and the characteristics of the plants, there are different types of phytoremediation mechanisms. These are:

1. Phytodegradation (Phytotransformation): Organic contaminants are metabolized or mineralized inside plant cells by specific enzymes such as nitro reductases (degradation of nitro aromatic compounds), dehalogenases (degradation of chlorinated solvents and pesticides) and laccases (degradation of anilines). The plants that have these enzymatic systems include *Populus* species and *Myriophyllium spicatum*.

2. Phytostabilization (Phytoimmobilization): Contaminants, organic or inorganic, are incorporated into the lignin of the cell wall of roots cells or humus. Metals are precipitated as insoluble forms by the direct action of root exudates and subsequently trapped in the soil matrix to avoid the mobilization of contaminants and limit their diffusion in the soil. Plants species of genera *Haumaniastrum*, *Eragrostis*, *Ascolepis*, *Gladiolus,* and *Alyssum* are grown for phytostabilization.

3. Phytovolatilization: This technique is based on the ability of some plants to absorb and volatilize certain metals/metalloids. Some elements (specifically Hg, Se, and as) are absorbed by the roots, converted into non-toxic forms, and then released into the atmosphere. Organic compounds can also be removed using this technique. Phytovolatilization can be done using the species *Astragalus bisulcatus* and *Stanleya pinnata* for Se or transgenic plants of *Arabidopsis thaliana*, *Nicotiana tabacum*, *Liriodendron tulipifera* or *Brassica napus* for Hg.

4. Phytoextraction (Phytoaccumulation): This involves the absorption of contaminants by roots followed by translocation and accumulation in the aerial parts. It is mainly used to remove Cd, Ni, Cu, Zn, Pb but can also be used for Se, As and organic compounds. This technique preferentially uses hyperaccumulator plants, that can store high concentrations of specific metals in their aerial parts (0.01% to 1% dry weight, depending on the metal). The hyperaccumulator plants used are *Elsholtzia splendens* for Cu, *Alyssum bertolonii* for Ni, *Thlaspi caerulescens* for Zn and Cd, and *Pteris vittata* for As.

5. Phytofiltration: In this technique, plants absorb, concentrate and/or precipitate contaminants, particularly heavy metals or radioactive elements, from an aqueous medium through their root system or other submerged organs. The plants are kept in a hydroponic system, whereby the effluents pass and are "filtered" by the roots (Rhizofiltration), or other organs that absorb and concentrate contaminants. Plants with high root biomass, or high absorption surface, with more accumulation capacity (aquatic hyperaccumulators) and tolerance to contaminants such as *Helianthus annus*, *Brassica juncea*, *Phragmites australis*, *Fontinalis antipyretica,* etc. are used.

6. Rhizodegradation (Phytostimulation): Growing roots promote the proliferation of degrading rhizosphere microorganisms that utilize exudates and metabolites of plants as a source of carbon and energy. Besides, plants may exude biodegrading enzymes themselves. The application of phytostimulation is limited to organic contaminants. The microbial community in the rhizosphere is heterogeneous due to variable spatial distribution of nutrients, however, species of the genus *Pseudomonas* are the predominant organisms associated with roots.

7. Phytodesalination: It utilizes halophytes to remove excess salts from saline soils. *Suaeda maritima* and *Sesuvium portulacastrum* have been reported to help in the removal and accumulation of NaCl, from highly saline soils.

Applicability of Phytoremediation

Phytoremediation is used for the remediation of metals, radionuclides, pesticides, explosives, fuels, volatile, and semi-volatile organic compounds. Research is underway to understand the role of phytoremediation to remediate perchlorate, a contaminant that is persistent in surface and groundwater systems. It may be used to clean up contaminants found in soil and groundwater. For radioactive substances, chelating agents are sometimes used to make the contaminants amenable to plant uptake. Plants have also been used effectively to remove nitrates at a former explosives manufacturing site.

Conclusion

Globally, environmental pollution is a major problem, which adversely affect crop yields, soil health and water quality. The phytoremediation is one of the most important remediation approaches which uses plants and their associated microorganisms to remove, degrade, or isolate toxic substances from the environment. Phytoremediation may be used to clean up contaminants found in soil and groundwater. Phytoremediation practices need to be popularized, selecting plant species that are native perennial in nature, fast-growing with well-developed root systems.

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Plant Bioacoustics: Do Plants Really Listen and Talk?

Article ID: 31561

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Introduction

Plants are engaged with correspondence with their surrounding environment from multiple points of view, utilizing colours or shapes or secreting chemicals. For instance, flowering plants draw in their pollinators by emitting alluring aromas and showing splendid colours. Upon herbivory or pest attack plants emanate volatile organic compounds (VOCs) which pull in their natural predators, thus lead to an expansion in the plant's endurance and overall fitness. Numerous VOCs can likewise be sent to neighbouring plants to increase their competitiveness and resistance against their enemies. Despite the fact that plants have been exhibited to utilize visual, chemical and tactical correspondence however the correspondence through the airborne sounds has not been investigated. Bioacoustics is a rising exploration field having significant spotlight on the sound waves created by living life forms including plants.

Bioacoustics

Plant Bioacoustics is the part of science deals with sounds created by or influencing plants, particularly as identifying with communication.

Phytoremediation

Phytoremediation is a bioremediation process (the use of organisms to clean up contaminated soil) that uses various types of plants to remove, transfer, stabilize, and/or destroy contaminants in the soil and groundwater. It is the use of plants (trees, shrubs, grasses, and aquatic plants) and their associated microorganisms to remove, degrade, or isolate toxic substances from the environment. The word "phytoremediation" has been derived from the Greek word "*phyton*" meaning "plant", and Latin word "*remedium*" which means "to remedy" (Phillips, 2019). Substances that may be subjected to phytoremediation include metals (Pb, Zn, Cd, Cu, Ni, Hg), metalloids (As, Sb), inorganic compounds (NO_3^-, NH_4^+, PO_4^{3-}), radioactive elements (U, Cs, Sr), petroleum hydrocarbons (BTEX), pesticides and herbicides (atrazine, bentazone, chlorinated and nitroaromatic compounds), explosives (TNT, DNT), chlorinated solvents (TCE, PCE) and industrial organic wastes (PCPs, PAHs), etc. Phytoremediation is an alternative to engineering procedures that are usually more destructive to the soil (Greipsson, 2011).

Why Should We Focus on Bioacoustics?

1. Sound waves can travel through soil and be produced with expenditure of minimal energy which might be exploited by plants to interpret about their environment and surroundings.

2. Plant roots respond only to sound waves at frequencies between 10-240 Hz. So, plants can receive and transduce sound vibrations into signals to elicit behavioural modifications as a form of below ground communication.

3. Listening to xylem clicking of leaves and root clicking revealed the health of plants through embolism phenomenon and active cell division process respectively. Under serious water pressure, water tension in xylem turns out to be high to the point, that broke down air inside water extends to fill xylem making cavitation.

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Timeline

1. The plants are in constant communication around us. We just don not notice it. SIR J.C. BOSE was the first to suggest in 1900 that plants could respond to music.

2. "Plants can recognize when they are growing next to a 'bad neighbor' and change their growth behavior accordingly, even when we remove all the channels of communication we know about" said by Monica Gagliano.

3. Experiments by Heidi Appel and Rex Cocroft at the University of Missouri for the first time was resulted that a plant responds to an ecologically relevant sound in its environment.

Fascinating Evidences of Vibrational Perception

Chili seedlings revive their development when a frightful sweet fennel plant is close by, fixed off from the chilies in a container that just transmits sound, not fragrance (as chemical signal) (Gagliano, 2012). Appel and Cocroft, 2014 observed that plants become defensive upon being eaten and releases glucosinolates when exposed to the vibrational playback recording of the insect chewing sound. Sound waves or vibrations can be perceived by roots of corn seedlings. These seedlings can use this cue specifically for reorienting root systems indicating positive root phonotropism (Gagliano et al. 2012). Gagliano et al. (2017) found that roots had the option to find a water source by detecting the vibrations created by water moving inside a closed channel, even without substrate moisture. At the point when both moisture and acoustic signals were accessible, root establishes specially utilized soil moisture over acoustic vibrations, proposing that acoustic inclinations empower roots to comprehensively distinguish a water source even at a good distance, while moisture gradients serve as the basis to help them arrive at their target all the more precisely.

Fascinating Evidences of Sound Production by Plants

Plants that are under stress can radiate distantly distinguishable sounds, utilizing ultrasound clicks indiscernible to human ears. Sounds additionally contain data that can uncover plant state. Ribera and Vicient, 2017 inspected sound treated Arabidopsis thaliana plants exposed to water stress and recorded the changes at genomic level related to quality articulation. Unlike plants under vacuum (devoid of matters and sound), sound treated plants show a better survivability to the water stress.

Hypothetical Model of Sound Perception and Signal Transduction in Plant Cell

The mechanical stimulus is perceived at plant cell wall and membrane interface.

↓

Increase in membrane tension and upregulation of cell wall modifying enzyme xylogucan endotransglucosylase alters the elasticity of cell wall.

↓

Activation of membrane bound mechano sensitive ion channel transduces the signal and various calcium binding calmodulin and kinases get activated. Simultaneously various ROS are generated which are deactivated by various antioxidant enzymes.

↓

Kinases activate different signalling proteins and transcription factors which lead to the gene expression.

↓

This changed expression affects photosynthesis, glycolysis, amino acid metabolism , sulfur metabolism and hormonal adjustments which result in enhanced frowth and defense

Conclusion

Though the events like sound induced hormonal changes, variation in soluble protein and sugar level, plant growth promotion from the very beginning event like seed germination via sound induced up regulation of photosynthesis related genes, growth promotion by stress relieving, up regulation of antioxidant system are so far proved but the signalling mechanism for sound evoked physiological and chemical responses in plants are yet to be answered. Alongside this the revelation of an organ or a particular protein in plants that perceives sound waves would help in boosting the adequacy of the utilization of sound treatment in field preliminaries, crop stress mitigation and yield improvement.

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Ecosystem for Sustainable Development of Farmers' Producer Organisation

Article ID: 31562

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Abstract

The need for Farmer Producer Organisations (FPOs) are being increasingly felt to overcome the challenges of small farmers who lack access to resources and services. Accordingly, there has been substantial increase in the number of FPOs. However, the growth of FPOs across states has not been uniform which has limited the success. This paper attempts to highlight the ecosystem that need to be created in each state for the sustainable development of FPOs.

Introduction

Indian agriculture is dominated by small farm holdings accounting for nearly 85% of the total operational land holdings. It has been recognised globally that achieving agricultural growth through small and marginal farmers is an effective pathway for poverty reduction (Evenson and Gallon 2003, Hazell et al. 2010). However, the challenges confronting the small and marginal farmers are multi-fold. Small farmers often have weak bargaining powers and suffer from greater dependency in the cultivation and monopolistic exploitation under formal contracts (Bachke, 2009). Major concerns related to small farm holders include:

1. Inadequate farming, extension services and low level of technology adoption.
2. Lack of capital and poor business skills.
3. Low income due to poor infrastructure and low market efficiency.

For tapping the potential of small farmers, different forms of farmers' collectives were evolved across the world. Farmers' collectives in the form of Farmer Producer Organisations (FPOs) are assumed to provide the small farmers better information on modern agriculture technologies, investments, inputs, markets and government policies and the collective effort is expected to reduce the problems associated with small holdings (Nikam et. al, 2019). In longer term perspective, FPOs are essential institutions for the empowerment, poverty alleviation and advancement of farmers and the rural poor (FAO 2007).

In India, Farmer Producer Companies emerged as farmer collectives in 2003 under the provision of the Companies Act. They were modelled as an interface between small holder farmers and markets by providing forward and backward linkages (Padmaja et.al, 2019). In 2013, Govt. of India formulated a policy guideline for FPOs. It put forth the role of centre and state government in promoting FPOs. Small Farmer Agri Business Consortium (SFAC) was established as a nodal agency for promoting FPOs. Later NABARD started promoting FPOs using their Producer Organisation Development and Upliftment Corpus Fund (NABARD, 2015). In the Union Budget 2019-20, the Govt. of India announced the formation of 10,000 new FPOs to ensure economies of scale for farmers over the next five years.

There are several studies highlighting the success of FPOs across country (Singh and Singh 2013, Bhamra et al 2016, Raju et al 2017, Sowmya and Raju 2017). However, there is significant heterogeneity in the functioning of FPOs which have limited the success so far. This is because the development of FPOs is dependent on favourable ecosystem which includes emergency credit, consumption credit, production credit, retail services of inputs for agriculture.

In this paper we evaluate the status of FPOs at the state level and the key factors that need to be enhanced for sustainable development of the FPOs. The following section gives a literature review on the different types of FPOs and the ecosystem required for sustainable growth. The subsequent section gives the current status of

FPOs at the state level and identifies key factors that need to be enhanced for sustainable development of FPOs and finally section 4 concludes the paper.

Literature Review: Types of FPOs and Ecosystem for Sustainable FPOs

The ecosystem required for FPOs depend on the different functions that FPO's undertake. These functions include, focus of service provisions, nature of service provided, integration into market, degree of structuring, nature of linkages and relations etc. The following table gives the different basis used by researchers to classify FPOs.

Table 1: Type of FPOs

Focus of Service Provisions (Onumah et al. 2007)	Diverse Service Providers Focussed Service Providers
Nature of service provided (GFRAS (2015) and Thompson et al. (2009)	Market oriented Input oriented Extension oriented Policy and advocacy oriented
Integration into Market (Bosc et al, 2001)	Strategically important Strategically less important
Degree of structuring (Bosc et al, 2001)	Grass root FPO Regional federation National associations
Nature of relations and linkages (Mercoiret et al 2001)	Traditional organisations New organisations

Source: Nikam et al (2019), "Farmer Producer Organizations: Innovative Institutions for Upliftment of Small Farmers, Indian Journal of Agricultural Sciences 89 (9).

Onumah et al. 2007 makes two broad categorisations of FPOs. One which provide services to range of crops and the other which provides range of services to focussed crops. GFRAS (2015) and Thompson et al. (2009) while studying FPOs in Ethiopia, Kenya, and Malawi identified four types of FPOs based on the functions and the value chain in agriculture that is addressed.

Bosc et al, 2001 classifies into two based on integration into market. The first type of FPOs include those which are engaged in the integrated sectors of export products on which the national economy depends or in food crops that are of strategic importance for food security. The second type of FPOs which work in less strategically important or fragmented sectors, like animal husbandry, rain fed crops etc. Bosc et al, 2001 also classifies FPOs based on degree of structuring. Mercoiret et al. (2001), gave two types of typology of the organisation: first traditional organizations whose function is to regulate the internal relations of the group; second new organisations whose function is to organise the external relations of the group and which therefore appear at the interface between producers and the public and private actors in their environment.

It is clear from above, there are various types of FPOs with their functions ranging from strategically important crops to non-strategic crops, from input-oriented functions to market oriented functions etc. It is therefore critical to have an ecosystem that can address the different functions of FPOs. NABARD, 2021 points out some of the critical ecosystem for proper functioning of FPOs:

1. Policy environment-production, market and price risk mitigation, licensing, agri-logistics, infrastructure arrangements, contract farming, compliances, etc.
2. Technology support- Extension and advisory services, value addition, processing & marketing, etc.
3. Consumption/ production/ post-production credit support- Banks/ financial institutions, NBFCs, Government institutions, Developmental Agencies, Corporates, etc.
4. Retail services/ Markets- Quality inputs, retail marketing, spot markets (eNAM, APMC), future's trading, linkages with agri corporates, exporters, direct marketing, etc.

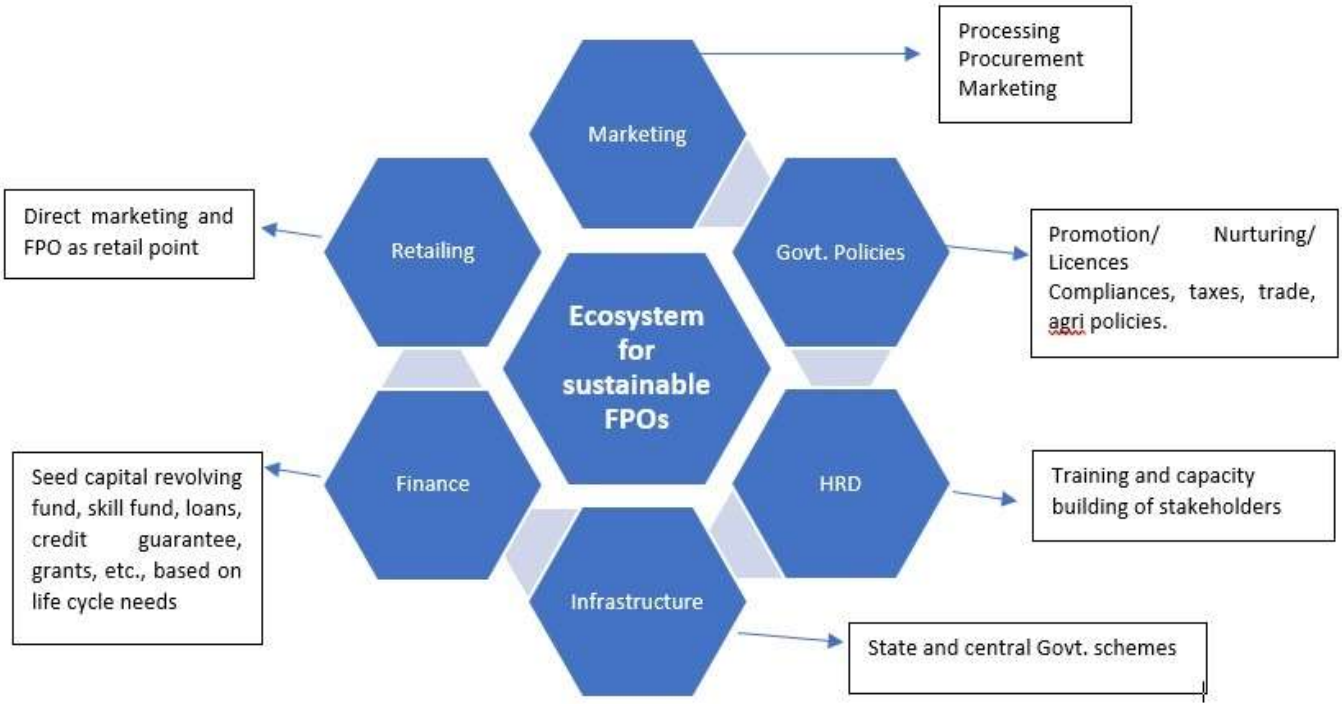

Fig 1: Ecosystem for Sustainable FPOs - Source: NABARD, 2020-21

Key Determinants for Sustainable FPOs

In India, currently there are about 6000 FPOs, which were formed under various initiatives of the Govt. of India, including SFAC, State Governments, NABARD and other organisations over the last 8-10 years. Of these, around 3200 FPOs are registered as producer companies and the remining as Cooperatives/ Societies.

The number of farmers mobilised towards FPOs vary widely across states. As evident from the table below, the number of farmers mobilised per FPO is more than 1000 in Tamil Nadu, while in Punjab, HP and UP, it is even less than 300. Almost 50% of the farmers mobilised are just in 5 states, i.e., Karnataka, Madhya Pradesh, Tamil Nadu, Maharashtra and Rajasthan. Karnataka and MP also top the list in terms of the number of FPOs that account for 9-10% of the total FPOs in the country.

Table 2: State-wise Performance of FPOs:

States	No. of FPOs promoted		Farmers mobilised under FPO
	SFAC	NABARD	
Tamil Nadu	13	170	1049
Chhattisgarh	26	57	876
Karnataka	121	159	836
Madhya Pradesh	146	160	723
Andhra Pradesh	7	95	660
Arunachal Pradesh	2	1	652
Haryana	23	50	651
Odisha	41	100	647
Jammu & Kashmir	2	13	631
Gujarat	25	117	617
Maharashtra	101	119	613
Assam	12	40	568
Rajasthan	50	143	566

Uttarakhand	7	52	559
Manipur	8	8	536
Sikkim	30	4	517
Telangana	21	68	500
Meghalaya	3	9	484
Mizoram	1	16	455
West Bengal	86	150	430
Kerala	0	132	379
Jharkhand	10	132	370
Bihar	35	118	330
Uttar Pradesh	55	116	292
Himachal Pradesh	7	51	282
Punjab	7	70	201

Source, SFAC, NABARD

In the Union Budget 2019-20, the Govt. of India announced the formation of 10,000 new FPOs to ensure economies of scale for farmers over the next five years. In pursuant to the budget announcement, total budgetary provision of Rs. 4496 crores for 5 years with a committed liability of Rs. 2386 crores towards handholding of each FPOs for five years has been created (Ministry of Finance, 2020).

However, sustainable FPOs is possible only when there is favorable ecosystem. To identify states with congenial ecosystem, we first identified the dominant factors that can help in the sustainable development of FPOs. Linear regression is done on pooled state level data to identify the key factors. The marginal effects of the regression analysis for the key variables is reported in the following table.

Evident from the table below, states with larger number of promoting institutions, like, NABARD and SFAC have so far helped the growth of FPOs. The funding institutions, like NABARD and SFAC provide fund support to promoting institutions for enabling them to mobilize farmers to form FPOs (Manaswi et al, 2018).

However, for sustainable development it should be supported with other key requirements. Agriculture credit is one of the crucial requirements for the formation of FPOs. States with large number of farmers using Kisan Credit Card (KCC) played a significant role in the functioning of FPOs.

Ease of doing business – in terms of ease of getting licenses, tax exemptions etc. again is a crucial factor in the formation of FPOs. The other key factors include marketing infrastructure and rural literacy.

Table 3: Results of Linear Regression Analysis:

Variables	Coeff.	Std. Error	P> |t|
Promoting Institutions (no. per ‘000 ha of gross cropped area	0.86	0.027	0.000
KCC per operational holding	0.35	0.014	0.000
Rural literacy rate	0.15	0.019	0.000
Ease of doing business	0.22	0.011	0.000
Markets (no per ‘000 gross cropped area)	0.18	0.012	0.001

Note: P> |t| ~0 indicates significance of the variable in the model.

Large number of promoting institutions recognised by NABARD and SFAC etc in Karnataka, MP and AP, clearly supported in the formation of FPOs and also in the mobilisation of farmers per FPOs.

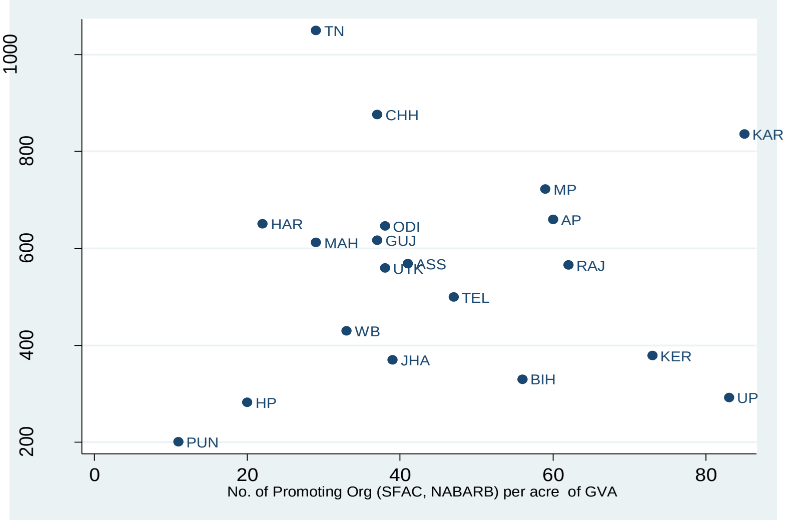

Fig 2: No. of promoting institutions and No. of Farmers Mobilized per FPO.

Large number of Kisan Credit Cards per farmers in Karnataka, MP, AP, Maharashtra supported the mobilization of farmers per FPOs.

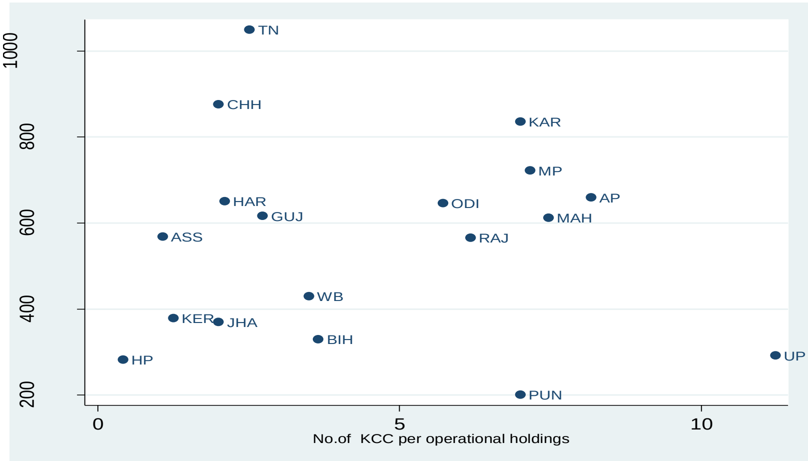

Fig 3: No. of promoting institutions and No. of Farmers Mobilized per FPO

Ease of doing business in Tamil Nadu, Chhattisgarh, Karnataka, MP, AP, Maharashtra, Odisha, Gujarat supported the formation and mobilization of farmers per FPOs.

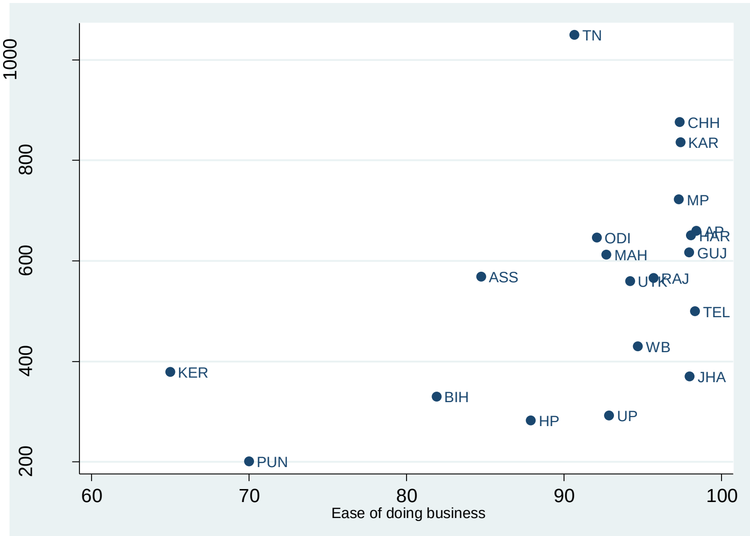

Fig 4: Ease of doing business and No. of Farmers Mobilized per FPO

The above analysis shows that the ecosystem for Karnataka and Madhya Pradesh is favorable for sustainable development of FPOs which is clearly reflected in the number of farmers mobilized per FPO in these states. These states are dominant in all the three key factors, i.e., number of FPO promoting institutions, KCC disbursement and ease of doing business. Ease of doing business in Tamil Nadu, Chhattisgarh, Haryana and Gujarat have supported the growth of famer mobilization per FPO. However, by expanding FPO promoting institutions and KCC disbursement a more conducive environment for sustainable growth of FPOs can be created. Punjab, Bihar, Kerala are amongst the lowest in terms of farmer mobilization per FPOs. This also coincides with low rating in terms of ease of business in these states.

Conclusion

FPOs will play a decisive role in shaping Indian agriculture in the years ahead. The Government of India has taken several measures for the growth of FPOs. Total budgetary provision of Rs. 4496 crores for 5 years with a committed liability of Rs. 2386 crores towards handholding of each FPOs for five years has been created. However, sustainable growth of FPOs is dependent on a conducive environment. It is therefore essential that an ecosystem is created first which can support the growth of FPOs. Tamil Nadu tops the list in terms of farmers mobilised under FPO. Ease of doing business in the state supported its growth. However, for a continued and sustainable development it is essential that more FPO promoting institutions are also created in the state. Karnataka and Madhya Pradesh are among the top performers and these two states fare well in most of the indicators. On the other hand, Punjab, Bihar, Kerala are amongst the lowest in terms of farmer mobilisation per FPO. This also coincides with low rating in terms of ease of doing business in these states. Clearly, sustainable development of FPOs require an environment which can promote, meet financial needs, ease restrictions, provide infrastructural support and spread awareness amongst the farmers.

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Impact of Agronomic Biofortification in Cereals

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Introduction

Agronomic biofortification is one of the approaches to reach the poorest rural people who are suffering from micronutrient deficiency due to an inadequate intake of essential micronutrients in the daily diet, also known as Hidden Hunger more than 5 million childhood deaths occur from micro nutrient mal nutrition every year.

Need for Agronomic Biofortification

Biofortification through agronomic methods requires physical application of nutrients to temporarily improve the nutritional and health status of crops and consumption of such crops improve the human nutritional status.

1. Macronutrients like nitrogen, phosphorus and potassium make an important contribution to attainment of higher crop yields.

2. Micro minerals iron, zinc, copper, manganese, iodine, selenium, molybdenum, cobalt and nickel are found in varying degrees in the edible from the soil targets improvement of the soil micronutrient status by their application as fertilizers can contribute to decrease in micronutrient deficiency in human. When crops are grown in soils, where mineral elements become immediately unavailable in the soil (or) not readily translocated to edible tissues targeted application of soluble inorganic fertilizers to the roots (or) to the leaves are practices.

3. In addition to fertilizers, plant growth promoting soil microorganisms can be used to enhance the nutritional mobility from soil to edible parts of plants and improve their nutritional status. (Bacillus, Pseudomonas, Rhizobium and Azotobacter).

Objectives of Agronomic Biofortification

1. To produce crops for human nutrition with improved micro nutrient concentrations.
2. To improve the efficiency either which minerals are mobilized in the soil.
3. To improve the efficiency with which the minerals are taken up from the soil into the roots of the plant.
4. To improve the transport of minerals from the storage tissues, such as grain.
5. To Increase the capacity of storage tissues to accumulate minerals in a form that bioavailable for humans.

Response of Cereal Crops have Been Targeted through Agronomical Biofortification to Improve the Human Nutritional Status

1. Agronomic biofortification in rice:

a. Biofortification of rice plants by foliar spray of iron was an effective way to promote iron concentration in grains.
b. Foliar application of zin has been promoted rice grain zinc concentration and zinc bioavailability
c. Selenium, which is an essential trace element for human health and proved to be a potent antioxidant, has been also increased by the application of selenite as foliar spray.

2. Agronomic biofortification in wheat:

a. Inclusion of iron in foliar urea fertilizers has been positively correlated with high iron accumulation.
b. Application of foliar zinc has reduced human zinc deficiency soil and also improved its bio-viability by reducing antinutrient factors like phytic acid.

c. Iron biofortification of wheat grains has been accomplished through integrated use of organic and chemical fertilizers and zinc biofortification by using Bacillus sps.

3. Agronomic biofortification in maize:

a. The foliar application of zinc resulted with nutrient enriched grain and optimum yield in maize

b. In maize, plant growth promoting rhizobium have led to nutrient enrichment in the plants and have been included in agronomic approaches to develop effective biofortification in crops.

4. Agronomic biofortification in barley:

a. The micronutrient content of barley has been improved by the application of various organic and inorganic biofertilizers.

b. The concentration of zinc and iron in grains has been enhanced by the application of biofertilizers along with inorganic and vermicompost.

5. Agronomic biofortification in sorghum:

a. The nutrient profile of sorghum has been promoted by the application of fertilizers both organic and inorganic that have an additive effect on the yield.

b. The inoculation of azospirillum alone and in combination with phosphate solubilizing bacteria increased sorghum grain yield and protein content by improving the status of phosphorus and nitrogen in the soil.

Advantages of Agronomic Biofortification

1. Agronomic biofortification is often considered as a short-term solution to increase micronutrient availability and mainly to complement genetic biofortification which is seen as a more sustainable approach.
2. Agronomic biofortification is an effective, feasible and sustainable approach to alleviate micronutrient deficiencies.
3. Application of micronutrient enriched fertilizers in the crop have minimal environmental impact.
4. The agronomic biofortification not only improved the micronutrient content in grains but also increased the crop yields.
6. Agronomic biofortification provides an immediate and effective route to enhancing micronutrient concentrations in edible crop products, although genetic biofortification may be more cost effective in long term.

Limitations of Agronomic Biofortification

1. The success of agronomic biofortification is highly variable due to differences in mineral mobility, mineral accumulation among plant species, and soil compositions in the specific geographical location of each crop.
2. The biggest of all constraints is that the fertilizers accumulation in soil and water poses adverse environmental effects.
3. It is not always possible to target the micronutrient into edible plant parts like seed (or) fruit and can sometimes results in the accumulation of desired nutrient in the leaves (or) other non-edible portion of the plants.

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Are Really Anti Nutritional Components Harmful in Horse Gram: An Insight

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Introduction

Horse gram (*Macrotyloma uniflorum* Lam. Verdc.) is a nutritious pulse crop being widely cultivated in peninsular region of India. The seeds are consumed along with rice, pearl millet or sorghum after processing (soaking followed by cooking). Horse gram is also taken as sprouted legume in many parts of India. Due to its immense nutrient benefits, horse gram is considered as potential crop of future by US National Academy of Sciences. It has good source of protein (18-29%), carbohydrates, dietary fibre, fat, calcium, phosphorous, iron and vitamins such as niacin, riboflavin, thiamine. Utilization of horse gram flour with sesame had resulted in improved protein efficiency ratio (Vijaylaksmi and Venkatrao, 1977). The horse gram flour is added along with cereals in many Indian food recipes. Though horse gram possesses numerous nutrient and health benefits, its potential is not fully exploited due to presence of anti-nutritional factors. These components are negatively associated with protein digestibility and mineral absorption (Stanely and Aguilera, 1985). Several anti-nutrient factors viz., polyphenols, protease inhibitors, lectins, hemagglutinin activities, phytates, tannin and flatulence-causing factors were reported in horse gram (Borade et al., 1984; Kadam and Salunkhe, 1985).

Anti-Nutritional Components

Presence of hemagglutinins compounds tends to agglutinate red blood cells. Horse gram possess four identical subunits of hemagglutinins which were found to exhibit retarded growth activity in rats. However, the toxicity of these compounds can be eliminated by germination, cooking and moist heat.

Lectins are the protein compounds having high affinity for carbohydrate moieties. These compounds bind to glycoproteins present in midgut lining and thereby affect the digestibility rate and nutrient assimilation. It constitutes around 10 per cent of soluble protein in horse gram seed extracts. Lectin activity can be partially modified by fermentation and cooking process. Lectin interferes with hormones and signalling compounds, modifies the gut microbial flora, causes blood clotting, damages epithelial cells, induce allergic reaction and so on. However, it is non-toxic at moderate concentration in human body.

Protease inhibitors affect the digestibility of proteins in the human body by inhibiting the proteases such as trypsin, chemotrypsin and so on. Bowman-Birk (BBI) and kunitz are the well explored serine protease inhibitors in horse gram. The isolated BBI (Sreerama and Gowda, 1998) in horse gram had anti-carcinogenic property which may be further studied for its utilization as functional foods.

Anti-nutritional factors such as polyphenols and phytates, binds with proteins and minerals (calcium, iron, magnesium and zinc) making it unavailable during digestion. Large proportion of total phosphorous is stored in the form of phytic acid in cotyledon part of horse gram seeds. Presence of phytic acid is the major factor contributing to the cooking hardiness of horse gram (Turner et al., 2002).

Horse gram seed coat contains rich source of phenolic compounds which was found to exhibit endogenous antioxidant activity. Different categories of phenols such as flavonoids and sterols have been isolated in horse gram (Handa et al., 1990). Though it is an anti-nutrient component, its possess several health promoting factors which attracts many researchers and food manufacturers. It acts as anti-cancer agent, helps in scavenging free radicals, possess chelating property and so on.

Oligosaccharides viz., sucrose, raffinose, galactose, glucose and stachyose had negative impact on human body causing flatulence on large consumption. These compounds are found higher in horse gram cotyledons. Absence of α-galactosidase enzyme in gut results in partial hydrolysis of the sugar compounds leading to gas accumulation. Experiments on galactosidase enzymatic treatment had resulted in decline of non-digestible oligosaccharide components (Sreerama et al., 2009). This would offer scope on production of flatulence free horse gram flour making it suitable for food industries.

By adoption of processing techniques, anti-nutritional components can be significantly reduced making horse gram a potential legume. Few compounds were found to have positive association with disease preventing factors (anti-carcinogenic, anti-oxidant) which has to be explored deeply for its utilization as functional foods.

Objectives of Agronomic Biofortification

1. To produce crops for human nutrition with improved micro nutrient concentrations.
2. To improve the efficiency either which minerals are mobilized in the soil.
3. To improve the efficiency with which the minerals are taken up from the soil into the roots of the plant.
4. To improve the transport of minerals from the storage tissues, such as grain.
5. To Increase the capacity of storage tissues to accumulate minerals in a form that bioavailable for humans.

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Soybean - Meat for Veganism

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Introduction

Vegetarians are a group of people who restrict themselves from consuming meat (red meat, organ meat, poultry, fish and other sea foods). In other words, they do not eat the flesh and bones of multicellular organisms. There are several reasons for one to follow vegetarianism starting from kindness towards co-living organisms to environmental concern in preventing forests that are destroyed for cattle maintenance. Among the many types of vegetarianism, veganism is considered the extreme one. Vegans avoid all form of foods which directly or indirectly contains animals' flesh and bones. In addition to meat, milk is also avoided. Even though vegans enjoy certain benefits like weight loss, reduced risk of cardiovascular diseases and reduced cholesterol build up they might lack some vital nutrients especially protein which might possibly result in some serious illness / deficiencies / disorders. This article focuses on importance of protein and soybean as the best substitute for meat to vegans.

Protein

Proteins are compounds present in all living cells that plays both structural and protective role in the body. Protein forms an integral part of muscle, bones, hair, nerves, white blood cells, and almost all cells and also present in enzymes, hormones and cellular secretions. Also, protein is necessary to build, repair and maintain the body.

Proteins are macronutrients obtained from diet. RDA (Recommended Dietary Allowance) of protein required for Indians as recommended by ICMR/NIH (Indian Council of Medical Research/ National Institute of Health) is given below:

Table 1: RDA/ day for Protein:

Group	Particular	Protein (g)/ day
Infants	0-6 months	Exclusive breast milk
	6-12 months	19
Children	1-3 yrs	27
	4-6 yrs	25
	7-9 yrs	30
Boys	10-12 yrs	35
	13-15 yrs	45
	16-17 yrs	50
Girls	10-12 yrs	35
	13-15 yrs	40
	16-17 yrs	35
Woman	≥ 18 yrs	55
	Pregnant Woman	78

	Lactating women 0-6 months 6-12 months	 74 68
Man	≥ 18 yrs	60

The proportion of protein present in plant source is comparatively lower to that of animal source and also bio-availability of protein (percentage of protein absorbed on consumption) is inferior in plant source.

Table 2: Bio-availability of various Foods:

Protein Source	Whole Egg	Cow's milk	Egg white	Fish	Beef	Chicken	Casein	Soy
Bio-availability	100	91	88	83	80	79	77	59

From the Table 2 it is evident that animal sources have the maximum bio-availability of protein followed by plant source from soybean. Insufficient consumption of protein results in PEM (Protein Energy Malnutrition). Vegans are more prone to develop protein deficiencies as protein availability from plant sources is lower than non-vegetarian sources.

Soybean also known as miracle bean can be consumed by vegans for its high protein content, functional and nutraceutical properties as an alternative to animal protein.

Soybean

Soybean, among the plant sources has the richest protein content as an average percentage of dietary protein is about 40% while it is 20-25% in other beans.Various products of soy including soy milk, tofu, soy protein concentrates and soy flour are available in commercial market and the protein content of them are given in Table 3. Fortified soymilk with Vitamin D_3 and B_{12} is another beneficial factor for vegans as animal products forms the predominant dietary source of Vitamin B_{12}. Soybean with 7g of lysine can be used as complementary to cereals amino acid profile.

Table 3: Protein value of soybean and its products:

Soybean Products	Protein (g)/100 g
Soybean (White)	37
Soy milk	3
Soy protein concentrate	6
Tofu	8
Soy flour	13

Other Health Benefits of Soybean

Apart from high dietary protein, soybean showed functional properties like anti-inflammatory, anti-oxidant, hypocholesteremia and anti-proliferative activities due to the presence of phytosterols and phytoestrogens (isoflavones, anthocyanins, genistein and daidzein). Soybean with 3 g and 7 g of glycine and arginine helps in reducing blood insulin level while its fiber content is useful in controlling plasma glucose level. Effect of soybean on insulin moderator action, hypertension, thrombosis in atherosclerosis and hypercholesterolemia favors individuals with type 2 diabetes.

Conclusion

Soybean in regards to its excellent dietary protein, functional properties and proven health benefits when consumed adequately can possibly be advantageous for vegans on considering the nutritional cons of veganism. Therefore, soy bean comparatively might be acknowledged as vegan's meat owing to its protein content and bioavailability.

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Walnut: A Miracle Nut

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Introduction

Walnuts are the most commercially and most important valuable tree after Apple and Almond of temperate region. The botanical name of walnuts is Juglans regia L. belonging to the family of Juglandaceae and having a chromosome number (2n=32) which means it is a diploid in condition. Walnuts having a wide range of origin from Eastern Europe, Asia Minor and points towards east to the Himalayan Mountains. The native habitat of the walnuts extends from the Carpathanian Mountains to Europe across Turkey, Iraq, Afghanistan, South Russia and further towards the eastern foot hills of Himalayas. But some of the historians found the evidences that Iran is the natural habitat of walnuts since the time ages. In India, walnuts are usually grown in the mid hills of Jammu and Kashmir, Himachal Pradesh and the Upper hills of Uttarakhand and Arunachal Pradesh as well.

History

Walnuts are having a wide rich history of dating back thousands of years. Walnuts are the oldest tree food which is known to mankind, dating back to more than 7000 B.C. The Romans called walnuts (Juglans regia) as a "Jupiter's royal acorn". Early history indicates that the English walnuts came from ancient Persia (Iran) where they are reserved for the royalty servings. Thus, from here the walnuts are often known as the "Persian Walnuts". Walnuts were traded along the Silk Route between the Asia and the Middle East. English merchant marines transported walnuts and its produce for the trades in ports around the world and they became to be known as "English Walnuts" across all over the area where they were used to trade by the carriages on the land route. According to one of the Archaeological Survey the oldest walnuts to be discovered in Iran and they were believed to be from 50,000 B.C. The Greeks and Romans were found of walnuts and they were considered as the foods for the gods by the early Romans. They were early used for oils and sometimes were powdered to thicken food much as corn starch is used today.

The walnut was first cultivated in California by the Franciscan Fathers in the late 1700's. The earliest walnuts to enter California were to be called as "Mission walnuts". Unlikely today, earlier entries of walnuts were found to be small with hard shells. The tress flourished in the Mediterranean-like climatic zones of California and its adjoining areas. Now many of presently improved cultivars are descendent of early plantings of walnuts in California and became a hub of walnuts eventually. Though, the first commercial plantings began in 1867 when Joseph Sexton, an orchardist and nurseryman in the Santa Barbara planted English Walnuts. For many several years, walnuts were planted in the Southern regions of California with a 65% of all bearing acreage. After a long period of 70 years after Sexton first planting, California Walnuts production moved towards the north and Central Valley area is one of the most dramatic Horticultural moves in history.

Species

Luther Burbank an American botanist, horticulturist, and pioneer in agricultural sciences is credited with early research in California Walnut cultivation. Luther Burbank began in making the controlled crosses between the walnut species in the late 19th century after hearing about a "Supposed Natural European Hybrid Walnut". He though then crossed between Juglans hindsii (Northern Californian Black Walnuts) × Juglans regia (Persian Walnuts) and produced a variety called ‘Paradox’ because of its really fast vigorous growth and other “anomalies”. He also crossed two American species, of walnut that is Juglans hindsii × Juglans nigra (Eastern Black Walnut) producing the “Royal” walnuts progeny that were having an identification of vigorous growth and are prolific nut producers. A third inter-specific hybrid was a cross between Juglans ailantifolia (Japanese walnut) × Juglans regia that was recognized as extremely vigorous progeny but was not named. He also observed segregation in the F2 population and described giants and dwarfs as reversions of the ancestral forms. Luther Burbank also made various selections of walnut scion cultivar and he was especially interested in the thin shelled kernels of walnuts.

Later, he collected the seeds of the J. regia growing in the regions of the San Francisco because it produced the regularly and have very high-quality nuts with relatively thin but poorly sealed shells. He selected one of the seedlings named “Santa Rosa Soft Shell” and identified it as a large bearing crops of nuts that were nearly white with thin shells and delicious white meat. Thus, Luther Burbank’s contribution in walnuts industries was memorized to this day, especially for the widespread use of the seedlings and clonal Paradox walnut rootstock. Thus, its history is very large running throughout the world in different centuries by different people.

Taxonomical Status

Walnut is a deciduous, large and vigorous with a widespread canopy tree grown for its edible seeds. The average diameter of a walnut tree trunk can reach up to 2 meter and a matured tree possesses smooth, silver grey bark. Walnut leaves are composed of all numbers of smaller, oval shaped leaflets which are bright green in color. The leaves of the tree are alternate compound, flowers are unisexual and plants are monoecious. The trees produce staminate male flowers on pendulate catkins having sepals with no corolla and having many stamens. The pistillate flowers are erect spikes having sepals with no petals. The gynoecia of the pistillate flowers have 2-3 united carpels with inferior ovary and have single locule. Thus, the staminate floral formula is $K^{*}C^{O}A^{*}G^{O}$ and of pistillate floral formula is $K^{*}C^{O}A^{O}G$ (2-3). The two common of pollination in walnuts are by wind pollination or bringing the catkins of the neighboring trees close to the female flowers. The fruits of the walnuts are fleshy green, drupe in which the nut is enclosed. The kernels of the nut are protected by a corrugated woody shell. A walnut can attain a height of 23-35 meters and have a lifespan period up to more than 200 years.

Fig 1: Male flowers image on catkins in walnut tree

Walnuts are the rounded, single seeded stone fruits of the walnut tree commonly used for its meat after ripening. The fruits of the walnuts are a type of accessory fruit known as pseudo- drupe (or drupe-like nut). The outer covering of the fruit is the involucres in a drupe covering would be derived from the carpel. Following the fully ripening, the removal of the husk reveals the wrinkled shells of the walnuts which is usually commercially found in two stages (exceptionally third stage may also be formed). During the ripening process, the shell becomes hard and brittle. The shell encloses the kernel or the meat, which is usually made up of two halves separated by a partition. The seed kernels commonly available as shelled walnuts which are enclosed in a brown colored seed coat which contains antioxidants. The antioxidants protect the oil rich seeds from atmospheric oxygen thereby preventing rancidity. The seedling tree attains the giant size and start bearing nuts of variable size and shape after 10-15years, whereas vegetative propagated plants are true-to-and produce almost uniformed sized nuts after 4-5 years. They remain in manageable size. But the major constraint is low success in the vegetative propagation.

Fig 2: Female flower image of a walnut tree

Conclusion

Soybean in regards to its excellent dietary protein, functional properties and proven health benefits when consumed adequately can possibly be advantageous for vegans on considering the nutritional cons of veganism. Therefore, soy bean comparatively might be acknowledged as vegan's meat owing to its protein content and bioavailability.

Statistics of Walnut Production in World and in India

The world produces a total of 871 thousand metric tonnes of walnut kernels production in which China is the largest producer of walnuts. In the year 2016-2017, the country produced 10,60,000 metric tonnes of walnuts. China accounted for about 50% of the total world walnut production. The country is also a biggest consumer of walnuts in the world. The other major producer countries of walnuts followed by China are Iran, United States of America, Turkey, Ukraine, Mexico, India, Chile, France, and Romania. According to the statistical report published by the National Horticultural Board in 2017-2018, the total production of walnuts in India is 299.11metric tonnes of which Jammu and Kashmir produces 91.91%, Uttarakhand 7.06%, while Himachal Pradesh produces 0.82%, and Arunachal Pradesh produces 0.21%. Though, this graph of walnut production state wise in India is less and more steps is to be taken for the production and export of walnuts wisely presently and also in near future.

Soil and Climate

A well-drained silt loam soil abundant in organic matter having a pH of 6.5-7.2 is ideal. The soil must be free from rock, impervious clay, course and sandy soil with hard pan, layers of gravel and fluctuating table. Walnuts can be grown at an elevation of 1200-2000 meters above mean sea level. Hot summers with low humidity results in blank nuts. They also grow well in the areas of well spread rain of about 75cm or more.

Propagation

Propagation is generally done during springs and its propagation method is tongue or cleft grafting of one-year old root stocks with scion of similar diameter should be worked out. Though, apart from grafting as commercial propagation budding can also be achieved.

Spacing, Planting and Planting Time

The spacing of the walnut plants can be sown according to their method of sowing. In both cases, direct sowing or after stratification i.e. the nut should be sown maintaining 25cm distance from nut-to-nut and 75cm from row-to-row. Seedling plants should be planted 10 metre apart while for budded/grafted plants it should be7-8metre apart. Generally, the ideal time for planting is December to March but, for sowing directly in seed bed is November. The planting systems generally followed are square, hexagonal or contour systems for plantation.

Training and Pruning

Modified Central Leader System is most ideal for training since it provides it very good strength to its framework. Pruning is almost impossible for seedling origin in our country because of attaining large size later on makes it difficult.

Seed Rate

The seedling plants are to be planted at a rate of 100kg/ hectare, whereas vegetative propagated plants at a rate of 200 Kg/ hectare. In case of hexagonal system of planting, the number of plants is 15% more.

Manure and Fertilizers

Manure and Fertilizers are very crucial for growth and development and also to the yield of the plant. Thought, it is not specified yet that what is the requirement of the crop towards the nutrition. The use of well rotten manure, FYM and Vermicomposting in equal quantity can be used at a time of vegetative growth and fruiting as prescribed by the experts.

Irrigation

Generally, walnuts are grown under rainfed condition, but they need adequate water during 5-6 weeks after blooming. Inadequate moisture results in poor quality. Due to lack of plumpness of kernels, yield is reduced considerably. Hence, irrigation is required to the planted area at every fortnight.

Harvesting

Harvesting of the walnuts is done when they fall to the ground. The nuts come to into its maturity at a period of September to October. Collection of nuts can be alley done as soon as possible to avoid mould. The identification of the maturity of nuts is the natural de-husking taking place by visibility of brown layered shell.

Yielding

The average walnut tree starts bearing nuts at an age of 8-10 yrs. There are many cases of having a walnut tree starts to produce about 7-10 kg of nut at an age of 5-7 yrs. Most commercial walnut orchards reach their peak production levels at an age of 30yrs or more. Healthy and mature trees produce from 30 to160 kg /tree.

Cultural Operations

1. In the absence of irrigation facilities, sod culture in conjunction with mulching helps in moisture conservation.
2. However, if irrigation is available it should be applied at 1-2 fortnightly intervals depending upon dry spell period and water holding capacity of the soil.
3. An Alley cropping of agronomic crops such as wheat, soya beans and horticultural crops like cabbage, cauliflower and flowers like marigold and leguminous crops etc should be used as intercropping to avoid predator and parasitoids and help in nematode management.
4. Repeated application of same pesticides should be avoided.
5. Use selective insecticides during early fruiting phase of crop growth.
6. Encourage use of neem base formulations.

7. Orchard management practices should be followed strictly like clean cultivation.

8. Ensure cultivation of 2 cultivars in an orchard with 33% pollinizer.

9. Avoid planting of pest infected saplings.

10. Application of balanced dose of chemical fertilizers and FYM to keep up the vigour of the plant and to reduce the attack of shot hole, bark beetles and other pests.

11. Nitrogen application is made in 2-3 splits.

12. Proper selection of cultivars having commercial value and suitable for effective cross pollination be made.

13. Before, planting of walnut trees, the proper soil selection be made, and the most suitable soil is loam with abundant organic matter.

14. Regular training and pruning should be done for the discard of damaged and diseased plant.

15. Before laying or raising of plant nursery make use of *Trichoderma viride* and *T. harzianum* to control root rot disease and at later stage for control of collar rot also.

16. Solarization of nursery beds is made to ward off soilborne disease.

Integration of *Azolla* and Fish in Rice-Duck Farming System

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Abstract
Rice-duck farming is a low cost, organic farming method for small and marginal farmers. Generally, on-farm resources like duck manure and feed waste are not adequately used and recycled. As, the agricultural land is fixed and to fulfil the demand of food of increasing population of India integration of fish and free-floating nitrogen fixing fern *Azolla* with rice-duck farming system is a viable solution. Through integration of *Azolla* and fish in rice-duck farming increase the rice yield. Fish, *Azolla* and duck integrated with rice farming can result in nutrient enhancement and biological control of weeds and pest. So, it reduces the use of chemical fertilizers and pesticides. As, women generally take the ducks to the pond and bring them back, this system will minimise the laborious work and saves their time. But more awareness should be created that ducks and fish will not harm the rice. The ducks and fish provide another source of added income. It not only improves soil fertility, maintains soil biodiversity but also improves food security status of small holder farmers.

Keywords: *Azolla*, Food Security, Soil fertility.

Introduction
Rice is the most important staple food crops in India but yields of rice have been steadily declining; thus, serious efforts are needed to enhance the yield of rice. Because of the high prices of chemical fertilizers and inefficient use of available natural resources, the farmers can barely afford to use expensive chemical fertilizers, and thus cannot achieve optimum yield. *Azolla* is an aquatic floating fern is incorporated in the field before transplanting of paddy. Fish is a cheap source of protein and cultivation of fish will open for source of income. Integration of *Azolla* and fish in rice-duck farming, not only useful in controlling weeds and pest but also reduce the use of chemical fertilizer and sustain the rice production.

Rice-Duck Farming System
Rice-duck farming is an integrated type of farming system which is especially suitable for resource poor farmers to produce rice in low cost. In many countries like Japan, Bangladesh, Philippines, Vietnam and Nepal have proved the integration of ducks and fish in rice field as a successful and productive farming system. However, raising duck in small scale is a common practice for small and marginal farmers in India. Rice-duck farming is beneficial in terms of providing social, economic and environmental benefits. In this type of farming technology, ducks are released in the field after 15-20 days of rice transplantation until the flowering stage about 2 months later. However, the ducks remove weeds, eat unwanted pests, soften the soil with their bill and feet movements

thereby releasing trapped nutrients. Against the traditional rice farming system, integrated rice-duck farming minimizes the cost of production, increases rice productivity, provides environmental benefits and fosters the income of farmers through sale of organic rice and duck meat. Rice-duck farming technology can enhance the productivity of rice by 20 per cent and net profit to the farmers by 50 per cent. Duck meat has high content of protein and other nutrition which can significantly contribute to solve the problem of food insecurity and

malnutrition.

Integrating *Azolla* and Fish in Rice-Duck Cropping System

The productivity of current practices of rice-duck farming has great potential for improvement. Rice-duck farming can be integrated with fish and nitrogen fixing aquatic fern *Azolla. Azolla* develops a symbiotic relationship with a blue-green alga, Anabaena azollae and can be easily grown up in pond or wet land. Fish can also be grown and will generate higher return. The duck manure serves as an organic fertilizer for plankton production while the spilled feed can be directly consumed by fish. The ducks are herded into the rice field after harvest of paddy. They are confined in their sheds and until fish are at least 2-3 weeks old. Meanwhile, any kind of pesticides has dissipated and size of fish is large enough to prevent predation by ducks. Ducks are allowed to move in the rice field until the harvest. Fresh biomass of *Azolla* 200kg/ha is inoculated in the main field after 7-10 days after transplantation of rice. The growth curve of *Azolla* is sigmoidal and is slow initially in the rice field but attains a doubling period of 3-4 days. *Azolla* can be utilized not only for organic fertilizer for crops but also as feed for fish and ducks.

The integration of *Azolla* and fish creates symbiotic relationship with rice-duck farming yielding mutual benefits to both entities as follows:

1. Integration of *Azolla* and fish in rice-duck farming prevents accumulation of harmful gases in the rhizosphere thus reduction of emission of methane gas, hydrogen sulphide and other toxic gases from rice field contributing to reduce the global warming.
2. It reduces women's laborious tasks in the field.
3. Additional and alternative source of food and income from duck as well as from fish.
4. The oxygen released from *Azolla* due to oxygenic photosynthesis, helps the respiration of root system of the crops as well as other soil microorganisms.
5. *Azolla* fosters the egg and meat productivity of ducks as well as growth of fishes.
6. *Azolla* and fish in rice-duck farming reduces evaporation rate from the irrigated rice field.

Effect on Yield of Rice

The rice-duck system enhanced the yield contributing characteristics of the rice plants, namely, the number of tillers per hill, number of grains per panicle, and average grain weight. Ahmed et al. (2004) showed that yields of the rice-duck sub-plots are 20% higher than those of the sole rice sub-plots. *Azolla* is often a substitute for chemical nitrogenous fertilizers to a particular extent (20 kg/ha) and it increases the crop yield and quality. Through integration of *Azolla* and fish in rice-duck farming, there is 58% increase in yield over conventional rice monoculture (Cagauan et al.,2000). *Azolla* releases plant growth regulators and vitamins which enhance the development of the rice plant.

Effect on Insect Pest

The insect pest populations of the green leafhopper, brown plant hopper, zigzag leaf hopper, rice bug, short horned grasshopper, and long-horned grasshopper were significantly lower in integrated Azolla-fish-rice-duck plots compared to normal rice-duck field. Ducks gets nutritious diet from eating insects. Azolla serves as a biological attractant for snails. Fish and ducks not only economized on feed cost but also very effective in control of herbivores like snails.

Effect on Weed Population

Weeds affect the yield of rice upto 15-35%. *Echinocloa crusgalli, Scirpus mucronatus, Monochoria vaginalis* and *Fimbristylis miliaceae* are some of the predominant weed species observed in the rice field. Duck alnd fish eat weeds averting the use of chemical herbicides and manual weeding in the rice field. Azolla suppresses tender weeds like Chara and Nitella in rice field. Moreover, their trampling activity also kept the weeds under control by as much as 90%, thereby oxygenating the water and encouraging the roots of the rice plants to grow vigorously (Isobe et al.,1998).

Effect on Nutrient Cycling and Soil Health

Nutrient recycling is more in comparison of only rice-duck or rice-fish farming. The droplets of duck's excreta enrich the soil's nutrients and preventing the use of chemical fertilisers in rice. The continuous movement of fishes and ducks in the rice field provides natural stimulation and enhance aeration which increases the availability of nutrients like Nitrogen, Phosphorous and Potash to the rice crop. Furono (1996) reported that movement of duck and feeding activity in the rice field disturbed the soil, resulting in the improvement of the soil's physical property, hence, increasing the rice root systems. Azolla can fix atmospheric nitrogen and CO2 for the formation of ammonia and carbohydrates respectively and after decomposition it adds up available nitrogen for crop uptake and organic carbon content to the soil and It solubilises Zn, Fe and Mn and make them available to the rice.

Conclusion

Besides increasing the yield of rice, the infestation of weeds and insect pests is controlled through integration of *Azolla* and fish in the rice-duck farming system. Consequently, labour and pesticide costs for controlling weeds and insects decreased are eliminated. As it is eco-friendly in nature the long-term adverse effects of insecticides, herbicides and chemical fertilizer use were also substantially reduced. Women would have a good opportunity to participate in these activities. Fish and duck raised together with rice have their own economic value resulting in increased overall productivity of the farm. It is highly beneficial for farmers as well as improves the nutritional status of the resource-poor farmers but awareness raising programmes for smallholder farmers should be organised by government agencies. This integration of Azolla and fish in rice-duck farming is a promising approach in addressing ecological issue pertaining to conservation of rice field ecology, aquatic biodiversity and enhancing sustainability of rice production.

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Importance of Tissue Culture in Horticulture

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Tissue culture is entirely new approaches in plant improvement, breeding and production of horticultural crops. The uses of embryo culture in fruit tree breeding and in the propagation of orchards in the 1930s were among the first applications of the technology to plants. The present role of tissue culture techniques in horticulture can be seen in the production of specific pathogen-free plants, germplasm storage, micropropagation and in plant modification. In plant modification and improvement, several different in vitro approaches are being used. These include embryo rescue, anther/microspore culture, somaclonal variation, protoplast fusion, and transformation. The application of this technique for the various horticultural crops and their superiority from the ordinary plants are discussed with a suitable example:

Clonal Propagation

The conventional method of clonal propagation is slow & often not applicable. For example, the only in-vivo method for clonal multiplication of cultivated orchids, which are complex hybrids is 'back-bulb' propagation. It involves separating the oldest pseudo bulbil to force the development buds. This process allows, at best doubling the plant number every year.

Micropropagation Generally Involves Three Steps

1. Shooting multiplication: The most popular method of shoot multiplication is forced proliferation of axillary shoots. For this culture are initiated from apical or nodal cuttings carrying one or more vegetative buds. In the presence of cytokinin alone or in combination with a low concentration of an auxin, such as IAA or NAA, the pre-existing buds grow & produce 4-6 shoots within 3-4 weeks.

2. Rooting: Shoots produced through axillary branching or adventitious differentiation are rooted in-vitro on a medium containing a suitable auxin, such as IAA, NAA or IBA. Alternatively, where possible the shoots are treated with auxin & directly planted in the potting mixture for in-vivo rooting.

3. Transplantation: The shoots or plantlets multiplied on a medium containing organic nutrients, show poor photosynthetic capability. In practice, the plants are maintained under high humidity for 10-15 days after they removed from culture vessels. During the next few weeks, the humidity around the plants is gradually lowered, before they are transferred to natural conditions.

Production of Disease-Free Plants

Under normal conditions plants are infected by a wide range of pathogens such as bacteria, fungi, viruses, viroids & insects like nematodes & insects. Many perennial plants & those propagated by vegetative means are systematically infected with one or more pathogens, which reduce yield, vigor & quality of the plant. If explants for micro propagation are derived from an infected plant, the pathogens can multiply & spread to a large number of plants. It is therefore essential to use disease free stock plants for micropropagation. Eradication of viruses & other pathogens is also desirable from the point of view of international exchange of plant materials.

Advantages of Tissue Culture

There are several advantages to using the tissue culture process:

1. The new plant can be in very less period of time as compared to traditional methods.

2. For the development of new plantlets only a small amount of plant tissue is required.
3. The plants are more likely to be free of viruses and diseases where as several percentage of plants are infected in traditional methods.
4. The tissue culture process can be carried out throughout the year without any environmental effect.
5. It required relatively lesser space to perform the process for devolving the large number of plants.
6. The technique is suitable for the fast multiplication of new verities relies for the farmers.
7. People looking to cultivate challenging plants such as specific breeds of orchid find more success with the tissue culture process than traditional soil.

Tissue Culture Technology Developed for Horticultural Crops in India

Sl. No.	Crop	Institute
1	Annona	IIHR- Bangalore, BARC-Mumbai, NCL Pune
2	Banana	IIHR- Bangalore, NCL Pune, TNAUCoimbatore
3	Citrus	NBRI-Lucknow, NRC- Citrus Nagpur
4	Grape	IARI- New Delhi
5	Papaya	IARI- New Delhi
6	Pineapple	BARC-Mumbai
7	Strawberry	TERI, New Delhi
8	Guava	GBPUAT Pantnagar

The Crops which Being Commercially Propagated Using Plant Tissue Culture Technique in India

1. Fruit Crops: Apple, Banana, Fig, Grape, Pineapple, Strawberry and Citrus.
2. Spice Crops: Turmeric, Ginger, Vanilla, Large cardamom, Small Cardamom, and Black Pepper.
3. Cash Crops: Potato, and Sugarcane.
4. Medicinal Plants: Stevia, Patchouli, Neem, Aloe Vera, and Geranium.
5. Ornamental Crops: Gerbera, Syngonium, Carnation, Anthurium, Lily (Lillium), and Cymbidium.
6. Bio-fuel Crops: Jatropha and Pongamia.
7. Woody Plants: Teak, Populus, Bamboo, and Eucalyptus.

Advantages of Tissue Cultured Plant Over the Conventional Plants

Banana: Tissue cultured banana plants are most popular as compared to any other horticulture plant. The traditional banana farming encountered various problems like non-availability of disease-free uniform suckers, high mortality in the field during establishment due to excessive flood irrigation, long gestation period and low yield. The reasons behind this could be adduced to non-availability of disease-free quality planting material and lack of hi-tech farming awareness among the growers. Mass propagation of disease-free high yielding clones to produce consistently uniform and true to type plants by tissue culture is the only alternative for banana plantations. The benefits of tissue-cultured banana plantlets are discussed as follow:

1. Tissue culture banana cultivation leads to true to the type of mother plant. No room for variations in a well-managed plant production. This ensures that the offspring plants are of the same high yielding and good quality as the parent.

2. Better establishment in the field due to accelerated growth and well-developed root system for better absorption of nutrients. This is important for ensuring the efficient utilisation of resources.

3. Infection free planting material (Pest free, Disease free and Virus free). This important because one diseased plant may infect all nearby ones and thus drastically reducing crop yields.

4. Uniform growth of all the plants unlike plants cultivated using suckers. So minimum number of harvests that reduces the cost and scope for getting a uniform ratoon crop. This ensures that fruits are ready to be harvested at the same time from all plants, rather than a staggered harvest.

5. Optimal yield is ensured following proper cultural practices. This is not only about more bananas, but also a better quality of the fruit with respect to size, weight and flavour.

6. Shorter harvesting period (Earlier maturity of crop) enables flexibility in accordance with planting season and marketing demand. Because of shorter crop duration of crop, two successive ratoons are possible with reduced cost of cultivation and increased profits.

7. Large quantities of healthy and uniform tissue culture banana plants can be supplied at a time round the year. This ensures the best returns on the investment into the field.

8. 95 to 98% plants bear bunches. This maximizes the crop output of the field, leading to a better overall profit to cost ratio per plant in the field.

9. High benefit to cost ratio ensure good profits.


Pictures: The images showing the symmetry of the tissue-culture derived plants and the traditionally raised plants.

Pineapple: Pineapples are usually propagated by means of their crowns, which grow on top of the fruit; their suckers, which appear near the leaves; their slips which form below the pineapple; and from their ratoons, which grow out from under the ground. Propagation through seeds is undesirable, and the use of pineapple seeds is usually restricted to breeding programs.

Tissue cultured Pineapple in portrays

Conventionally the average production is 4-5 propagules per year and it takes considerable time to produce enough planting material. Large-scale production of planting material can be achieved by using the plant tissue culture techniques. A protocol for large-scale multiplication has been established using shoot tip as well as dormant axillary buds from pineapple crowns with a capacity of producing 1000-1200 plants in a year from a single crown. The tissue culture protocol for pineapple developed by BARC Mumbai. and a large number of disease free, elite variety plants can be produced using the protocol.

Date palm: The propagation of date palms through seeds is not a reliable method of producing true-to-type plants because no two date palm seedlings are alike. Therefore, in order to preserve valuable rare cultivars, date palms need to be vegetative propagated to insure true-to-type parentage of the donor palm. Traditional vegetative propagation of the date palm consists of removing and planting the offshoot from the mother plant. Although reliable, this method is slow, the number of offshoots is limited and it can take decades to generate enough plants to become commercially viable. Through date palm tissue culture, the number of genetically identical plants regenerated from a single mother stock plant is greatly increased producing thousands, even millions of plants in a shorter period of time.

Tissue cultured Date Palm in portrays

Pomegranate: Pomegranate Plantation is vulnerable to many diseases such as:

Cercospora fruit spot in which tiny dark spots appear on leaves and sepals. The spots eventually enlarge and coalesce leading to yellowing of leaves until it finally drops off.

1. Heart rot which is a fungal disease that causes the decay of wood at the center of the trunk and branches. Fungi enter the tree through wounds in the bark and decay the heartwood. The diseased heartwood softens resulting in trees being structurally weaker and prone to breakage.

2. Pests such as Aphids and Leaf-Footed Plant Bugs. *Aphis punicae Passerini* is one among the serious pests attacking pomegranate orchards. Young pomegranate leaves are highly susceptible to aphid attacks during June- August. High humidity favours the multiplication aphid.

3. Despite of the fact that India has all the favourable conditions for cultivation of pomegranate, the annual production is very less due to scarcity of good quality disease free planting material of a selected variety. This warrants an urgent large-scale production of the pomegranate plants of the selected varieties. The traditional methods involve propagation through hard and soft wood cuttings but these methods are very time-consuming, labour-intensive and require a year for the establishment of new plants. Further, it is not guaranteed that all the plants produced through this method are 100% disease free clones. Propagation by seed results in heterozygous population which leads to wide variations in tree and fruit characteristics. The use of tissue culture techniques for large scale propagation has increased considerably over the past few decades. As the technique

has great potential to meet the large demand for the quality planting material need to be explored in the general farmer community so that everyone could get the benefits from the technology.

Tissue cultured Pomegranate plant

Advantages of Tissue Culture Technique in Papaya

Seeds is the common means of commercial propagation of papaya around the world to ensure a uniform stand of hermaphrodite plants in the field, five or more seeds are planted per hole, and then at sexual maturity (4–5 months after germination), surplus hermaphrodites and females are rogued, leaving one hermaphrodite per hole. Overplanting adds to the cost of production as it causes early competition for water, nutrients, and sunlight among seedlings and requires additional inputs, as well as extra labour to rogue unwanted plantlets. Micropropagation can produce large numbers of elite homogeneous clones, allowing for the planting of a single hermaphrodite in each hole and eliminating the negative aspects of seed propagation.

Tissue cultured Papaya plant

Technology intervention in horticulture leads to improve the socioeconomic status of the horticulture farmers community in the country, the new technologies like protected cultivation, High-Density Planting, Micro irrigation, Precision farming, Remote sensing are getting popularity among the farmer's community. The importance of tissue culture plants may also lead to upliftment the economic status of the growers as these provides several benefits in many ways as discussed earlier in the article, considering the above facts the tissue cultured plants can be an additional option for the progressive farmers.

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Treated Wastewater Use in Agricultural Irrigation

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Introduction

Waste water recycling to the aid of agriculture Farming is without a doubt the business sector that is the greatest consumer of water. It is, in fact, considered to represent 70% of global water consumption. This is why, to preserve water resources, more and more countries are reusing their wastewater to irrigate fields.

The efficiency of standard irrigation techniques must still be improved: it is estimated that 30 to 60 % of water for irrigation evaporates and is not of any benefit to crops. By way of example: 25 litres of water are needed to produce 1 kg of lettuce; 100 litres of water are needed to produce 1 kg of potatoes; 400 litres of water are needed to produce 1 kg of maize 1,500 litres of water are needed to produce 1 kg of wheat.

Water recycling mainly refers to reusing waste water such as from residential, industrial places, agricultural irrigation, etc. to implement in something beneficial. Water recycling offers a great deal of benefits for today's generation as over use and waste of water led to fresh water shortage.

This not only saves water but also saves money in different effective ways and the treated water becomes multi-functional. The type of recycling also depends on the source of the waste water. "Grey water", is the water which comes from non-toilet plumbing, like basin, shower and taps. "Black water" is the toilet plumbing water. Water from kitchen and dishwashers are categorized as black water because they contain harsh chemicals, pathogens and grease.

Wastewater Treatment

1. Primary Treatment: Treatment involving sedimentation sometimes preceded by screening and grit removal) to remove gross and settle able solids. The remaining settled solids referred to as sludge, are removed and treated separately.

2. Secondary Treatment: Generally, a level of treatment that removes 85% of Biological Oxygen Demand (BOD) and suspended solids via biological or chemical treatment process. Secondary treated reclaimed water usually has a BOD Of <20 milligrams per liter (mg/L) and suspended solids of <30 mg/L, but this may increase to >100 mg/L due to algal solids in lagoon systems.

3. Tertiary Treatment: The treatment of reclaimed water beyond the secondary biological stage. The normally implies the removal of a high percentage of suspended solids and/or nutrients, followed by disinfection. It may include processes such as coagulation, flocculation and filtration.

Application of Treated Wastewater

1. Agricultural Irrigation:
  a. Crop irrigation
  b. Commercial nurseries

2. Landscape Irrigation:
  a. Parks
  b. School yards
  c. Highway medians
  d. Golf courses
  e. Cemeteries

f. Residential

3. Industrial Recycling and Reuse:

a. Cooling water.
b. Boiler feed.
c. Process water.
d. Heavy construction.

4. Groundwater Recharge:

a. Groundwater replenishment.
b. Saltwater intrusion control.
c. Subsidence control.

5. Recreational / Environmental Uses

a. Lakes &ponds.
b. Marsh enhancement.
c. Stream-flow augmentation.
d. Fisheries.

6. Non-Potable Urban Uses

a. Fire protection.
b. Air conditioning.
c. Toilet flushing.

7. Potable Reuse

a. Blending in water supply reservoirs.
b. Pipe-to-pipe water supply.

6. Problems associated with Treated Wastewater

a. Groundwater contamination.
b. Nitrate contamination on private drinking wells.
c. Antibiotics.
d. Lower effectiveness of antibiotics if irrigation of fodder is involved.
e. Odor.
f. Public health of neighboring communities.
g. Aesthetic concern - Reduced land values.

7. Concerns with industrial processes

a. Scaling.
b. Corrosion.
c. Biological growth & fouling.

8. Reclaimed wastewater can be safe for agricultural irrigation

a. Reduce the pathogen levels.
b. Avoid direct contact of crops with reclaimed wastewater.
c. Restrict the type of crops irrigated.

9. Different treatment for safe irrigation of different crops:

a. For tree nurseries, pastures, industrial crops.
b. Secondary treatment & detention in surface reservoirs.
c. For fruits to be canned, vegetables for cooking and fruits with non-edible peels.
d. Tertiary treatment (ie. AS & Sand Filtration).
e. For edible crops (uncooked).
f. Tertiary treatment followed by soil aquifer treatment (or advanced).

Some Treated Wastewater Advantages and Disadvantages

1. Advantages:

a. This technology reduces the demands of potable sources of fresh water.

b. It may reduce the need for large wastewater treatment systems, if significant portions of the waste stream are recycled.

c. The technology may diminish the volume of wastewater discharged, resulting in a beneficial impact on the aquatic environment

d. Capital costs are low to medium for most systems and are recoverable in a very short time; this excludes systems designed for direct reuse of sewage water

e. Operation and maintenance are relatively simple.

f. Provision of nutrient -rich waste waters can increase agricultural production in water- poor areas.

g. Pollution of rivers and ground water may be reduced.

h. Lawn maintenance and golf course irrigation is facilitated in resort areas

i. In most cases, the quality of the wastewater, as an irrigation water supply, is superior to that of well water.

2. Disadvantages:

a. If implemented on a large scale, revenues to water supply and wastewater utilities may fall as the demand for potable water for non-potable uses and the discharge of wastewaters is reduced.

b. Treated of wastewater may be seasonal in nature, resulting in the overloading of treatment and disposal facilities during the rainy season if the wet season is of long duration and/or high intensity, the seasonal discharge of raw wastewaters may occur.

c. Health problems, such as water-borne diseases and skin irritations.

d. Gases, such as Sulphuric acid, produced during the treatment process can result in chronic health problems.

e. In some cases, treated of wastewater is not economically feasible because of the requirement for an addition al distribution system.

f. Application of untreated wastewater as irrigation water or as injected recharge water may result in ground.

Conclusions

Agriculture is a major consumer of wastewater. The search for alternative irrigation sources is believed to be vital to ensure food safety and to preserve natural water bodies. The safe use of wastewater, as an alternative source of irrigation, is an acknowledged strategy for the efficient use and prevention of water pollution that is gaining increasing relevance worldwide, especially in countries confronted with water shortages. The risks of wastewater reuse in agriculture are extensive, ranging from changes to physicochemical and microbiological properties of soils to impacts on human health. In unfavorable economic conditions, the search for alternative irrigation sources irrigation, such as the reuse of raw or inadequately treated wastewater may result in avoidable risk factors.

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Climate Control in Greenhouse Growing Flower Crops and Equipment Used for Measuring Weather Parameters

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Summary

Climate control refers to keep the desired value of the greenhouse inside parameters as temperature, light, humidity, and CO_2 concentration in order to provide optimal conditions for the plants. Microclimate of greenhouses is important for better plant growth and greater yield. The dynamic behaviour of the greenhouse microclimate is a combination of physical processes involving energy transfer and mass balance. The greenhouse microclimate can be manipulated by control actions, such as heating, ventilation, carbon dioxide enrichment to provide appropriate environmental conditions for crops to attain higher yield. These modifications imply the additional use of energy in the production process. Because of its complexity, excessive climatic conditions in greenhouses can adversely affect the growing environment for crops. An optimal ambient control is needed to accomplish complicated processes involved in greenhouse energy balancing, including low emissions and reduced production costs.

Introduction

A greenhouse is defined as a covered structure that provides plants with optimally controlled environment for adjustment of climate growth conditions, to reduce cost of production and increase crop yields (Badgery-Parker, 1999).

The main reason for microclimate control in greenhouses is to achieve maximum plant growth and yield. Automatic control system monitors inside the greenhouse (soil and air temperature, relative humidity, carbon dioxide concentrations, electrical conductivity and soil moisture) and outside the greenhouse (temperature, relative humidity, solar radiation, wind speed, wind direction and rainfall rate). Crop yield mainly depends on the responses of plants to environmental influences. For example, temperature has considerable influence on crop timing and yield (Pearson et al., 1995). Light is primary determinant of crop growth.

Greenhouse Micro Climate Parameters

Some of the important microclimate parameters required for growing flower crops in greenhouse are solar radiation, temperature, relative humidity, light and carbon dioxide.

1. Solar radiation: The minimum amount of irradiation necessary to ensure sufficient growth and flowering corresponds to a daily global radiation of 2.0–2.3 kWh/m2day (Nisenet al., 1984).

2. Relative humidity: Relative humidity within the range 60-90 % is suitable to plant growth.

3. Carbondioxide: The optimal CO_2 concentration for growth and yield seems to be 700–900 µmol mol-1 (De Pascale and Maggio, 2008).

4. Temperature: The majorities of plants grown in greenhouses are warm season species and are adapted to average temperatures range 20-30°C, Lower and upper temperature limits ranges between 10°C and 35°C. If the average minimum outside temperature is below 10°C - heating, particularly at night. When the average maximum outside temperature is less than 27°C -ventilation - during the day; however, if the average maximum temperature exceeds 27-28°C then artificial cooling is necessary.

5. Shading: There are two distinct categories of shading materials for greenhouses: shading compounds (or diluted latex paint) applied to the outside greenhouse covering material or fabrics draped over or used as a curtain inside the greenhouse.

6. Cooling: There are two primary reasons airflow is necessary in greenhouses:

a. To remove excess heat through ventilation as the temperature rises, replacing hot air with cooler air.

b. To control relative humidity and carbon dioxide within the plant canopy.

Types of Cooling

Glazing materials (increase inner temperature), Passive venting (roof vents), Shading system (black cloth / retractable shading).

Ventilation Systems

1. Natural ventilation: Natural ventilation is a process that directly influences the climate inside the greenhouse (Kittaset al., 2001) and is a decisive factor when it comes to designing. Inadequate ventilation generates overheating and excessive transpiration, leading to problems such as plant water stress and physiological disorders, including fruit cracking and abortion of flowers and fruits. On the other hand, natural ventilation helps to evacuate excess moisture and prevent its accumulation in the air layer near the leaves which can cause condensation, leading to the onset of diseases.

2. Forced ventilation: The principle of forced ventilation is to create an air flow through the house. Forced ventilation by fans is the most effective way to ventilate a greenhouse, but consumes electricity. Fans are installed to maintain uniform temperature and humidity inside the greenhouse. Ventilation fans should be located on the wind side of the greenhouse and the distance between two fans should not exceed 8-10 m. Furthermore, an inlet opening on the opposite side of a fan should be at least 1.25 times of the fan area. The air speed should not exceed 0.5 m s-1in the greenhouse with crop.

Evaporative Cooling

Conversion of sensible heat into latent heat by means of evaporation of water supplied directly into the greenhouse atmosphere (mist or fog system, sprinklers), fan and pad system, etc.

Light Quality

Plants are sensitive to the light spectrum range 400 - 700 nm, called a Photosynthetic Active Radiation (PAR).

Light Sources and Different Types of Lamps

1. Incandescent: Available in range of 40-500 W at 115 and 230 V. 7% light to energy (lumen/ watt). Produce a high proportion of red and far red wavelength spectrum. Causes tall and soft growth in the plants. Average service is 750 -1000h. Dome reflectors are used to reflect light. Very low energy efficiency in converting electricity into PAR (around 6%) emitting most of the energy in the IR range.

2. Tungsten: Provide linear light source than a point source. Light output is 40 -60 lumen/watt. Gives cool white light for growth. Converts 20% electrical energy in to light energy. More efficient than the incandescent, with around 20% efficiency of conversion into PAR

3. Halogen: High intensity discharge (HID) lamps are most often used for greenhouse supplemental light because of their high light output and relatively little shading – there are two main types: high pressure sodium (HPS) which look yellow/orange and metal halide (MH) which look bluish. Lifespan is about 20,000 hours for MH and 30,000 hours for HPS.

4. Light emitting diode (LED) lamps are becoming more affordable and higher output. For plants they are often red and blue to target spectra where photosynthesis is slightly more efficient. They produce heat but out of the back of the fixture (not with the light) therefore they can be placed close to the plant (similar to fluorescent). Lifespan is 25,000-50,000 but this is very temperature dependent (lower lifespan at warmer temperatures).

For long day – use of shade cloth to reduce the day length.
For short day – supplemental lighting / night interruption.

Requirements of Flower Crops Under Greenhouse

1. Rose: Temperature (Day: 18-28 and night: 15-18° C). Light (Photoperiod over 12 hours and intensity: 6000-8000-foot candles). Relative humidity (50-60 %). Aeration (Good in air and soil). CO2 (1000-3000 ppm).

2. Carnation: Light: Photoperiod (long days over 16 hours) and intensity (100 watts bulb spaced at 10.5m at 1.5m height). Temperature: Night (winter: 10-11°C, spring: 12.7°C and summer: 13-15.4 °C) and day (18-23°C). Ventilation: Free circulation of air. Relative humidity: 50-60%.CO2 (500-1500 ppm).

3. Chrysanthemum: Light (Intensity: 1.2-1.6 MJ/m2/day, Quality(600-800nm), Photoperiod(less than 9.5 hours). Temperature (night: 10-16°C, day: 18-21°C). CO2 (500-1000ppm).

4. Gerbera: Light (Long days are good). Temperature (Day: 16-22°C and night: 12-15°C).

5. Lilium: Temperature (Day: 18-25°C and Night: 12-18°C). Partial shade (40-50%). Good aeration/ ventilation is needed.

6. Alstroemeria: Alstroemeria prefers cool climate with partial shade. The optimum temperature in greenhouse during night and day is 15 and 18°C, respectively. The newly planted rhizomes/ plants should not get more than 13 hours light at least for 6-8 weeks, which will allow the roots to develop sufficiently before flowering. After which supplementary light of more than 16 hours a day ensures early, profuse flowering for longer duration. During summer, when the air- temperature exceeds 30°C and soil temperature exceeds 18°C, the plants become dormant and should normally be divided.

Instruments Used Under Greenhouse

1. Thermohydrograph – Rs.6500/unit: A Thermo Hygrograph is a scientific instrument which measures the Temperature and Humidity and plots it on a chart.

2. Lux meter – Rs. 3000-18000: A lux meter is a device for measuring brightness, specifically, the intensity with which the brightness appears to the human eye. A lux meter works by using a photo cell to capture light.

3. CO_2 sensor- Rs. 1500-7000: The carbon dioxide gas sensor measures gaseous carbon dioxide levels by detecting the quantity of IR radiation absorbed by carbon dioxide molecules. The sensor employs a hot metal filament that acts as an IR source to generate IR radiation.

Review

Though, there are different types of the greenhouses, naturally ventilated polyhouses are preferred in mild climate in which temperature is reduced by ventilation (Ryagiet al., 2007).

Ajaykumarsinghet al. (2013) evaluated eight Carnation varieties viz. Diana, Aurturo, White Dona, Pink Dona, Soto, Red King, Tuareg and Dona., under naturally ventilated greenhouse and subjected to uniform treatment and cultural package of practices, the variety Red King was found best with respect to number of branches (8.0), number of flowers/plant (35.6), fresh weight of flower (8.38 g), dry weight of flower (2.66 g), flower diameter (7.83 cm) and vase life an important post-harvest quality parameter was observed to be the superior in variety Red King (29.3 days) followed by cv Tuareg (24 days) and Pink Dona (21.3 days).

Abaykumar Gaurav et al. (2015) studied the effect of different shade levels on the production and quality of cordyline under subtropical condition. The plants grown under 50% shade level showed increased like plant height, number of leaves, chlorophyll content, photosynthetic rate, whereas harvest index and vaselife was optimum.

Abaykumar Gaurav et al. (2015) studied effect of different coloured shade-nets on production and quality of *Dracaena fragrans*. Plants grown under red and white shade-nets exhibited better plant height, leaf number, chlorophyll content, leaf area, fresh weight, dry weight, photosynthetic rate and transpiration.

Conclusions

The greenhouse climate control is one of the challenging tasks in precision agriculture. Temperature and humidity are the main variables which have a direct relationship with the plant production. So far researches conducted in different regions are not enough to control and maintain desired temperature, humidity and other parameters which are affordable to plant by economical means applicable to all the agro-climatic regions. Hence, there is need for researchers to analyse different control methods and develop affordable greenhouses applicable for different climatic zones.

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Quinoa – An Underutilized Crop for Food and Nutritional Security

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Quinoa – Super Food

Quinoa (Chenopodium quinoa Wild.) is a pseudo cereal and belongs to Amaranthaceae family. It has the native of Andes mountain of South America ("Miracle grain of Andeas") and cultivated during 5000 BC and 3000 BC. It is the staple food of Incas civilization of America and also a prominent food source of indigenous descendants. During 1532, Spanish emperor destroyed Incas civilization as well as quinoa fields and only few survived in high elevations of Andes. Quinoa is reintroduced into modern world by 1970s. Over past decades, the cultivation of quinoa increases consistently and the year, 2013 is considered as International Year of Quinoa. Recently, based on consumer's preference and marketability, Quinoa is called as "Super food".

Botany

Quinoa is not a true cereal, because it belongs to dicotyledonous, in contrast cereals belongs to monocotyledonous. It can tolerate and grow under varied acidic soil (pH 6.0-8.5) condition. Quinoa plant grows up to 1-3 m height and root may penetrate up to 30 cm. Stem is cylindrical with approx. 3.5 cm diameter, may persist with or without branch. Leaves resembles like goose foot and flowers are incomplete (without petals). The inflorescence type is racemose and 15-70 cm long. The fruit type is achene and the seeds are small, round and flattened and 1.5 mm in size. The seed color ranges from red, purple, orange, green, black and yellow and the stalk bearing the inflorescence is deep magenta in color. Based on small group of flowers (glomeruli) originating axes, there are two types of inflorescence as glomerulates (tertiary axes) and amaranthiformes (secondary axes). Totally, there are 22 races and 5 ecotypes.




Cultivation

The planting season is highly varied from august in Andean highlands, extending through December in some areas. Row to row spacing is 40-80cm and density in row is varied according to region. Under favorable cool weather, quinoa seeds will germinate within a day. Physiological maturity is achieved within 70-90 days after flowering. Harvest should be done, once the plant turns into pale yellow or red color. Manual harvest is easy and highly preferable. Depending upon variety and growing condition, yield ranges between 45 – 500 g/m^2. Quinoa can withstand drought, frost, salinity and even grow under poor to moderate fertile lands.

Pest and Disease

Scrobipalpula sp. is the most serious pest and damage is comparatively high under severe drought as well as high temperature. Other pests of Quinoa are aphids (Aphis spp.), inflorescence caterpillar *(Pachyzanda)*, defoliating insects *(Epicanta)* and sucking insect *(Myzus persicae)*. Downy and brown stalk rot are considered as major diseases which cause major yield loss in Quinoa.

Nutritional Aspects

The protein content of quinoa seeds ranges between 8-22%, which is higher than cereal crops. Albumin and globulin are the major protein fraction as 44-77% and there is no prolamin, which makes quinoa, a gluten free grain. Amylose content is 11% and fat content ranges between 2 to 10%. The mineral compositions (mg/kg of dry weight) of quinoa in comparison with other cereals are listed below.

Minerals	Quinoa	Wheat	Rice	Barley
Ca	1487	503	69	430
Mg	2496	1694	735	1291
K	9267	5783	1183	5028
P	3837	4677	1378	3873
Fe	132	38	7	32
Cu	51	7	2	3
Zn	44	47	6	35

The major antinutritional factors are saponin and phytic acid in high level and tannin, trypsin inhibitors and polyphenols in low level. Saponins usually present in pericarp and gives bitter taste. Saponin and polyphenols can be removed by rinsing seeds in cold alkaline water or through mechanical abrasion. Trypsin inhibitors are temperature sensitive and can be inactivated by heat treatment.

Post-Harvest Processing

Quinoa undergoes series of post-harvest processes includes drying or stalking, threshing, venting and storage. It also includes removal of impurities, saponin removal and drying. For commercial purpose, seed sorting is done based on seed size and color. After processing, industrialized food products can be produced from quinoa seeds and the waste (saponin) can also be utilized for food, cosmetics, pharmaceutics as well as bio pesticides.

Commercial Uses

1. Quinoa acts as a rice replacement and used as infant cereal food.
2. Seeds are boiled like rice and used for preparation of soup and porridge.
3. Seeds can be popped like popcorn.
4. Quinoa seed flour can be used as substitute for wheat and maize flour (bread – 10-13%, noodles and pasta – 30-40% and sweet cookies – 60%).

Conclusions

Quinoa is emerging as a best source of nutritional quality and also better climate resilient crop. Understanding the crop botany, cultivation and nutritional aspects will paves a way to breed varieties with better agronomic background. In future, it will become a better alternative for many agricultural crops.

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Production Technology of *Aristolochia indica*

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Family	Aristolochiaceae
Parts used	Leaves and roots
Dosage	Root powder- 1 to 3 g; Leaf juice- 5 to 10 ml

Morphological Characteristics

Aristolochia indica is a glabrous, shrubby or herbaceous perennial plant with woody root stock and long, slender, grooved, glabrous branches. It is found mostly in the Himalayan belt near Nepal, South India and Bengal up to an altitude of 3000 feet. The stem part of the climber is woody and thin. The leaves are 2-4 inch in length and 1-2-inch-wide, variable, fiddle shaped to linear. Leaves are alternate, entire with more or less undulate margins, somewhat cordate, acuminate or obovate. It is glabrous with a slightly undulate margin. The roots of the plant are long and cylindrical with little bends. The outer side is brownish with white color inside. They are bitter in taste and have camphor like odor.

Floral Characteristics

Flowers constitute of greenish-white or light purplish perianth with inflorescence in axillary cymes or fascicles, 1-2 lipped, hairy within limbs dilated. Stamens are six in number, adnate and filaments are not distinguishable from the style. Anthers are adnate to column and carpel is six locular with two ovules. The flowers are usually foetid in odour. The flowers are 1-1.5 inch in length, found in small clusters and they appear like hood of the cobra. They bloom in the rainy season. The fruits are round and are found in the month of November to March. Fruit is globose, oblong, septicidal, six valved capsule and opening from below upwards. The seeds are triangular and flat. Seeds are many in number, flat and winged.

Distribution

Plant is distributed in lower hills and plains of India, Bengal and Assam.

Climate and Soil

It grows in warm and moist climate, with temperature ranging from 20ºC to 33º C, and annual rainfall ranging 100-150 cm and spread out to a greater part of the year. It can also be cultivated over well drained sandy- loam soil rich in organic matter. It needs irrigation at lower elevation where rainfall is low.

Propagation Material

Seeds.

Nursery Technique - Raising Propagules

Seeds mature during May-July. Germination of seed is about 80%. Seeds may be sown in rows over raised beds and 10 cm apart. Seedlings at 4-5 leaves stage can be transferred in polybags or kept in the nursery bed till it attains 15 cm height, when it is ready for transplantation. Seed viability remains at 70-80% up to one year. Seeds should be treated in Bavistin / Captan / Thiram before sowing. About 30,000 seedlings are needed for one-hectare land.

Planting in the Field

1. Land Preparation and Fertilizer Application: Land should be deeply ploughed and harrowed twice and made into good tilth. FYM @ 10 t/ha alongwith NPK @ 25:60:100 kg/ha during land preparation may be applied. Later N @ 25 kg/ha may be applied after planting and again at 3 months interval.

2. Transplanting and Optimum Spacing: Seedlings may be raised in May-July and their transplantation done in August-September. 60X60 cm spacing is optimal requirement.

3. Intercropping System: Annual herbs like chilli can be grown as intercrop.

4. Inter-culture and Maintenance Practices: Hoeing and hand weedings are carried out simultaneously 45 days after planting, thereafter at 6 months interval in first year. In second year, periodicity of interculture remains same.

5. Irrigation Practices: Usually rainfed crop, but supplementary irrigation is needed during dry seasons.

6. Weed Control: Pre-emergence application of Pendimethaline @ 1.0 kg/ha or Simazine @ 2.0 kg/ha may be applied, thereafter hand weeding at 90 days after tansplanting and later as per weed population. Application of post-emergence herbicides is not suggested.

7. Disease and Pest Control: Leaf blight is observed in the plantation during winter season. Application of Dithane M-45 @ 3 gm/lit at 15 days interval is found to control the disease. Infestation of *Pachlioptera aristolochia* is found to attack the vines and eat on tender leaves during May-August. Application of Rogor 30 EC @ 0.02% keeps the moth away. Thiodan 35 EC @ 0.09% is also found effective against the insect.

8. Crop Maturity and Harvesting: Crop matures after one-year growth but the leaves are pruned and harvested after 180 days onwards periodically. The collection of roots is advisable after two years of age.

9. Post-harvest Management: Leaves and roots after collection are cleaned thoroughly and all foreign matters are removed. These may be dried in shade for a week when it has 10-12% moisture and then it is ready for storage. It is packed in air tight polythene bags and stacked in bamboo or wooden crates.

10. Chemical Constituents: Plant possesses aristolochic acid up to 0.017% and essential oil upto 0.5%. Besides, it has potassium and β-sitosterol. Two sesquiterpene hydrocarbons viz. ishwarane and aristolochene have been identified from the root and their structure is established.

11. Yield and Cost of Cultivation: Estimated yield is 640 kg/ha/year in the second year and onwards.

Uses of Ishwari

1. The powdered root of Ishwari is given with honey in a dose of 3 g for dropsy, leukoderma, tonsillitis and chronic dyspepsia.

2. One pinch of root powder of *Aristolochia indica* is taken with warm water to treat fever, indigestion and digestive disorders.
3. The paste prepared from the leaf of the plant is applied over the joints affected with pain and swelling.
4. The paste of the fresh leaf is applied over the forehead with turmeric powder to reduce headache.
5. The powder of the seed of Ishwari is mixed with warm water and applied over joints to reduce pain and inflammation.
6. For leucoderma, skin diseases, wounds and swelling the paste of leaves is applied topically on affected areas.
7. In patients suffering from cough, the juice of the leaf of *Aristolochia indica* is given in a dose of 5-6 ml to induce vomiting and remove the excessive kapha dosha.

Adverse Effects

Excess use of the root and leaf of Ishwari can cause nausea, vomiting and abdominal cramps. Hence the herb should be used with extreme care.

Anti-Microbial Activity

Ethanolic extract of *Aristolachia indica* had moderately significant antibacterial and significant antifungal activity. It inhibited the growth of both bacterial and fungal species dose dependently. The inhibition of growth was highest at 100mg/ml as compared to the controls. Ethanolic extract showed stronger antimicrobial activity against the fungi than that of the bacteria.

Conclusions

Aristolochia species have covered 164 compounds belonged to the classes of aristolochic acids and esters, aristolactams, aporphines, protoberberines, isoquinolines, benzylisoquinolines, amides, flavonoids, lignans, biphenyl ethers, coumarins, tetralones, terpenoids, benzenoids, steroids, and others with extensive physiological activities. It can be planted even in our homes as climber and attractive plant.

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Plug Tray Nursery Technology for Farmers, Modern Vegetable Production System

Article ID: 31573

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Introduction

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

Types of Containers or Plug Trays Used for Vegetable Nursery Raising

1. Plastic trays of the same size with same size of cells are fixed in Styrofoam are mostly preferred because they encourage more uniform root zone temperature and moisture.
2. Cell size to use for raising vegetable seedlings will vary with the crop. Generally, smaller cells (8-10 cc in volume) are required for optimum growth of winter vegetable crops.

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

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

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

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

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

Material Required

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

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

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

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

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

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

Procedure

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

Precautions

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

Advantages of Plug Tray Nursery


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

Rapid Flower Induction Through Virus-Based System – To Accelerating Crop Breeding

Article ID: 31574

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Abstract
Plant breeding requires the production of fertile flowers to produce seeds. However, obtaining such fertile flowers in a synchronized manner at a practical period of time and along with good seed set can be challenging. The transition from vegetative stage to flowering requires the coordination of developmental and environmental signals. Many plants experience an extended juvenile phase before transitioning to reproductive growth, and this can severely delay the development of new cultivars with preferred traits. Fruits and nut crops require 3-5 years for flowering, in this case developing new varieties can span decade. Thus, rapid flower induction is required for reducing the long breeding cycle.

Keywords: FT, Florigen, Virus induced flowering.

Molecular Mechanism of Flowering
The faster transition from juvenile to reproductive phase is either due to the ectopic expression of FLOWERING LOCUS T (FT orthologs) which encodes for the florigen or by silencing TERMINAL FLOWER1 (TFL1) locus, which acts as the inhibitor of FT (Srinivasan et al., 2012; Zhang et al., 2010).

The FT overexpression or TFL loss of function will also results in determinate growth. FT and its orthologs are conserved among the plant species viz., FT in *Arabidopsis thaliana*, SINGLE FLOWER TRUSS (SFT) in tomato and HEADING DATE 3A (HD3A) in rice (Tsuji, 2017). At optimum day lengths, florigen (FT proteins) were produced in the companion cells. FT interacts with the FT-INTERACTING PROTEIN1(FTIP1) and translocated to sieve elements.

FT is then transported to shoot apical meristem (SAM) through phloem. In SAM, FT interacts with the 14-3-3 protein in cytoplasm and it enters into the nucleus and interacts with the FD and form the florigen activation complex (FAC). This FAC will bind to the promoters of floral meristem identity genes like FUL (FRUITFULL), LFY (LEAFY), SOC1, AP1(APETALA1) and promotes flowering.

Strategies to Accelerate Flowering
Vernalization and photoperiodism alteration by mimicking the natural environmental condition are used to stimulate flowering and their use is limited by cost. Vernalization is the prolonged chilling to stimulate flowering. It has major constraints that when and where should flowering occurs and also difficult to optimize the chilling hours requirement.

The modern varieties are day neutral but most of landraces and wild relatives, which are the rich source valuable alleles are photoperiod sensitive and this complicates the breeding process. In many horticulture crops, early flowering can be induced by grafting the non-flowering accession on the flowering root stocks and hormone application which have their own limitations (Fig.1).

The transgenic approach like over-expression of FT will accelerates the flowering uncouples the vernalization and photoperiod requirements. The use of transgenic lines with precocious flowering is colloquially called rapid cycling or “FastTrack” breeding, and is usually coupled with marker assisted selection (MAS) for desired traits (Van Nocker and Gardiner, 2014). Nevertheless, transgenic approach can be problematic for many reasons. To overcome this, viral based vectors are used to deliver the FT and its orthologs in to crops.

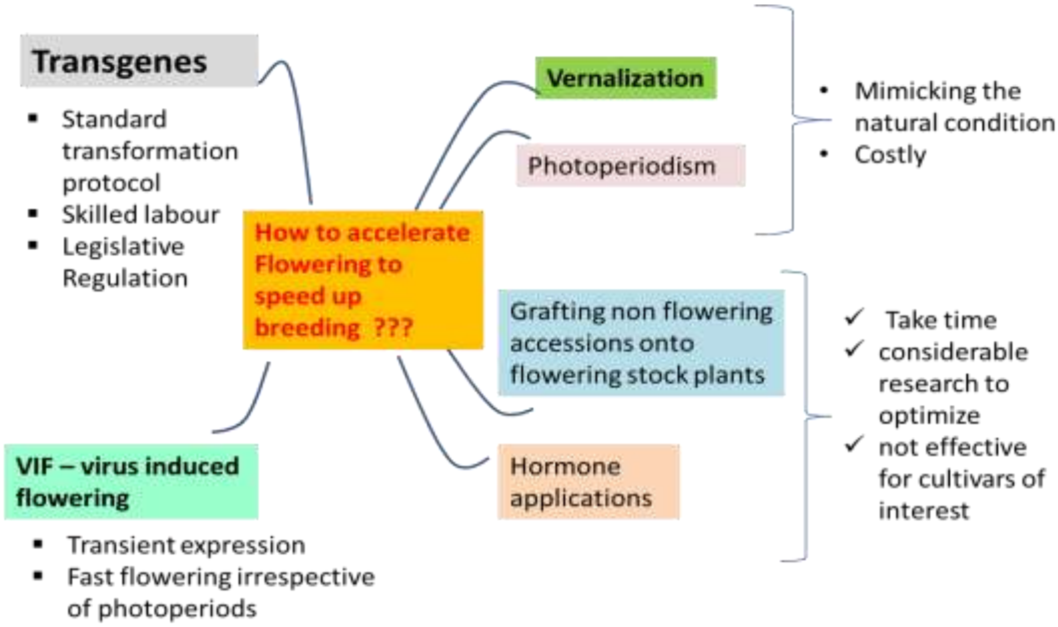

Fig1. Strategies for rapid flower induction

Virus Induced Flowering (VIF)

The use of a virus to deliver sequences that promote flowering was termed virus-induced flowering (VIF) (McGarry and Ayre, 2012). The first demonstration of VIF used Zucchini yellow mosaic virus to deliver FT to cucurbits, stimulating flowering in short-day melon under non-inductive long days. The florigen is basically phloem mobile and viruses also uses phloem pathway for systemic infection. By coupling this principle, an FT ortholog with a virus-based vector are delivered through agroinfiltration method that can amplify the inserted sequence and move it systemically will induce flowering (Fig2.) (Mcgarry and Kragler, 2013). Mcgarry and Ayre (2012) uses virus induced flowering technique in ancestral cotton line and make it to flowers nearly 55 days earlier than the normal condition. They also proved the interesting fact that, viruses are not transmitted to their offspring. Hence the VIF generated plants are safe and does not harbour any recombinant molecules. The VIF technique is risk-free because in this the coat protein gene in viruses are replaced or made disarm, which is essential for the insect-vector based plant to plant transmission. Usually citrus takes 5-6 years for flowering. Citrus flowering locus T (CiFT) was overexpressed using clbvINpr-CiFT vectors by graft inoculation method. The infected plants flowers in 4 to 6 months depends on the genotype without change in plant architecture and floral morphology (Velázquez et al., 2016).

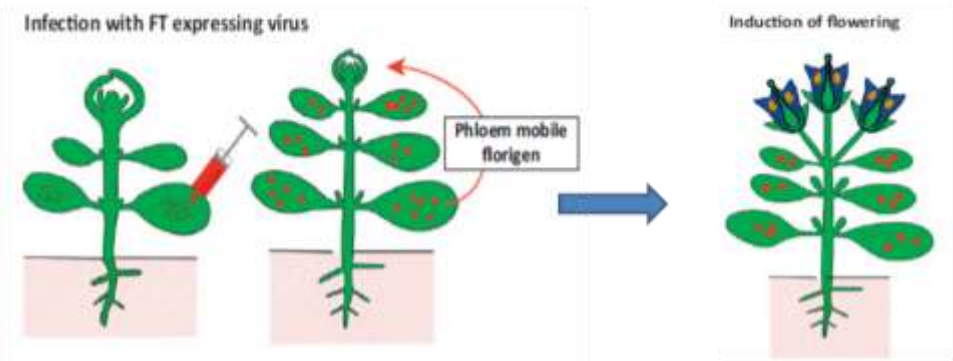

Fig 2. Schematic representation of virus induced flowering

VIF Over Transgenics

1. The VIF plants are free from antibiotic resistant genes.
2. The is no risk of alteration of plant genome by foreign gene integration.

3. Curtails the risk of horizontal gene transfer to other bacteria present in plants and soil.
4. In VIF, ~1% of progeny may have the seed transmission of viruses. On the other hand, in transgenic approach 50% of the cross progeny from a single-insertion event will carry the FT transgene.

The Pros and Cons of Using VIF for Breeding (Mcgarry et al., 2017)

VIF for breeding - Pros	VIF for breeding - Cons
Saves times and labour cost for regenerating transformants	Like transgenics, absence of recombinant materials must be verified
Removes the risk of somaclonal variation	Each virus has its own host range which can limit its utility across species
Most plant viruses do not integrate into the host genome and are not seed transmitted efficiently	FT expression is controlled by viral promoters, making inducible or tissue-specific expression is difficult to attain
FT and virus both are phloem-mobile hence improving the rate of floral induction	Regulations for VIF generated plants are largely untested outside of laboratories

Conclusion and Future Prospective

The studies witnessed that undoubtedly VIF is a powerful tool for flower induction. However, to make VIF a broadly used tool to accelerate research and breeding, a larger diversity of virus-based constructs needs to be developed that can reliably infect the crops of interest. Ideal virus-based vectors will be asymptomatic in the infected plants, and will not be germline or seed transmissible. The effects of VIF on mutation rate or epigenetic processes is largely unknown. Still studies are required to understands its full potential and limitations to make VIF tool eco-friendly.

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Fruit Piercing Moth - A Nightmare in Orchards

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Introduction

Fruit crops are commercially important in contributing to certain extent to the economy of many countries, including India. India stands rank second in fruit production after China. It is well known that fruit trees are commonly attacked by numerous insect pests and diseases. Among the insects, several Lepidopteran pests cause damage in their larval stages to fruits.

However, some of adult lepidopterans belonging to the genus Eudocima & Rhytia cause injury on semi ripening and ripening fruits such as citrus, guava, pomegranate, grapes, fig, sapota, mango, papaya and tomato etc.

Species Diversity of Fruit Piercing Moth Complex in Tamil Nadu

There are five species of primary fruit piercers viz., *Eudocima materna* (L.), *E. fullonia* (Clerck), *E. homaena Hubner*, *E. salaminia* (Cram.) and *Rhytia hypermnestra* (Stoll) were found to feed on above said fruit crops. Among the five species, *E. materna* was predominant piercers followed by *E. fullonia* and *E. homaena*. The species *E. salaminia* and *R. hypermnestra* were very less abundant in Tamil Nadu.

Seasonal Incidence of Fruit Piercing Moths

Since the adult moths having nocturnal habit, the activities of primary fruit piercers will be found around 8.00 p.m and then declined after 12.00 mid night in the orchards. Among the five species, the incidence of *E. materna* will start from second fortnight of July and then continued up to first fortnight of January. The peak incidence of *E. materna* will be found during August and September and then its population declined. Consequently, the activity of *E. fullonia* and *E. homaena* were noticed from September to first fortnight of January. The peak incidence of both the species was noticed during October and November and declined during December. Very scarce population of *R. hypermnestra* was observed during October, November and December.

Larval Hosts of Fruit Piercing Moths

The larval stages of the fruit piercing moth feed on leaves of Menispermaceae plants viz., *Tinospora cordifolia* (Willd.), *T. smilacina* Benth., *Cocculus hirsutus* (L.), *Stephania* spp., *Tiliacora* spp., *Diploclisia glaucescens* etc. The larvae of *E. materna, E. fullonia* and *R. hypermnestra* were found feeding on the natural vines of *Tinospora cordifolia* (Willd.) whereas *E. homaena* on the *Cocculus hirsutus* (L.).

	
Eudocima maternal	***Eudocima fullonia***

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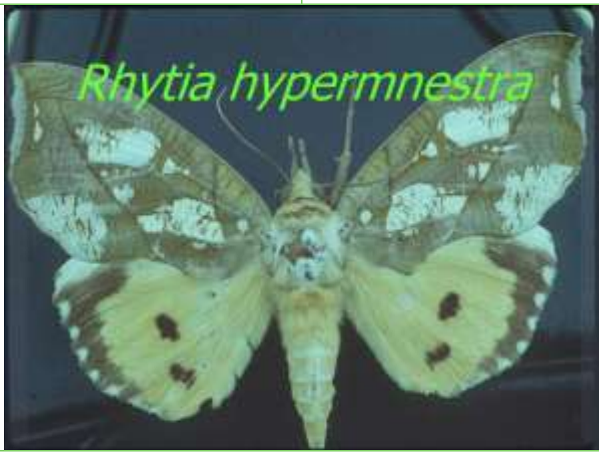
Eudocima homaena

Eudocima salaminia



Rhytia hypermnestra

Proboscis Morphology of Fruit Piercing Moths

Fruit piercing moths having sclerotized blades, serrations and erectile barbs at the tip of their proboscis which were used to group as primary piercers. The proboscis of male and female of *E. materna, E. fullonia, E. homaena* and *R. hypermnestra* having three sclerotized oblique blades with sharp edges, six erectile barbs arranged in two rows near the tip which was sharply pointed. By using this sclerotized proboscis, the moths pierce the hard rind of semi and ripening fruits.

Feeding Habit and Damage Potential of Fruit Piercing Moths

The adult moths visit the fruit orchards during night time and penetrate with the help of thick spines and sclerotised hooks at the tip of proboscis of siphoning mouth parts by making holes into semi-ripening and ripening fruits and suck the juice.

The moths pierce the fruits with a forward and backward movement by twisting the head. By this movement the entire proboscis is inserted into the fruit and moved in all directions with the forward and backward movement thereby sucking the juice through food canal of the proboscis and by macerating the soft tissue around the point of insertion.

Once drilled a hole it took nearly about 20-30 minutes to empty the contents around the point of insertion. If there is any disturbance during feeding the moth left the fruit without emptying the contents fully and made several holes to fulfil the feeding.

The affected fruits show punctured holes of penetration and through these holes' secondary infection by the saprophytic fungi viz., *Oospora* sp., *Fusarium* sp., *Colletotrichum* sp., and certain bacteria gain entry make the fruit unfit for consumption.

Due to rotting around the puncture hole, the affected fruit drop down to ground and resulting in heavy yield loss. The symptoms are sometimes mistaken by farmers for fruit fly attack and fruit rot disease as wrong diagnosis. There is less awareness among fruit growing farmers in respect of damage by fruit piercing moths.

Management of Fruit Piercing Moths

1. Physical sanitation: Dispose fallen fruits that attracts the moths.

2. Removal of larval host plants: Destruction of larval host plants to reduce moth population. This should be done at least two months before the actual damage is done by the adults to fruits. Mass destruction of larval host plants was done on village community basis for better results. All the uprooted host plant/vines should be burnt properly as many of the Menispermaceae plants shall be rooted easily if left unburnt.

3. Hand collection of moths: The moths have a relatively slow and heavy flight and could be easily followed in flight at night with torch light and netted. While feeding they are not easily disturbed and a beam of light stupefied them therefore could be beaten gently or caught into a wide mouthed poison bottle and killed.

4. Regulating fruit season: This is possible in citrus, which produce fruits in two seasons. All the flowers produced in January-March should be removed mechanically/chemically (by spraying ethryl etc.) and a heavy flush of flowers may be obtained in June-July by light root-pruning and manuring followed by very light irrigation shortly before the rainy season. Citrus fruit obtained during winter season were sweet and yield was high due to absence of damage by fruit piercing moths.

5. Provision of physical barrier: Cover the entire orchard with nylon net having one-centimetre hole to create physical barrier to the moth which was reported to be economical.

6. Provision of bait material: Bait with fermented molasses / jaggery (10 g/ lt) + malathion 50 EC 1 ml/lt. Take it in wide mouthed bottles @ 1 bottle per 10 trees tied to plants when the fruits are in unripe condition.

7. Smoking of orchard: Smoking of orchard should be done at wind entering edge of the orchard at least half an hour before dusk and continued for two or three hours after dusk.

8. Biological control: Encouraging natural enemy population in the vicinity of orchards. The egg parasitoid, Telenomus sp. found to parasitize the eggs of fruit piercing moths naturally.

Conclusion

In recent years, there is severe attack by fruit piercing moths on citrus, guava and pomegranate (seedless variety) in Tamil Nadu with heavy fruit drops and loss in yield. Hence, the fruit growers should aware about the biodiversity, seasonal incidence and damage potential of fruit piercing moths for escaping from its attack and to get assured income from the orchards.

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Kole Lands – A Unique Rice Bowl of Kerala

Article ID: 31576

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Kole lands are rice granaries of Thrissur (spread over Chavakkadu and Mukundhapuram Thaluk) and Malappuram (Ponnani Thaluk) districts of Kerala, providing 40 per cent of the state's rice requirement (Anno.2020). The word "Kole" is derived from the Malayalam word which means bumper yield from the crop. Kole lands are situated 0.5 to 2 m below mean sea levels (Johnkutty and Venugopal, 1993). These lands will become inundated with water with the onset of SW monsoon. After the withdrawal of SW monsoon, water level decreases and the salt water begin to intrude into the land from the sea and this phenomenon is regulated by water regulators installed in the Enamavu, Mulayam and Kottankettu regions (Joseph.2009).

Crop Seasons in Kole Lands

1. Second crop (Mundakan) - Sept – Dec.
2. Third crop (Punja) - Jan to April.

Second Crop (Mundakan)

High yielding varieties of medium duration are used for cultivation (110-125 days). Centrifugal pumps or Petti and para (indigenous pumping equipment for dewatering) are used to drain excess water from the field and land preparation will be performed in September. Field bunds or Padavu are constructed and strengthened with locally available materials. Direct sowing of sprouted seeds or transplantation will be performed after field preparation. Suitable varieties: Jyothi, Kanchana, Ahalaya and Uma.

Third Crop (Punja)

Short duration varieties are suitable because of low availability of irrigation water. At the end of January, sprouted seeds are sown after dewatering and land preparation. Transplanting is also practiced in some areas. Sown fields are drained until the soil cracks are formed and then flooding is done and first dose of fertilizer will be applied. Weeds are the major problem due to drying and wetting. Application of herbicides and manual weeding are the common practices followed in order to overcome this problem. Peechi and chimmini irrigation project are the provider of irrigation water in the later stages of crop development (Joseph, 2009).

Fertilizer Recommendation for Rice in Kole Lands (Kg/Ha)

Land type	Varieties	N	P_2O_5	K_2O
Kole lands	Short duration varieties	90	35	45
	Medium duration high yielding varieties	110	45	45
Ponnani Kole lands	Medium duration high yielding varieties	110	45	45

Source: KAU, 2016.

Fish Farming in Kole Lands

After the harvest of paddy, fish is cultivated when the fields are flooded. Fish farming is done during March – September. After 15 days of paddy harvest water is pumped in to the field for reducing the ill effect of agrochemicals used during the cultivation. The fish lings are raised in ponds until the paddy harvest is completed and fish are harvested at least 10 days before the start of agricultural operations paddy. Katla, Rohu and prawns are the major varieties grown.

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Spading Machine

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Spading machine is designed to approximate the effect of proven smaller-scale hand digging tool for the purpose of deeper aeration, and effective integration of organic matter. Its working principle is similar to digging of soil by spade. The blades of spading machine cut the soil alternatively. The blades lift the clods and throw them in backward direction when the machine moves forward direction. It has been claimed that their action subtly aerated/fractured the subsoil twice the depth of the stroke of the spades (Manfred, 2002). The spading machine is equipped with help of gears or chain and sprocket according to requirements. It can be adjusted according to operation requirement.

Spading machine is an alternative to using a rotary tiller or a plough (Hoffman,1993). It works either rotary or reciprocating, and the spades are moves slowly for both types. It works on soil more effectively without compaction. As a result, the roots of the plants develop in better manner and increases the water holding capacity (Giordano et al.,2015).

Spading machine incorporate large amount of organic material, such as crop residue, straw and compost. It removes the unwanted plants in the field. Operation of this machine does not involve draft force whereas the conventional soil engaging machines involved draft and also does not required tractive force while operation. Spading machines can operate at higher depth as compared to conventional tillage.

These machines are break up the soil up to 20 cm to 30 cm depth and it creates the good seedbed in single pass (Knight, 2013). The power requirements of spading machines are low as compared to conventional rotary tillage. Their life is also increased when, it works in the downward motion. Spading machine requires less fuel consumption as compared to conventional tillage operation. This could be a useful in where a greater number of cultivations carried out annually. It takes less time to complete the task. Removal of subsoil compaction by deep operation results 45% yield increases with spading machine (Davies et al., 2012).

The independent parameters are like soil types, speed of operation, depth of cut, width of cut, spade angle and spade frequency. The dependent parameters such as, bulk density, pulverization index, fuel consumption, cone index, field capacity and clod mean weight diameter. The bulk density and soil strength increase significantly with increases in depth of operation.

The spading machine comprise of a horizontal crankshaft with spades on the connecting rods plunging rotationally, sequentially, downwards into the soil (Manfred Palmer, 2002). The advantages of these machines are that these do not form any hard pan as the path of the tools is never parallel to the soil surface. The blade curvatures and angles influenced cutting force and pulverization.

Specific soil resistance decreased with increase in spading frequency and spade angle, but it increased with increase in radius of curvature and blade width. Minimum specific soil resistance is required for 10 cm width of blade with 300 spade angle and flat curvature at spading frequency of 4.62 cycles/sec (Bishnoi, 2008).

Energy consumed decreased with increase in spading frequency and spade angle, but increased with increase in radius of curvature and blade width. Weighted mean clod size decreased with increase in spading frequency, spading angle and radius of curvature, but increased with increase in blade width.

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Hydrogel: Technology to Produce More Crop Per Drop

Article ID: 31578

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Abstract

In India most of the agricultural field is located in the arid and semi-arid regions, more efficient use of water is needed in these areas. Maintenance of proper soil moisture soil infiltration rate, moisture holding capacity, increase in irrigation efficiency are ways through which water can be saved. 21st century has witnessed a decline in irrigation water potential along with increasing global population. It is estimated that by the year 2025 major issue in India will be water scarcity. As per the Central Water Commission, the demand for water is growing at a steady rate but the availability of clean water in future is declining at a faster rate. Agricultural practices are responsible for consuming 80% of the available water. Modern irrigation practices can still only cater to 40% of the cultivated crops, there are many areas that are susceptible to improper irrigation practices resulting in reduction of the effective use of available water for the crops. Super absorbent polymers (SAPs) can increase water use efficiency and enhance crop yield in the field of modern agriculture as well as rainfed agriculture. These are hydrophilic materials that can absorb and retain large amount of water or aqueous solution. These are sugar like hygroscopic crystals that can be directly added to the soil. They not only increase water use efficiency but also have the ability to reduce the attack by the plant-pathogen even with lower pesticides dose and an increase in the fertilizer use efficiency thus maintain environmental sustainability.

Introduction

Hydrogelare cross-linked three-dimensional water absorbent polymers. Natural polymers for manufacturing hydrogel include protein such as collage and polysaccharides like agarose. Synthetic polymer for hydrogelare prepared using chemical polymerization methods. Hydrogel works as water absorbent around root zones of plant.It expands to around 200 times of its original volume in presence of water.In addition to retention of water, super absorbents will increase amount of air in the soil due to continuous change in volume(expansion during inflation and contraction during losing water) (Kabiri, 2005). Most of super absorbent are manufactured from synthetic polymers mainly acrylic due to its high price to efficiency balance. Softness, smartness and the ability to store water make hydrogels unique materials (Shibayama and Tanaka, 1993).

Need of Hydrogel Technology

Irrigation practice predominantly used by Indian farmers is surface irrigation that is the direct application of water on the field. In this process only 50% of the water is available to the crop while rest is lost through runoff or by evaporation. Modern irrigation methods like drip or sprinkler came as a solution to these problems ,by reducing wastage of irrigation water but these methods are involved with high initial cost, lack of awareness about the government subsidies. In India, the population of a small and marginal farmers are more and they are hesitant to adopt such modern water management practices because of lack of technical support, damage of equipment by pests etc. So, hydrogel can be seen as a technology that can help in the utilization of farm resources in order to maximize the productivity without damaging the environment.

Desirable Characteristics of Hydrogel for Application in Agriculture

1. Water absorption capacity should be high in saline as well as hard water conditions.
2. It should have lowest soluble content and leaves no residue.
3. It should be cheap and affordable for the farmers.
4. It should be biodegradable.

5. It should have re-wetting ability.
6. It should be nontoxic, non-irritating and non-corrosive in nature.

Types of Hydrogel

Main types of hydrogel for agriculture use are:
1. Starch graft copolymers.
2. Cross linked polyacrylates.
3. Cross linked polyacrylamide and acrylamide acrylate copolymer.

Among these the most principal material used for preparation of hydrogel for agriculture use is potassium polyacrylate because of its high efficiency without any residual effect. Cross linked polymers have the capacity to hold water 400 times of their own weight and release 95% of that to the crops.

Applications in Agriculture

1. Hydrogel acts as mini water reservoirs at plant root zones by absorbing natural as well as supplied water thus preventing water loss in soil by leaching, evaporation and run off.
2. Hydrogel follows a cyclic process of absorption and release of water so that the water release can provide optimum moisture for quick germination of the seedlings resulting in reduction of seed mortality rate.
3. In cold regions, the seedlings die due to freezing of moisture. But hydrogel does not freeze preventing death of seedlings by providing them optimum moisture.
4. In addition to increasing water use efficiency, it also saves labour by reducing irrigation frequency.
5. Hydrogels also decrease the overuse of agrochemicals in the field by absorbing the chemicals and releasing them slowly does increasing their efficiency in the field.
6. Hydrogels help plant overcome drought condition, reduce leaching loss, runoff as well as soil erosion, agrochemical leaching to groundwater.

Effect of Using Hydrogel in Agriculture

1. Improvement in the quality of agricultural products in terms of fruit size and colour enhancement.
2. Hydrogel have caused to increase aggregate stability and reduction in crust formation.

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3. Slow rate of application also improves soil physical properties of porosity, aggregate stability and hydraulic conductivity.

Rate of Application

Type of Soil	Dose of Hydrogel (g/kg soil)
Soil of arid and semi-arid regions	4-6
To reduce drought stress	2-4
To delay permanent wilting in sandy soil	0.2-0.4

Conclusion

Hydrogel can be used in agriculture for ensuring food security along with environmental sustainability by eliminating the problem of drought, groundwater pollution, leaching. Hydrogels may exhibit drastic changes in volume in response to specific external stimuli, such as the temperature, solvent quality, pH, electric field etc. (Tanaka, 1978).Hydrogel have the ability to trap or store irrigation as well as rain water and release it gradually according to the crop requirement over prolonged periods. The super absorbent polymers while increasing water-holding capacity of light soils can address soil permeability problems of heavy soils and difficulties in washing agrochemicals (Asgariet al.1994). But more awareness should be created in farmers to use hydrogel. Hydrogel can be seen as a technology that can help in the utilization of farm resources in order to maximize the productivity without damaging the environment.

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Dynamics of Weed Seed Bank and its Management

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Introduction

Weeds are unwanted plants playing a very important role in different eco-systems and many of them cause enormous direct and indirect losses. The losses include interference with cultivation of crops, loss of biodiversity, loss of potentially productive lands, loss of grazing areas and livestock production, erosion following fires in heavily invaded areas, choking of navigational and irrigation canals and reduction of available water in water bodies. The seed bank is the resting place of weed seeds and is an important component of the life cycle of weeds. Seed banks are the sole source of future weed populations of the weed species both annuals and perennials that reproduce only by seeds. When weed management practices are not entirely effective, this seed reserve can germinate, mature, and within a short period produce enough seed to replenish the seedbank. Weeds are probably the most ever-present class of crop pests and on the odd occasion cause massive crop failures over vast areas. They reduce the crop yield and deteriorate the quality of produce and hence reduce the market value of the turn out (Arif et al., 2006). They use the soil fertility, available moisture and nutrients, compete for space and light with crop plants, which result in yield reduction (Khan et al., 2004). Weed seed bank analysis provides knowledge on the effect of agricultural management practices on weed community dynamics. Such knowledge is difficult to acquire from short-term studies based on actual weed flora, whose composition is subjected to considerable variation in time and space (Birthisel et al., 2015). Weed communities are also affected by crop type and sequence. Crops with different growth cycles (winter or spring) affect weed spread, germination and growth.

Weed Seed Bank

The weed seed bank is the reserve of viable weed seeds present on the soil surface and scattered in the soil profile. It consists of both new weed seeds recently shed and older seeds that have persisted in the soil for several years. The weed seed bank not only serves as a physical history of the past successes and failures of cropping systems, it can also help producers predict the degree to which crop-weed competition will affect crop yield and quality (Menalled, 2008) Weed seed banks are particularly critical in farming systems, which rely on cultivation as a primary means of weed control. Because a cultivation pass generally kills a fixed proportion of weed seedlings present, a high initial population will result in a high density of weeds surviving cultivation and competing with the crop. Initial weed population is directly related to the density of seeds in the seed bank (Brainard et al., 2008). Weed seeds can reach the soil surface and become part of the soil seed bank through several avenues. The main source of weed seeds in the seed bank is from local matured weeds that set seed. Agricultural weed seeds can also enter a field by animals, wind, water and human activities, like cultivation and harvesting. How far weed seeds can travel depends on the dispersal process and the weed species. Understanding the importance of these dispersal mechanisms is vital in the development of preventive weed management strategies.

Weed Seed Bank Dynamics

The species composition and density of weed seed in soil vary greatly and are closely linked to the cropping history of the land. Seed composition is influenced by farming practices, and varies from field to field (Buhler et al. 1984). Generally, seedbanks are composed of many species, with a few dominant species comprising 70-90% of the total seedbank (Wilson 1988).

These species are the primary pests in agronomic systems because of resistance to control measures and adaptation to the cropping system. A second group of species, comprising 10-20% of the seedbank, are generally those adapted to the geographic area but not to current production practices. The final group accounts for a small percentage of the total seed and includes recalcitrant seeds from previous seedbanks, newly introduced species, and seeds of the previous crop (Wilson et al. 1985).

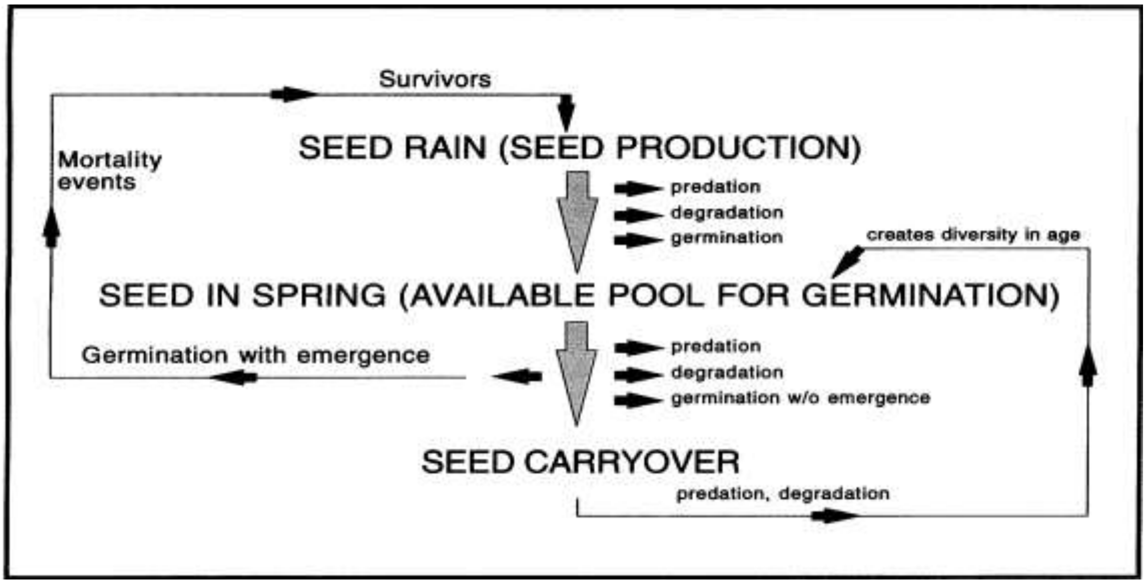

Fig. 1: Weed seed cycle

Sources of Weed Seed Bank

New seeds may enter the seedbank through many sources, but the largest source is plants producing seed with-in the field (Cavers 1983). A characteristic of many weed species is the potential for prolific seed production (Cousens and Mortimer 1995; Stevens 1957).

Seed may also enter fields from external sources such as farm equipment, contaminated crop seed, animals, wind, or manure. The number of seeds introduced into the seedbank by these sources is usually smaller than those produced by weeds in the field; however, these sources can be important in establishing infestations of new species.

Many weeds viz. Canada thistle Horseweed and Dandelion have seeds adapted to wind dispersal. Dandelion and Horseweed have become problems in no-tillage systems partially due to the wind transport of seeds (Buhler 1995).

Manure can also be a source of weed seed. While the majority of seeds are killed when passing through the digestive tracts of animals, a small percentage typically survive (Harmon and Keim 1934). If manure is spread on fields from where the feed was harvested, seeds returned to the field will be of little consequence. However, manure can be a source of new weed problems if feed is moved among farms and contaminated with seed of species not currently found in the field.

Another mechanism of weed seed transport is farm machinery moving between fields. This has become increasingly important as machinery is moved greater distances due to increasing farm size. The movement of weed seed by combines and other harvest equipment is of particular concern.

Management Practices

Weed seed densities can be greatly reduced by eliminating seed production for a few years; conversely, soil with low seed density can increase crop production at an extremely rapid rate. The most important weed management strategy is to reduce the number of weed seeds present in the field, and thereby limit potential weed populations during crop production.

Herbicide applications that do not kill plants may also reduce seed production. Sublethal doses of herbicide reduced seed production of several weed species as much as 90% (Biniak and Aldrich 1986; Salzman et al. 1988). Although seed production in most weed species can be reduced by management factors, seed production will likely remain great enough to maintain or decrease the seedbank with low to moderate weed infestations (Hartzler 1996).

Rotation of herbicides with different modes of action may be important in avoiding the evolution of resistance. Three new herbicides, namely, Sulfosulfuron and fenoxaprop-p-ethyl have shown promising results in controlling Isoproturon resistant biotypes of Phalaris minor.

Crop Rotation is effective for weed management because selection pressure is diversified by changing patterns of disturbance. This diversification prevents the proliferation of weed species well suited to the practices associated with a single crop(Liebman and Dyck 1993).

The mechanisms by which crop rotation reduces the size of weed seedbanks are related to the use of crop sequences employing varying patterns of resource competition, allelopathic interference, soil disturbance, and variable weed management strategies. Proliferation of otherwise well adapted weed species is reduced by these processes, which provide a more diverse environment.

Sowing time of crop should be adjusted so that it is maximum favourable for crop growth and development and least favourable for weed germination and growth e.g. to control Phalaris minor in wheat. The sowing of wheat is preferred between 25 October to 10 November, when temperature is still high for the germination of Phalaris minor and when it germinates the crop has established and it poses great competition to weeds. However, length of delayed sowing of improved weed management has to be offset against reduced yield due to shortened growing season.

Manipulating planting method of sowing to get even dense canopy also helps to control weeds by causing shading effects on weeds due to overcrowding e.g. bidirectional sowing in wheat gives less weeds as compared to unidirectional sowing although seed rate is same.

Conclusion

Several fates and processes occur in the weed seed bank, many of which are not very well understood. Nevertheless, current knowledge about weed seed banks has shown some potential management options. Reduced inputs to the seed bank are an important component in the management of seed bank, while other weed management strategies discussed above, also be used to directly affect germination, persistence and mortality of weed seeds. Managing weed seed banks is very important for long term weed management.

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A New Root Phenotyping Platform in Sugarcane

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Introduction

Sugarcane is the major source of sugar and ethanol. Sugarcane productivity is directly influenced by water availability. Drought is the major yield limiting abiotic stress in sugarcane. A sugarcane variety with strong root system would sustain the yield under droughted situations. Roots are the important component of the soil-plant atmosphere continuum and play an indispensable role in water and mineral uptake for a successful crop. The complex and hidden nature of roots offer limited scope of researches while shoot related experiments are momentous. Targeted breeding efforts for selection and root trait modifications are limited in sugarcane. This scanty information underpins the importance of roots in sustaining the productivity under drought. Therefore, researches on the root system architecture and adaptive root plasticity to various environmental conditions are assuming importance in sugarcane. Plant roots utilize trait specific plasticity to adapt to stress stimuli. Identifying those specific root traits that increase the capacity of root foraging and sustain productivity is essential for targeted crop improvement in sugarcane.

Need for Root Studies

The cost of cultivation in sugarcane can be managed economically by developing varieties with climate resilience and cultivars suited for mechanical harvesting. These targets can be achieved by good root systems.

Biologically, sugarcane root system is highly divergent, comprising of:
1. Highly branched sett roots (roots originating from the sett).
2. Shoot roots (Main roots originating directly from the shoot).
3. Deep rope roots formed by the agglomeration of shoot roots.

These root system architecture, longevity and specific roles in popular mobilized cultivars and germplasm are poorly known. A better understanding of the sugarcane root architecture is essential to develop genotypes with better absorption and soil-plant continuum thereby resulting in improved yield under droughted conditions. Mechanical harvesting is the order of the day to reduce the cost of cultivation. Identification and or evolution of sugarcane variety with deep and sturdy root system architecture are essential to withstand mechanized harvest for many seasons. Sugarcane being an annual crop has a huge root system. Field screening under natural conditions for drought tolerance is tedious and cannot have control over rainfall. Therefore, it is highly essential to develop a large, non-destructive and easy monitoring phenotyping platform for efficient root studies. With this view we were motivated to develop a platform which mimics natural ecosystem in sugarcane root studies.

Steps Involved in the New Non-Destructive Platform

For this non-destructive sugarcane root phenotyping facility, PVC columns were designed for efficient monitoring of root development both under ideal and droughted conditions. This methodology comprised of following major steps:
1. The PVC columns of 60" longer and 14" wider are to be split opened into two halves and reassembled for easy monitoring of root development (Fig.1).
2. Filling the PVC columns with soil and planting of sugarcane setts in replications.
3. Growing of genotypes under ideal conditions for 60 days.
4. Imposing drought after 60 days of planting by withholding irrigation with a set of control under normal irrigation (Fig.2).
5. Splitting open of PVC columns after 50 days of moisture stress.

6. Phenotyping for various root traits such as morphology, root length and root biomass (Fig.3).

Practical Utility

This new phenotyping platform would helpful in identification of newer sugarcane germplasm with better root architecture. These genotypes can be utilized in breeding programs for developing superior varieties with enhanced root system. Using the customized large size and non-destructive PVC columns we could successfully phenotype the root system of sugarcane under normal as well as water limiting conditions up to 90 days. The platform developed is economical.

Fig.1 Customized 60" long and 14" wider PVC columns

Fig.2 Seedlings after 60 days of planting

Fig.3 Split opened PVC coloumn after 50 days of moisture stress

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Response of Drought Stress in Flowers and Ornamental Crops

Article ID: 31581

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Introduction

Drought is an important stress for plants which causes low availability of water to plants for a prolonged period of time which disturbs the plant growth, development, water relations and efficiency of many terrestrial plants. Drought is also claimed as an important abiotic stress that limits the plant growth and efficiency (Yuyan et al., 2007; Hamayun et al., 2010). The severity of drought is unpredictable as it depends on many factors such as occurrence and distribution of rainfall, evaporative demands and moisture storing capacity of soils (Wery et al., 1994). Flower crops widely grown for its ornamental and commercial value also faces the drought stress. Most of the flower crops get adversely affected by drought stress, however based on nature of the plant, it gets acclimatize to different biochemical, physiological, morphological changes to overcome drought conditions.

Effects of Drought on Growth and Physiology

Vegetative growth found to be decreased in water stressed crop. The first effect of the stress may well be a loss of turgor that affects the rate of cell expansion and ultimate cell size. Loss of turgor is probably the process most sensitive to water (drought) stress. The result is a decrease of growth rate, of stem elongation, of leaf expansion, and of stomatal aperture. According to Hsiao (1973) the mechanisms underlying the responses of plants to water stress may be divided into five categories:

1. Reduction of water potential or activity of cellular water.
2. Decrease of cell turgor pressure.
3. Concentration of small molecules and macromolecules as cell volume decreases with reduced turgor.
4. Alteration of spatial relations in the plasma lemma, tonoplast, and organelle membranes by volume changes.
5. Changes in structure or configuration of macromolecules by removal of water of hydration or through modification of structure of adjacent water.

Influence on Photosynthesis

A major effect of drought is reduction in photosynthesis, which arises by a decrease in leaf expansion, impaired photosynthetic machinery, premature leaf senescence and associated reduction in food production. The role of drought-induced stomatal closure, which limits CO2 uptake by leaves, is very important.

In different flower crops, different responses for drought was seen. This may be due to individual nature of the plants. People expect most of the ornamentals should be grown with limited irrigation. Need of drought tolerant crops/varieties increasing in the up-coming years.

Influence of Drought on Flowers

1. Rose: For Cut-flower production, it is important to identify the critical moisture levels that negatively affect flower quality and yield. Ideally, plants should be irrigated at minimum amount of water where plant growth is not negatively affected (Farooq et al., 2009). For greenhouse cut rose (Rosa x hybrida), water stress affects both quantity (flower yield) and quality (decreased stem length). In traditional loose flowers, water stress causes reduced morphological parameters but in contrast improves the essential oil content, because of increased secondary metabolites production during stress. The performance of a grafted rose plant under drought stress depends on the drought tolerance of the scions and the rootstocks and their compatibility (interaction). R. x fortuniana was the most tolerant and *R. odorata* was the least tolerant to drought stress. (Niu and Rodriguez, 2009).

2. Pot marigold: In *Calendula officinalis*, water deficit caused reduction of all yield related and growth traits, except the essential oil content that it raised along with severe stress. This is because of production of secondary metabolites was stimulated under stress. (Azimi et al., 2012).

3. Jasmine: Physiological activity of jasmine flowers decreased with the increase of degree and time of drought stress. Free radical scavenging capacity of double petal was stronger than single petal and multiple petal type of Jasminum sambac and the injury was also lighter. Under severe drought stress, assimilation capacity in mesophyll cell of single petal and multiple petal jasmine decreased which led to excess light and photo inhibition. Double petalled jasminum species proved to be a drought toleramt one. (Guo et al., 2013).

Water stress decreased net photosynthetic rate, stomatal conductance and maximum photochemical efficiency (Fv/Fm) in both single petal and double petal type jasmine but increased minimum fluorescence (F0) only in double petal jasmine. Water stress also decreased starch content, while increased contents of total soluble sugars and proline in the leaves of both types. Single petal -jasmine demonstrated higher drought tolerance as evidenced by maintaining higher gas exchange and photochemical efficiency and lower alteration of metabolites than double petal jasmine. Recovery analysis revealed that drought-induced injury in photosynthetic machinery in jasmine plants was reversible. Double petal jasmine exhibited a slow recovery of drought-induced impairment in photosynthetic activity and associated metabolites, suggesting that this genotype had lower capacity to adapt to water limited condition. Higher yield stability of Single petal than that of double type under rain-fed condition finally confirmed higher drought tolerance of Single petal jasmine (Chai et al., 2007).

Conclusion

Identification and exploration of plant species / varieties / types based on their response to drought stress is an initial step to manage and escape from drought. Thus, varied response was given by the potential flower crops in both positive and negative way. Hence, crop plant's response to drought is a critical stage to identify and study the physiology of plants.

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Stylet-Ensheath – A Feeding Mechanism of Plant Sucking Bugs

Article ID: 31582

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Introduction

Generally, plant bug refers to the hemipteran insects. The Hemiptera or true bugs are an order of insects comprising some 50,000 to 80,000 species of groups such as the cicadas, aphids, planthoppers, leafhoppers, and shield bugs. They range in size from 1 mm (0.04 in) to around 15 cm (6 in), and share a common arrangement of sucking mouthparts. They are widely distributed in the different ecological zones, starting from tropical to temperate. Hemiptera order consists of two sub orders, namely heteroptera and homoptera. Plant bugs come under both of these orders. Mostly homopteran insects are main responsible for sucking the sap from the plant. While heteropteran acts like predator insects. Among the all hemipteran insects, plant bugs are considered most important group of bugs as they are all associated with the interaction with humans through the crop losses. Plant bugs generally feed the plant sap by sucking the liquids from xylem or phloem vessels of plants by their sucking type of mouthparts. As they are systemic in nature, they cause huge crop losses of different crops by producing variable symptoms in the plant as direct methods or indirectly they transmit various plant diseases caused by virus. The evolution of plant bugs having such type of feeding behavior may be for several modifications in the different mouthparts. There are various types of liquid diets that plant bugs consumed from different plants. As they mostly reproduced by parthenogenetically, huge numbers of plant bugs are seen in congregate form to feed or suck the plant sap from different plant parts. As mouthparts play an important role in feeding of plant bugs, several modifications of mouthparts age generally observed in plant bug which are described below.

Mouthparts

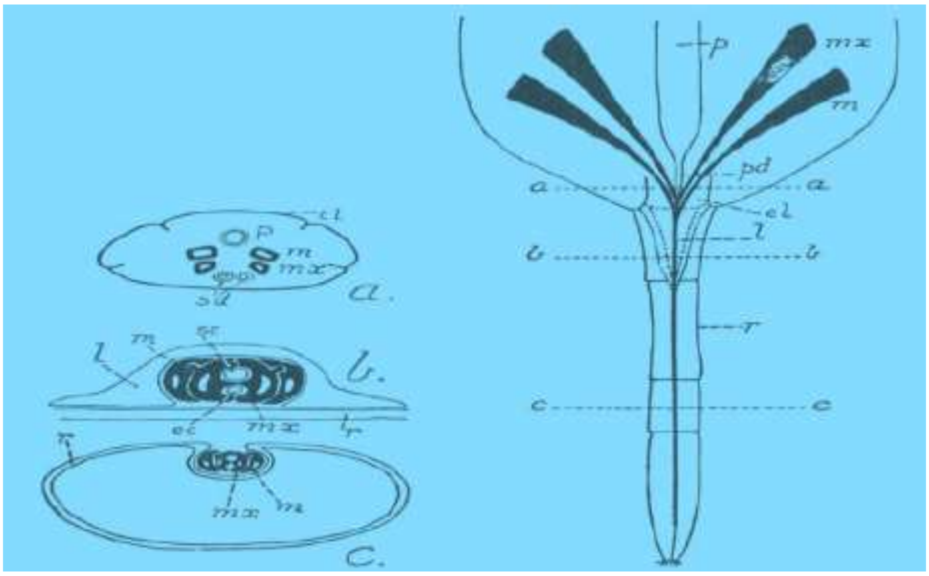

Fig 1: Diagram of the mouthparts of a hemipteran insect. d = clypeus; ec = ejection canal with salivary duct; l = labrum; m = mandible; mx = maxilla; p = pharynx; pd = pharyngeal duct; r = rostrum; sd = salivary ducts; ac = suction canal with pharyngeal duct (Smith KM. 1926).

The mouthpart of plant bug is piercing and sucking type. They are mainly adopted for piercing the tissues and sucking plant sap from the host. Mouth parts are represented by rostrum/beak which is a modification of labium i.e. labium projects downwards from the anterior part of the head like a beak which is four segmented and grooved throughout its entire length. It acts as a pouch for protecting the mandibular and maxillary stylets. At the base of the labium there is a triangular flap like structure called labrum. Both mandibles and maxillae are modified into long slender sclerotized hair like structure called stylets. They are lying close together and suited for piercing & sucking. The tips of the stylets may have minute teeth for piercing the plant tissue. The inner maxillary stylets are doubly grooved on their inner faces. The mandibular stylets form the outer pair and possess serrated margins at their tip. The maxillary stylets form the inner pair having smooth curved tips and combine together enclosing a food channel. The food channel is divided in to an upper cibarium and lower salivarium with the help of the grooves present inside the maxillary stylets. Salivarium is used for releasing the saliva and cibarium is used for sucking the sap. Saliva contents enzymes or toxins that can distort plant cell wall to permit the stylets to penetrate down and reach phloem for sucking the sap. Both palps are absent here. Insects with this type of mouthpart pierce the tissues with the mandibular stylets and suck the contents (sap) through cibarium with the action of pharyngeal and cibarial muscles.

Stylet-Ensheath Feeding Mechanism

Most hemipteran insects use the stylet-ensheath feeding system. The plant-feeding hemipterans employ this mechanism to obtain food. This technique is employed by many members of the suborders Auchenorryncha and Sternorrhyncha. The stylets are used to pierce plant tissue using the stylet-ensheath process. Multiple organisms target various sections of the plant.

The vascular tissues are common targets of plant sucking insects. Some species feed on tissues and contents of xylem while others feed on the phloem. Some hemipteras target not vascular tissue, but certain plant sections. The feeding process for the stylet-ensheath includes making a solidified sheath that encapsulates all the forms, consisting of saliva and other excretions.

The sheath is referred to as a sheath stylet. This sheath in stylet is shaped during the feeding act itself. When the styles pierce the plant, saliva is excreted and creates a sturdy hollow channel from the surface of the leaf to the lowest point entered by the stylets, which is also the xylem or phloem vascular. The stylet sheath feature is unclear but this has been investigated by many tests. Several scientists explored a variety of potential stylus sheath features.

The stylus sheath is ideally intended to carry such chemicals into the vine. Such compounds involve hemipteran saliva proteins and other chemicals, and they act by affecting many processes within the field. Such secretions influence wound healing, protective signalling pathways and the plant's release of volatile substances. When such mechanisms are eliminated, then there will be more successful feeding without intervention from the hemipterane herbivore.

Walling (2008) also noted that the type sheath acts to provide the mouthparts with greater flexibility and directionality when eating, as well as to minimize stylet slippage. Stylet sheaths can often be single or branched. Feeding on plant vascular fluids and tissues, including the xylem and phloem, raises fascinating problems for herbivorous hemipterans.

The vascular network material has poor viscosity and low nutritional quality. As a consequence, hemipteran herbivores suck up a significant amount of liquid to provide adequate nutrient uptake. Several scientists on the xylem and phloem mention feeding of hemipteran insects.

Many of the aphids (suborder Sternorrhincha) are sources of phloem feeding hemipteran insects and slicing the stylus through the channel cells of the phloem sieve. The aphid saliva produces other proteins that weaken cell walls, which lead to penetration.

Because of the need to extract a large volume of phloem material for the collection of nutrients, aphids also need the excretion of large amounts of waste. This scrap is called honeydew. Xylem feeding hemipterans are more challenging than phloem-feeding.

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The xylem's nutrient content is much smaller than that of the phloem, and therefore xylem-feeding insects require a larger volume of liquid to be taken up. To satisfy this, insects that eat xylem get a higher rate of eating. This occurs by utilizing a cibarial pump to increase the amount of suction.

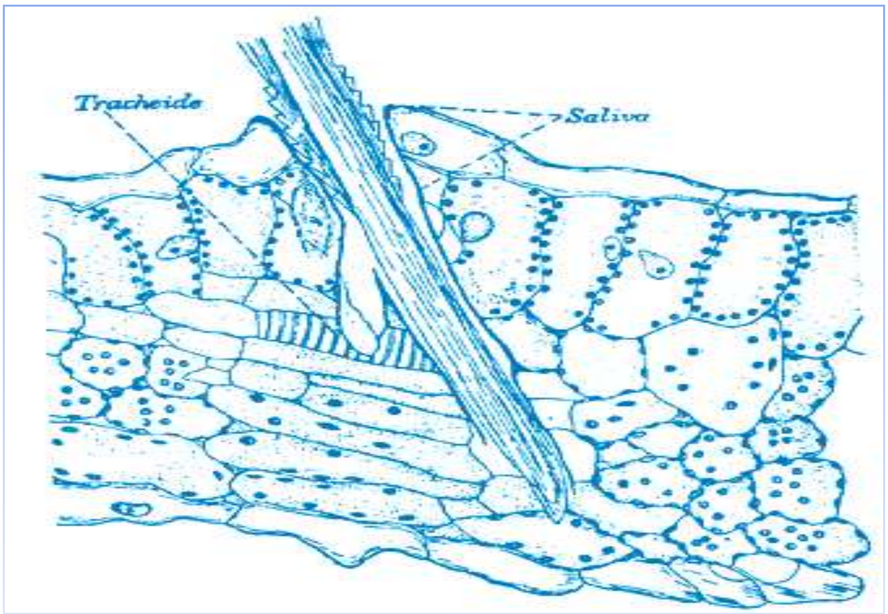

Fig 2: Stylets of a leaf-hopper (Auchenorrhyncha) piercing a potato leaf (Smith KM. 1926)

Conclusion

Thus, plant bugs are able to collect or suck their required plant sap from plant tissue. And it has been found that due to this peculiar feeding mechanism, they can effectively transmit some destructive plant viral diseases and thus they make them an important and significant plant damager to various plant species. Later on, based on this feeding mechanism, scientists evolved different chemicals to kill or suppress their population within a short period with various modes of actions of those chemicals. To know about the feeding mechanism of plant sucking bug is very necessary nowadays to control this destructive insect groups.

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Pusa Hydrogel – More Life Per Drop

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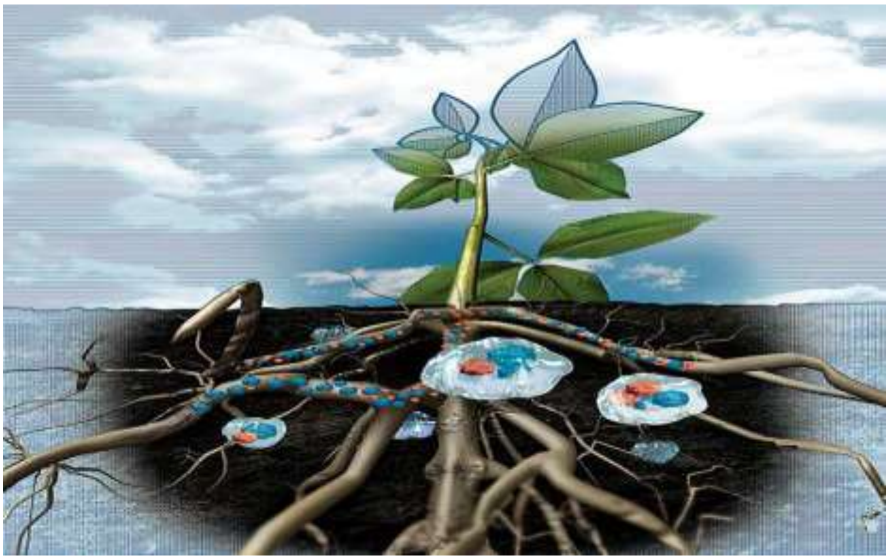
Introduction

Water is an important input for realizing high crop productivity; however, it is becoming the most limiting factor for crop production in almost every part of India with Jammu and Kashmir not being an exception. Water conservation is a key step to attain sustainable agriculture growth, development and productivity. The problem of optimal capitalization and recovery of water from any source should be seen as a major goal of scientific research. Water will become the "cornerstone" of sustainability and the future of humanity. So, there is a strong need for plant growth media with increased water holding capacity. From past few years researchers are developing water-saving technologies to sustain present food self-sufficiency and to meet future food requirements. Hydrogel is one of the most popular, having also been used to reduce water runoff and increase infiltration rates in field agriculture, in addition to increasing water holding capacity for agricultural applications. The use of hydrophilic polymers, to improve soil water retention properties and thus, crop productivity is attracting considerable interest.

Water conserving technologies such as drip irrigation, sprinkler irrigation, mulching, laser land leveling, water sheds, zero tillage, raised bed planting, direct seeding etc. are being disseminated and adopted by the farmers. In view of the agriculture specific requirements, scientists at Indian Agriculture Research Institute, New Delhi, developed a granular product called Pusa Hydrogel patented by the institute, which is being promoted by the ICAR and as well as by Ministry of Agriculture.

Chemical Nature of Hydrogel

A Hydrogel is a network of polymer chains that are hydrophilic, sometimes found as a colloidal gel in which water is the dispersion medium and a swelling agent. Hydrogels are highly absorbent (they can contain over 90% water) natural or synthetic polymeric networks. Hydrogels also possess a degree of flexibility very similar to natural tissue, due to their significant water content.



(Image source: www.eusa.ed.ac.uk)

Hydrogel for Plants

Hydrogel absorbs water after rain or applied irrigation from soil and water which it releases back to the soil as and when the plant demands it. This function is particularly important during dry seasons as the hydrogel will hold soil moisture in water limited areas and feed the necessary water into the root system of the plant. The efficiency of the technology is highly suited for farmers growing crops under rainfed and limited water availability areas. Application of Pusa hydrogel reduces frequency of irrigation in almost all the crops including cereals, pulses, vegetables and flowers, thus reducing time and money spend on irrigation, labour and water costs.

Suppose a farmer have to irrigate his paddy once every five days, after using this gel he needs to irrigate his paddy crop only once in seven days. The gel reduces water requirement for paddy, besides saving water from going waste in the field. In wheat crop, its performance was evaluated by the Institute and it was found that the farmers can easily save two irrigations without any yield reduction. Similar beneficial effects in wheat crop are also reported by PAU-Ludhiana, NDRI-Karnal and other platforms across country. In addition, satisfactory results have been observed in groundnut, soybean, vegetables, flowers and other crops.

(Image source: www.udyam.co)

Figure-2: Visual comparison of hydrogel not used and hydrogel used on root system.

Method of Application

Available in dry powder the gel should be mixed with approximately 10 times the quantity of the farm soil and basal dose of fertilizers. Seeds to be sown are also mixed with it. The mixture is then applied uniformly in the rows with the help of plough or seed drill. Care must be taken to ensure precision application of the product around or below the seed.

Application and Availability

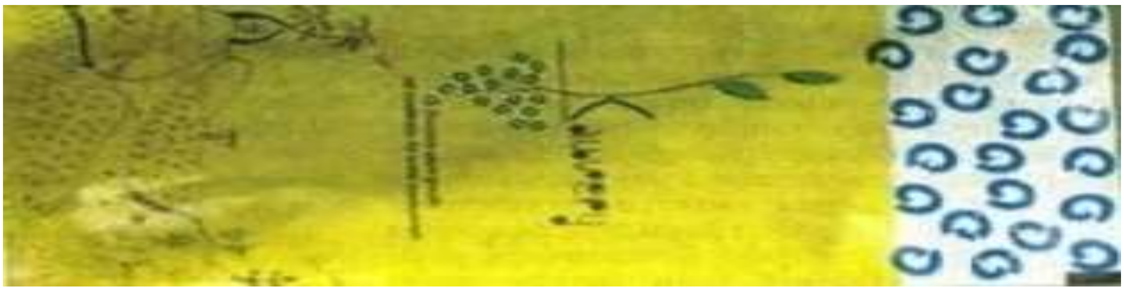


Figure-3: Pusa Hydrogel available in 250, 500 gm and one kg packets.

For most of the crops, the rate of Pusa hydrogel to be applied is 2.5 to 5 kg per hectare. It needs to be applied for every new crop. It has been licensed to six companies. In the market, it is available under two brand names

Cumijal and Vaaridhar-GIin 250, 500 gm and one kg packets priced at Rs. 1,200 to Rs. 1,800 per kg. Efforts are beingundertaken by the Institute to get subsidy on the product.

Adaptation of the Product

At present the product has been well adapted in Karnataka, Tamil Nadu, Andra Pradesh andMadhya Pradesh. Besides farmers from Maharashtra, Rajasthan, Haryana, Punjab, Himachal Pradesh, Western U.P. and Bihar arealso increasingly being aware of the technology owing to the efforts of the ICAR research institutes, state agriculture universities and KVK's.

Conclusion

Keeping in view, the decreasing water availability under irrigated conditions, larger areas under rainfed and dryland conditions and at the same time the efficiency of the Pusa Hydrogel in conserving the water and increasing water availability for longer periods to meet the crop water requirements. Sincere efforts are required to make farmers aware of the product and ensure its adaptation among farmers for sustainable water utilization.

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Role of Trees in Soil Fertility

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Introduction

Soil is one of the most important natural resources to suffer as a result of tree cutting. If it is not protected, its productivity declines and it may become difficult to sustain the human and animal population even at its present level. Therefore, protection of this resource is important and an understanding of how this resource is influenced in an agroforestry system is necessary.

1. Organic matter and nutrient addition: Tree species contain large quantities of 'living' biomass .About 20 to 25 per cent of the total living biomass of the trees is in roots and there is a constant addition of organic matter to the soil through dead and decaying roots. The major addition of organic matter and other nutrients to the soil from the trees standing on it is through litter fall ie., dead and falling leaves, twigs, branches, fruits etc.

During the lifetime of a tree, leaves, twigs and branches die and fall to the ground as litter. In agroforestry, trees are often managed and the biomass from the tree may be cut and used as mulch. The roles played by mulch and litter are similar.

In general, tree canopies only reduce the erosive effect of rainfall by about 10%, and in certain situations the canopy may make the rainfall even more erosive than if there were no tree. If the soil is covered with litter or mulch, on the other hand, erosion will often be reduced to low levels. Another characteristic of litter is its contribution to the organic-matter content of the soil after it decomposes. A soil that is rich in organic matter has a better capacity to absorb and retain water, and thus is also more resistant to erosion. A good cover of litter or mulch can also be very effective in suppressing weeds. In general, trees do not necessarily lead to control of erosion. What matters is their spatial arrangement and the way they are managed.

2. Nitrogen fixation: There is a possibility for improvement of the fertility status of agricultural lands' through additional amounts of nitrogen added to the soil by the tree legume component. Mimosoideae and Fabaceae are well known to fix nitrogen. Therefore, among the various avenues of addition of nitrogen to a soil through natural and biological means, the most significant one brought about by the presence of trees on agricultural lands could be nitrogen fixation by leguminous trees. For example, Leucaena leucocephala grown for forage for 9 months yields about 12,600 kg forage, 3,600 kg protein and 575 kg nitrogen per ha.

3. Nutrient cycling: The nutrient cycling model consists of the soil-plant system that is partitioned into several compartments. The crown surface forms the boundary of the system where input of bioelements occurs through precipitation. The soil surface is the entry point for inputs into the soil compartment, occurring through fertilizers, rainfall and stem flow. The surface layer may be considered the zone of intensive root activity, with the subsoil constituting the extensive root activity zone. The lower end of the extensive root layer is the boundary 'of the ecosystem to the hydrosphere and lithosphere. Bioelements transported beyond this layer are lost from the ecosystem and appear as output from the system.

Tree roots normally penetrate deeper into the soil than the roots of crops. It has, therefore, been assumed that trees are more efficient than crops in taking up nutrients released by weathering deep in the soil. Potassium, phosphorus and micronutrients are essential for plant growth and these elements are often released through such weathering. The nutrient uptake from deep layers of the soil, sometimes called nutrient pumping, has still not been experimentally verified.

The presence of a tree reduces wind speed and creates good conditions for the deposition of dust. Nutrients in the atmosphere are conveyed to the soil when they are dissolved in rain or settle with dust. Rain water dripping from leaves and flowing along the branches carries the nutrients to the ground, together with those released from the tree itself and associated plants growing on it. It is known that the amounts of nutrients reaching the ground in this way are substantial.

4. Tree Root Patterns: It is generally assumed that trees have deep and spreading roots and hence are capable of exploiting more soil volume and taking up nutrients and water from deeper layer not usually contacted by herbaceous crops. This process of taking up nutrients from deeper soil profiles and eventually depositing at least some portion of them on the surface layers through litter-fall and other mechanisms is referred to as 'nutrient pumping' by trees. It is well known that the development of plants depends on site characters and environmental factors. Many woody species have the largest number of roots and the majority of the fine roots are located in the uppermost fertile portion of the soil profile. Some tree species are shallow rooted. Prosopis chilensis has a shallow and spreading root system whereas *P. juliflora*, is known to have a very deep root system.

Conclusion

Trees acting as windbreaks and shelter belts also assist in regulating the ecoclimatic within the tree stands. They also reduce evaporation and temperature. The clearing of vegetation affects not only the farmlands in the immediate vicinity, but also destroys the water catchment areas causing flooding of rivers and rapid silting of dams.

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Giant African Snail: An Emerging Pest of Mulberry

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Introduction

Mollusca pests are the major group of non-insect pests which stand next to insect pests. This group includes both snails and slugs where in shell coiling is seen in snails but the same is absent in slugs. The molluscans which are reported to infest mulberry include 14 species *viz., Cryptozona semirugata, Cyclophorus fulgaratus, Cryptaustenia ovate, Rachis punctatus, Zachrysia provisoria, Achatina fulica and Laevicaulis alte* (slug) *etc.,* to name few. Among these species, the important species which pose major problem to mulberry plant is *Achatina fulica* Bowdich.

Achatina fulica Bowdich is commonly referred as Giant African Snail. Since it has bigger size, the first name Giant; African as middle name, as its origin is East Africa and the last name Snail, as it is molluscan pest.

Achatina fulica Bowdich – Giant African Snail

Achatina fulica is one of the world's 100 most invasive species, ranks next only to insects' pests. In India, it is introduced in Chouringhie gardens of Calcutta in 1847, by the British Conchologist William Henry Benson and from there on spread to many states and from Karnataka it is first time reported from Koratagere taluk of Tumkur district.

Life Cycle

This species is a simultaneous hermaphrodite; each individual has both testes and ovaries and is capable of producing both sperm and ova. Instances of self-fertilization are rare, occurring only in small populations. Although both snails in a mating pair can simultaneously transfer gametes to each other (bilateral mating), this is dependent on the size difference between the partners. Snails of similar size will reproduce in this way. Two snails of differing sizes will mate unilaterally (one way), with the larger individual acting as a female. This is due to the comparative resource investment associated with the different genders. Courtship can last up to half an hour and the actual transfer of gametes can last for two hours. Transferred sperm can be stored within the body for up to two years. Snails start laying eggs 2 to 3 weeks after mating, the eggs hatch only at temperatures above 15 ^{0}C. The number of eggs per clutch averages around 200. A snail may lay five to six clutches per year with a hatching viability of about 90 per cent. Adult size is reached in about six months, after which growth slows, but does not cease until death. Life expectancy is commonly five or six years in captivity, but the snails can live for up to ten years. They are active at night and spend the day buried underground. The giant African snail is capable of aestivating for up to three years in times of extreme drought, sealing itself into its shell by secretion of a calcareous compound that dries on contact with the air.

Ecology of *A. fulica*

1. Habitat: It is a highly invasive species, and its habitat includes most regions of the humid tropics, including many Pacific islands, southern and eastern Asia, and the Caribbean. The snail can now be found in agricultural areas, coastland, natural forest, planted forests, scrub and shrub lands, urban areas, and wetlands and it is nocturnal in nature.

2. Feeding: It is nocturnal in nature, polyphytophagous in nature, which feeds on more than 500 species of plants which includes all crops including vegetables, fruits, leaves, ornamental plants, flowers and also on grasses. It will sometimes eat sand, very small stones, bones from carcasses and even concrete as calcium sources for its shell. In captivity, this species can be fed on grain products such as bread, digestive biscuits and chicken feed which can be supplemented with calcium for shell development. It requires about 18.28 per cent of protein in its diet for optimal growth.

Giant African Snail as a Pest on Mulberry

1. In 1996-97, it was observed during a field visit to different mulberry gardens (M-5) in Koratagere and Madhugiri taluks in Tumkur district of Karnataka, that the snail infestation was very severe during rainy season. The characteristic symptom of the infestation was that the snails were feeding on bark of the stem which bring down the nutritive value as the vasculature is injured and hastens yellowing (chlorosis), senescence of mulberry leaves leading to defoliation. According to sericulturists of the area, severe cocoon loss was not only due to infestation by snails, but also due to the stinking smell of mucus layer on the mulberry leaves (Shree et. al., 2006).

2. The mulberry gardens in Bangalore Rural, Ramanagara, Mandya and Tumkur are being attacked by the pest. In mulberry, they feed on tender leaves, stem and bark portion and cause damage. The infested leaves have circular holes in the centre and the plant showed stunted growth, resulting in loss of leaf quality (Narendra Kumar et. al., 2011).

3. The mulberry gardens of K. P. Doddi Silk Farm in Ramanagara were severely infested by the pest causing considerable damage to plants in general and chawki gardens. Primarily eat up the bark of mulberry plants thus damaging the vasculature besides weakening of stems exposing the shoots to other infections. The severely damaged shoots became fragile and collapsed and leaves lose their nutritive value and finally get defoliated (Ramanjaneyulu et. al., 2011).

4. In parts of Tamil Nadu, especially Hosur and Tirupattur sericulture belt, snails found to infest mulberry garden and the damage was severe. They eat the mulberry leaves voraciously and even the bark which weakens the stem. The shoots become fragile yellowish and collapse (Gopinath et. al., 2013).

5. A survey was undertaken in Yalgud and surrounding villages of Kagal taluk from Kolhapur districts during July 2012 to August 2014 on every 10 days. Farmers were interviewed to obtain feedback on the snail problem. Based on the data collected from the farmers and actual visits it was observed that, the snail population was spreading from field to field throughout the village (Jadhav et. al, 2016).

Reasons for Spread of Giant African Snail

1. High reproductive capacity.
2. Voracious feeding habit.
3. Inadequate quarantine arrangements and human aided dispersal.

Management of Giant African Snail

Management strategies include cultural, physical, chemical and biological approaches, they are as follows.

1. Cultural methods:

a. Field sanitation and regular inspection in and around the farm to check the infestation.

b. Periodic cleaning of the sewage/ drain canal and river banks adjacent to mulberry farms.

c. Deep ploughing helps in exposing snails and their egg masses present in the soil to their natural enemies.

d. Locate hiding places and destroy hiding snails.

2. Physical methods:

a. Different stages of snails i.e., adults, immature ones and egg masses can be physically collected, crushed and killed by immersing in soap solution. The same can be poured into compost pit which is the most effective as compared to all other methods.

b. Snails do not move on dry areas. Therefore, areas surrounding their hiding places may be kept dry by spreading the materials like lime, ash, salt or saw dust. These materials restrict their movement. When lime/salt comes in contact with muscular part of the snails, they die due to dehydration As such; minimum quantity should be used so as to see that soil does not become saline or alkaline. Also, ash may be sprinkled around the base of mulberry plants to avoid snails reaching mulberry plants.

c. During rainy season, moist gunny sacks or dry leaves can be heaped in the garden at one place. Next day morning, collect the snails hiding below these and kill by immersing in 25 per cent salt solution (mix 1 kg of salt in 4 liters of water).

d. Inside the plot, dig trenches at few places. Mix sugar, yeast, water and place this material in the trenches after rotting as attractant bait.

3. Chemical methods:

a. Common crystal salt can be spread in the paths of snails and also in the infested area.

b. Spray of 1 per cent copper sulphate solution on soil and sprinkling of coffee powder deter the pest.

c. 2.5 per cent of metaldehyde, commercially known as “Snail Kill”, is the most effective molluscicide. Pellets of metaldehyde may be spread over the field or near their hiding places which is a specific attractant toxicant. It is toxic by ingestion and absorption by the foot of the snails. It causes increase in the secretion of slime resulting in immobilization and ultimate death by desiccation.

d. Bordeaux mixture (5 kg copper sulphate and 5 kg lime mixed in 100 litre of water) can be sprayed on the soil bordering the garden so that snails which come in contact with the same die due to desiccation.

Naturally Occurring Chemicals

1. An extract of the fruit of *Thevetia peruviana* has molluscide activity against *A. fulica.*
2. A natural softwood cutting fences made of alligator apple *(Annona glabra)* act as snail repellent.

Biological methods:

a. A solution of bacterial pathogen that causes leucoderma-like disease extracted from dead snails sprayed on healthy snails provided significant control

b. The predatory turbellarian flatworm, *Platydemus manokwari*, introduced in infested gardens effectively reduced the snail population

c. The bandicoot rat, *Bandicota indica* was observed to be an effective predator especially for its nocturnal habit and the ability to locate both active and aestivating snails

d. Duck rearing in mulberry garden can control snails (Jayashankar et. al., 2013).

Conclusion

An integrated approach which includes innovative control methodologies and collaborative models will help to increase the capacity to solve new invasive species problem. However, early detection, rapid assessment and response would increase the likelihood of controlling the pest in the introduced area. And also, creation of awareness among the farmers about newly emerging pests is very important to increase the mulberry production which ultimately adds to increased raw silk production of the country.

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Post-Harvest Decays of Fruits and Vegetables

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Some of the most common Ascomycetes or mitosporic fungi that because postharvest diseases are listed here.

Aspergillus, Penicillium, Rhizopus and *Mucor*

All four of them are found commonly to cause moulding of bread, whereas Penicillium and Rhizopus also cause postharvest rots of numerous kinds of wounded or senescent fruits and vegetables. Aspergillus is found more commonly causing moulding of grains and legumes; Rhizopus causes many fruit rots, as in peach and strawberry, whereas Penicillium causes the rotting of many wounded fruits, e.g., pears.

Alternaria

The various species of Alternaria cause decay on most, if not all, fresh fruits and vegetables either before or after harvest. Symptoms appear as brown or black, flat or sunken spots with definite margins or as diffuse, large, decayed areas that are shallow or extend deep into the flesh of the fruit or vegetable. The fungus develops well at a wide range of temperatures, even in the refrigerator, although at a slower rate. The fungus may spread into and rot tissues internally with little or no mycelium appearing on the surface, but usually a mat of mycelium that is white at first but later turns brown to black forms on the surface of the rotted area.

Botrytis

Botrytis causes the grey moulds or grey mould rots of fruits and vegetables, both in the field and in storage. Almost all fresh fruits, vegetables, and bulbs are attacked by Botrytis in storage. Some products, such as strawberry, lettuce, onion, grape, and apple, are also attacked in the field near maturity or while green. The decay may start at the blossom or stem end of the fruit or at any wound. The decay appears as a well-defined water soaked, then brownish, area that penetrates deeply and advances rapidly into the tissue. In most hosts and under humid conditions a greyish or brownish-grey, granular, mould layer develops on the surface of decaying areas. Gray moulds are most severe in cool, humid environments and continue to develop, although slowly, even at 0°C.

Fusarium

Fusarium causes postharvest pink or yellow moulds on vegetables and ornamentals and especially on root crops, tubers, and bulbs. Low-lying crops such as cucurbits and tomatoes are also affected frequently. Contamination with *Fusarium* usually takes place in the field before or during harvest, but infection may develop in the field or in storage. Losses are particularly heavy with crops such as potatoes that are stored for long periods of time. Affected tissues appear fairly moist and light brown at first, but later they become darker brown and somewhat dry. As the decaying areas enlarge, they often become sunken, the skin is wrinkled, and small tufts of whitish, pink, or yellow mould appear. The infection of softer tissues such as tomatoes and cucurbits develop faster and is characterized by pink mycelium and pink, rotten tissues.

Geotrichum

Geotrichum causes the sour rots of citrus fruits, tomatoes, carrots, and other fruits and vegetables. Sour rot is one of the messiest and most unpleasant rots of susceptible fruits and vegetables. Although it may affect them at the mature green stage, it is the ripe or overripe fruits and vegetables and those kept in moisture holding plastic bags or packages that are particularly susceptible to sour rot. The fungus occurs in soils and decaying fruits and vegetables and contaminates new ones before or during harvest. The fungus penetrates fruits, usually after harvest, at wounds of various sorts. Infected areas appear water soaked and soft and are punctured easily. The decay spreads rapidly. Later, the skin frequently cracks over the affected area and is usually filled with a white, cheesy, or scum-like development of the fungus. Also, a thin, water-soaked layer of compact, cream-colored fungal growth develops on the surface, while the whole inside becomes a sour-smelling, decayed, watery mass. Fruit flies, which are attracted to tissues affected with sour rot, spread the pathogen further. The fungus prefers high temperatures (24–30°C) and humidity but is active at temperatures as low as 2°C.

Penicillium

The various species of *Penicillium* cause the blue mould rots and the green mould rots, also known as Penicillium rots. They are the most common and usually the most destructive of all postharvest diseases, affecting most kinds of fruits and vegetables. On some fruits, such as citrus, some infections may take place in the field, but blue moulds or green moulds are essentially postharvest diseases and often account for up to 90% of decay in transit, in storage, and in the market. Penicillium enters tissues through wounds. However, it can spread from infected fruit in contact with healthy ones through the uninjured skin. Penicillium rots at first appear as soft, watery, slightly discoloured spots of varying size and on any part of the fruit. The spots are rather shallow at first but quickly become deeper. At room temperature most or all of the fruit decays in just a few days. Soon a white mould begins to grow on the surface of the fruit, near the centre of the spot, and starts producing spores. The sporulating area has a blue, bluish-green, or olive-green colour and is usually surrounded by white mycelium and a band of water-soaked tissue. The fungus develops on spots of any size as long as the air is moist and warm. In cool, dry air, surface mould is rare, even when the fruits are totally decayed. Decaying fruit has a musty odour. Under dry conditions it may shrink and become mummified. Under moist conditions, secondary fungi and yeasts also enter the fruit, which is then reduced to a wet, soft mass.

Sclerotinia

Sclerotinia causes the cottony rot of citrus fruits, especially lemons, and the watery soft rot of many fruits and practically all vegetables except onions and potatoes. In a moist atmosphere, a soft, watery decay is produced, and the affected tissues are covered rapidly with a white, cottony growth of mycelium that is characteristic of this decay. In moist air, succulent decaying products may be completely liquefied, leak, and leave a pool of juice. In dry air the water may evaporate as fast as it is liberated by the decay, and the tissues dry down into a mummy or parchment-like remains. Cottony rot is a rapidly spreading, contact decay that attacks both green and mature fruits and vegetables. Black sclerotia, 2 to 15 millimetres long, later develop in the fungus mat. The activity of the fungus and the severity of the rot increase with temperature up to 25°C, but once started, rotting of tissues continues at temperatures as low as 0°C.

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Economic Survey 2020-Macro Economic Indicators

Article ID: 31587

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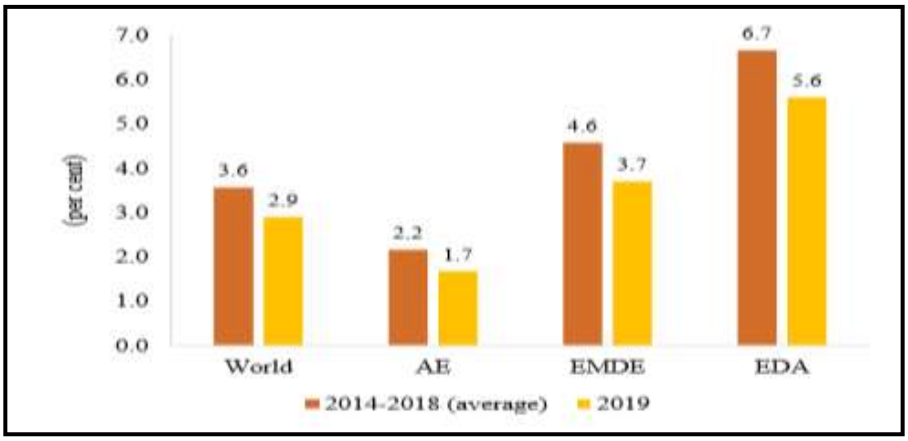
Introduction

The economic survey talks about the overall economic progress made in the previous fiscal year and the challenges faced to achieve the targeted GDP growth. The survey 2020 focuses on the theme of integrating old with new through trust in the economy, promoting pro-business policies and creating wealth and job opportunities. Macroeconomic indicators are statistics that reflect the economic circumstances of a particular country, region or sector. They are used to make financial decisions. They show past and future trends in an economy.

Global Economy in 2019-20

The World Economic Outlook (WEO) Update of January 2020 published by IMF has estimated the global output to grow at 2.9 per cent in 2019, declining from 3.6 per cent in 2018 and 3.8 per cent in 2017. The global output growth in 2019 is estimated to be the slowest since the global financial crisis of 2009, arising from a geographically broad-based decline in manufacturing activity and trade. The growth of advanced economies has similarly declined from 2.5 per cent in 2017 to 2.2 per cent in 2018 and is estimated to further decline to 1.7 per cent in 2019. The larger group of OECD countries has also seen a drop in their growth from 2.6 per cent in 2017 to 2.3 per cent in 2018 and is estimated to grow at 1.7 per cent in 2019. WEO has projected the declining growth of global output to rebound in 2020 with a modest uptick to 3.3 per cent.

Growth of Global Output



Indian Economy in 2019-20

The WEO of October 2019 has estimated India's economy to become the fifth largest in the world, as measured using GDP at current US$ prices, moving past United Kingdom and France. The size of the economy is estimated at US$ 2.9 trillion in 2019. In July 2019, the Union Budget 201920 had articulated the vision of the Hon'ble Prime Minister to make India a US$ 5 trillion economy by 2024-25. The march towards this milestone has, however, been challenged by less than expected growth of India's GDP so far this year, on the back of a decline in world output. Yet, given India's record of growth with macroeconomic stability over the last five years (annual average growth rate of 7.5 per cent and annual average inflation of 4.5 per cent), the economy is poised for a rebound towards the US$ 5 trillion goal.

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Quarter Wise Growth of Real Gross Value Added (GVA) and GDP (Per Cent)

	2018-19				2019-20	
	Q1	Q2	Q3	Q4	Q1	Q2
GVA at basic prices	7.7	6.9	6.3	5.7	4.9	4.3
Agriculture, forestry & fishing	5.1	4.9	2.8	-0.1	2.0	2.1
Industry	9.8	6.7	7.0	4.2	2.7	0.5
Services	7.1	7.3	7.2	8.4	6.9	6.8
GDP at market prices	8.0	7.0	6.6	5.8	5.0	4.5

On the demand side, the deceleration in GDP growth was caused by a decline in the growth of real fixed investment in H1 of 2019-20 when compared to 2018-19 induced in part by a sluggish growth of real consumption. Growth of real consumption started picking up in Q2 of 2019-20, mostly driven by a significant jump in government final consumption. Growth of private final consumption expenditure also picked up in the same quarter. The contribution of net exports to GDP in Q2 of 2019-20 became less negative as in real terms the contraction of exports was much smaller than contraction of imports. Lower growth of GDP and softer price of crude oil caused a large contraction in imports.

Real Growth of GDP (Per Cent)

	2017-18	2018-19 (PE)	2019-20	
			Q1	Q2
Gross Domestic Product	7.2	6.8	5.0	4.5
Total consumption	8.6	8.3	4.1	6.9
Govt consumption	15.0	9.2	8.8	15.6
Private consumption	7.4	8.1	3.1	5.1
Fixed investment	9.3	10.0	4.0	1.0
Exports of goods and services	4.7	12.5	5.7	-0.4
Imports of goods and services	17.6	15.4	4.2	-6.9

Inflation

The core-CPI and WPI inflation together moderated inflation, as captured by the GDP deflator, which fell from 3.7 per cent in H2 of 2018-19 to 2.1 per cent in H1 of 2019-20. This significantly lowered the nominal growth of GDP as well.

Employment: Formal Vs. Informal

As several policies have been implemented to enhance the formalization of the economy, examining the impact of the same is crucial. Due to the changes in methodology and sampling design, labour market estimates based on Periodic Labour Force Survey (PLFS) are not strictly comparable with the results of earlier quinquennial surveys Employment-Unemployment conducted by National Sample Survey Organization (NSSO). Yet a limited comparability has been attempted to highlight the shift towards increased employability in formal sector jobs. As per the latest available data on employment, there has been an increase in the share of formal employment, as captured by 'Regular wage/salaried', from 17.9 per cent in 2011-12 to 22.8 per cent in 2017-18. This 5 percentage points increase in the share of 'Regular wage/salaried' group has been on account of 5 percentage points decrease in the share of casual workers, which reflects formalization in the economy. As a result, in absolute terms, there was a significant jump of around 2.62 crore new jobs over this period in the usual status category with 1.21 crore in rural areas and 1.39 crore in urban areas. Remarkably, the proportion of women workers in 'Regular wage/salaried' employees' category has increased by 8 percentage points (from 13 percent in 201112 to 21 per cent in 2017-18) with addition of 0.7 crore new jobs for female workers in this category. The drop in casual labour has mainly originated from the rural sector where rural labourers have shifted from agricultural to industrial and services activity. In urban region, there has been a shift of employment from self-employed to salaried jobs. The provisional Annual Survey of Industries for fiscal year ending March 2018 also showed an increase in jobs in the organized manufacturing sector. Between 2014-15 and 2017-18, total number of workers increased by 14.7 lakhs and total persons engaged increased by 17.3 lakhs, in the organised manufacturing sector in India.

Sectoral Developments

1. Share of agriculture and allied sectors in the total GVA of the country has declined from 2009-14 to 2014-19 mainly on account of relatively higher growth performance of tertiary sectors. This is a natural outcome of the development process that leads to faster growth of non-agricultural sectors.

2. The contribution of industrial activities to GVA has also declined from 2009-14 to 2014-19. Manufacturing sector, which contributes more than 50 per cent of industrial GVA, has driven the decline while the share of construction sector has also moderated.

3. Services sector has moved ahead faster, distancing itself further from agriculture and industry. Financial, real estate and professional services has driven the increase in the contribution of service sector followed by public administration.

Conclusion

Given a 4.8 per cent real GDP growth in H1 of 2019-20, the first Advance Estimates imply that growth in H2 of 2019-20 will witness an uptick over H1 of 2019-20. Based on CSO's first Advance Estimates of India's GDP growth for 2019-20 at 5 per cent, an uptick in GDP growth is expected in H2 of 2019-20. The government must use its strong mandate to deliver expeditiously on reforms, which will enable the economy to strongly rebound in 2020-21.

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Fodder Maize - Cowpea System for Livestock Nutritional Security

Article ID: 31588

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India has the largest livestock population, which accounts for 18 per cent of the world's livestock population. However, livestock productivity is constrained by an acute shortage of feed and fodder. A common consensus is that by the year 2050 there will be a shortfall of 13.2 per cent dry fodder and 18.4 per cent green fodder against the requirement of 631 and 1012 million tonnes for dry and green fodder, respectively (Anno. 2015). The two obvious approaches to bridge this wide gap between fodder requirement and availability are either to increase area under fodder production or to increase the productivity of existing production systems. Increase in area under fodder production does not appear feasible because of ever increasing demand of food and farmers prefer to grow grain and cash crops even on grasslands and pastures. The second approach imperatively becomes a necessity in this scenario. Intercropping and mixed cropping has been recognized as a beneficial system of crop production as well as one of the potent means of better utilization of resources and higher fodder production per unit area per unit time. Incorporation of legume component in cereal fodder helps to improve the tonnage as well as quality of fodder to meet requirement of both carbohydrates and protein in the balanced animal diet.

Green fodder availability is very important for livestock health and productivity. This is especially true in case of dairy enterprises where consistent supply of green fodder is imperative to sustained milk production. In addition to energy, green fodder provides vitamins and minerals and helps in digestion (Surve et al., 2012). A balanced diet should contain suitable proportions of carbohydrates, minerals and proteins. Low protein content of non-legume fodder can be supplemented using protein supplements but they are expensive. Legumes can be used in livestock nutrition for their higher protein content and thus cost saving. Since, legumes have low dry matter, green forage yield, quality fodder can be obtained from intercropping of cereals and legumes compared with their sole crops. Fodder supply can be improved by increasing the fodder production per unit area per unit time (Somashekar et al., 2014).

Maize (*Zea mays* L.) is a succulent forage crop, which has the potential to supply large amounts of energy-rich forage for animals and its fodder can safely be fed at all stages of growth without any danger of prussic acid as in the case of sorghum. In recent years, forage maize has thus become a major constituent of ruminant rations in recent years, where its inclusion in dairy cow diets enhances the forage intake, increases animal performance and reduces production costs. Although maize provides high yield in terms of dry matter, it produces forage with low protein content. However, protein is needed by livestock for growth and milk production. Protein is also needed by rumen bacteria which digest much of the feed for ruminant animals. It is necessary to provide livestock with protein supplements when forage quality is low. Purchase of protein supplements is expensive leading to high feed costs.

Cowpea (*Vigna unguiculata* L.), an annual legume with high level of protein (about two times than maize) may be mixed with maize to improve forage protein content. According to USDA food database, cowpea has the highest per cent of calories from protein among vegetarian foods. As a forage crop, it is tolerant to drought and shade, quick growing, high yielding, with substantially rich biomass production, grows well with associated crops. For fodder production, it is mainly grown as mixed or intercrop with cereals.

Effect of Intercropping on Fodder Yield

To get better yield of quality fodder, forage maize should be intercropped with forage legumes, preferably cowpea alternate rows (Iqbal et al., 2012). Intercropping of maize and cowpea in 2:1 row ratio recorded significantly higher total (maize + cowpea) green forage (422.92 q ha^{-1}) and dry matter yield (98.92 q ha^{-1}) (Deore et al., 2013).

Effect of Intercropping on Fodder Quality

Hamdollah (2012) reported that the intercropping systems had a significant effect on the dry matter yield and maize-legumes intercrops could substantially increase forage quantity and quality and decrease requirements for protein supplements as compared to maize monocultures.

Cowpea as an intercrop helped to enhance crude protein content and total crude protein yield of intercropping system. The maximum crude protein content of maize (5.44 %) was achieved with the row ratio of 2:1 and this treatment also recorded higher total crude protein yield (7.73 q ha-1) (Deore et al., 2013).

Effect of Intercropping on Economics

Intercropping of fodder maize with cowpea in 2:1 ratio recorded higher B: C ratio (2.41) compared to sole crops (Bhagat et al., 2017).Higher B: C ratio (1.83) was recorded under the treatment intercropping of fodder maize and cowpea in 1:1 ratrio compared to sole maize and sole cowpea (Mishra, 2019). The inclusion of fodder legumes in cereal-based cropping system is a sustainable way of boosting quality fodder production. Thus, fodder maize –cowpea system could be a promising one for the livestock nutritional security.

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Varietal Identification Methods for Seed Quality Control

Article ID: 31589

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Summary of Article

Varietal identification therefore attained critical importance to maintain genetic purity of seeds. Genetic purity is simply defined as true to type plants or seeds conforming the characteristics of variety as described by breeder. Genetic purity is determined on the basis of observation made on plant morphological Characters with reference to authentic sample. Extracting various morphological, tonal, textural, and colour features for classification of grains by variety, grades, and damage has been the focus of the reported research. Let's check the detail information about it.

Introduction

According to some estimates, the private hybrid seeds industry in the country is today worth well over Rs 14,000 crore, with cotton hybrids alone accounting for close to 30 per cent of that figure (Singh, 2019). Intense crop improvement programme developed large number of hybrids & varieties. Varietal identification therefore attained critical importance to maintain genetic purity of seeds.

Genetic purity is simply defined as true to type plants or seeds conforming the characteristics of variety as described by breeder. Genetic purity or geniuses of the cultivar is a tested by means of heritable character (morphological, physiological, chemical) of seed, seedling, and plant. There are so many factors affecting genetic purity for example natural crossing, mechanical admixture, random drift, mutation and selective influence of pest and diseases.

Effect of Intercropping on Economics

Intercropping of fodder maize with cowpea in 2:1 ratio recorded higher B: C ratio (2.41) compared to sole crops (Bhagat et al., 2017).Higher B: C ratio (1.83) was recorded under the treatment intercropping of fodder maize and cowpea in 1:1 ratrio compared to sole maize and sole cowpea (Mishra, 2019). The inclusion of fodder legumes in cereal-based cropping system is a sustainable way of boosting quality fodder production. Thus, fodder maize –cowpea system could be a promising one for the livestock nutritional security.

Table 1. Minimum standards for Genetic purity of different classes of seed:

Sr. No.	Class of Seeds	Purity %
1	Breeder seeds	100%
2	Foundation seeds	99%
3	Certified seeds	98%
4	Hybrids	95%

Need for Genetic Purity Testing

1. To increase crop production at national level.
2. To increase farmer's income and standard of living.
3. To make IPR (plant breeders right and plant variety protection) part strong.
4. For Novelty, distinctiveness, uniformity and stability (NDUS) test.
5. Quality control of grains for processing.
6. Documentation of genetic resources.

What is NDUS?

1. N: Novelty - The variety should not have been commercially exploited for >1 year.
2. D: Distinctness - The variety should be clearly unique.
3. U: Uniformity - The variety should be sufficiently uniform.
4. S: Stability - The variety should be stable in its relevant characteristics.

Main Approaches for Genetic or Varietal Purity Testing

1. Morphological / conventional grow out test.
2. The use of computerized system to capture and process morphological information (Machine vision).
3. The use Biochemical method to analyzes various component of seeds (chemotaxonomy).
4. Biochemical markers (proteins and isozymes).
5. Molecular markers.

Morphological Test (In Field or Green House Condition)

Grow out Test (GOT test): The seed sample sown in the controlled condition with the authentic sample. Genetic purity is determined on the basis of observation made on plant morphological Characters with reference to authentic sample. Genetic purity is always expressed in percentage. The size of the submitted sample will be varying as per crop plant for GOT.

1000 gm	-	For maize, cotton, groundnut, soybean and species of other genera with seed of similar size.
500 gm	-	For sorghum, wheat, paddy, species of other genera with seeds of similar size.
250 gm	-	Beta sp. and species of other genera with seed of similar size.
100 gm	-	For bajra, jute, and species of all other genera.
250 tubers/plantings	-	Seed potato, sweet potato and other vegetatively propagating crops.

Steps of GOT test:

1. Raising of desired population by following recommended cultural practices e.g. field preparation, size of the plot, etc.
2. Provide equal opportunity to each and every plant for full expression of genetically controlled characters.
3. Show the various samples of the same variety /cultivar in succession and standard sample at suitable intervals.
4. Adjust of seed rate depending on germination % of individual sample and Subsequent thinning is not recommended.
5. This test is preferably conducted in area to which the variety is recommended.
6. A minimum of 200 plant from control sample should be raised along with test crop.
7. The analyst employed for conducting grow out test should possess the qualification as Identified under seed Rules, 1968.
8. Examination features of seeds such as a length, width, thickness, shape, weight, colour, seed coat colour etc. and comparing them with those of authentic sample. Which are examined with naked eye / with magnified hand lens / with the help of scanning electron microscope.

Limitations of Morphological Methods

1. Environmental stress conditions often mask specific morphological traits
2. Large amount of land required
3. Laborious
4. Time consuming
5. Unfavourable condition, i.e. disease and insect infestation may limit GOT in field

6. Morphological markers are becoming limited in relation to rapid increase in number of varieties, hybrids and transgenic.

Machine Vision

Machine vision is becoming the successful application in agricultural product inspection. Extracting various morphological, tonal, textural, and colour features for classification of grains by variety, grades, and damage has been the focus of the reported research. Initially most of the work was done on wheat and corn but now a day focus is shifted to all the other significant crops. Machine vision systems for grain identification have been used under the precise conditions of a laboratory. In most of the above-mentioned applications, well-separated seeds were physically placed on a plate or tray for gathering images. Some researchers have created automatic seed positioning system for putting individual grain kernels under a camera for imaging. Combining such a seed presentation device with the machine vision system, however, will make the overall system more expensive and less portable (OuYang et al. 2010).

Chemical Test

Use of different reacting chemicals for testing purity in seed sample. Methods of testing are based on use of chemical.

Table 2. Varietal identification by chemical test:

Sr. No.	Test	Crop	Characters
1.	KOH	Sorghum	Seed darken or remain light
2.	NAOH	Rice and Sunflower	Yellow or light-yellow seeds
3.	Ferrous sulphate colour test	Sunflower	Yellow, Grey, light grey and black
4.	Potassium dichromate test	-	-
5.	HCL	Cucumber and melon	Melon seeds exhibit strong orange and yellow colour
6.	DDT	-	-
7.	Phenol test	Wheat, rice, pearl millet, sorghum, foxtail millet	Light brown to deep black
8.	Modified Phenol test	Wheat, rice, pearl millet, sorghum, foxtail millet, groundnut.	Light brown to deep black
9.	Peroxide test	Soybean	Colourless to radish brown
10.	GA3 soaking test	Cotton	Response to shoot & root elongation as high & low
11.	Alkaloid test (Lugol's solution)	Lupinus species	Distinct brown-red precipitate
12.	Iodine test	Millet grain seeds from weed seeds	Millet seeds remain same or changed into a light pink colour

Advantages and Limitations of Chemical Tests

1. They are quick.
2. They require virtually no technical expertise or training.
3. Relatively inexpensive to conduct.
4. No sophisticated equipment's are required.
5. The test permits detection of percentage admixture of other type.
6. Its results are usually distinct and easily interpretable.

7. They are not as much accurate as grow out test.

Biochemical Markers

1. Electrophoresis:
    a. Polyacrylamide gel electrophoresis (PAGE).
    b. SDS-PAGE.
    c. Isoelectric focusing (IEF).
    d. Ultra-thin layer isoelectric focusing (UTLIEF).
2. Peroxidase test.
3. Phenol reaction.
4. Serological.
5. Chromatography.
    a. GLC.
    b. HPLC.
    c. RP-HPL.

Advantages and Limitations of Biochemical Methods

1. They are not affected by the field or green house environment.
2. They are cost effective compared to other methods and the turnaround time is relatively rapid.
3. Multi-locus analysis provide useful information for verifying inbred and hybrid genotypes.
4. An array of enzymatic analysis can be made using small quantities of leaf and seed material.
5. There are limited number of marker isozymes as compared to molecular markers.

Molecular Markers

Markers linked to specific characters of the particular variety (variety specific marker) are identified and use as a milestone for that variety. Most prominent molecular markers generally use for varietal identification are:

1. RAPD (Random Amplification of Polymorphic DNA).
2. SCAR (Sequence Characterized Amplified Region).
3. SSR (Simple Sequence Repeats).
4. STS (Sequence Tagged Site).

General Methodology for Molecular Markers

1. DNA extraction.
2. PCR amplification using nucleotide primer:
    a. Initial Denaturation.
    b. Repeated Cycles.
    c. Denaturation.
    d. Annealing.
    e. Extension.
    f. Final Extension.
3. Electrophoretic run and identification of PCR amplified product.

Conclusion

1. Combination of different methods make variety identification economical and accurate.
2. Chemical test creates very less polymorphism and are crop specific.
3. Hybrid purity testing is possible before the harvesting of crop.
4. Application of isozymes is limited due to their less number and crop specific nature.
5. Molecular markers are most effective for variety identification and hybrid purity testing.

Future Thrust

1. Development and standardisation of existing technology to make it an integral part in seed testing and IPR.
2. Development of low-cost purity testing method.
3. Identification of maximum number of microsatellite loci in plants, which will help in developing maximum number of polymorphisms.
4. Use of genotyping by sequencing for variety identification.

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Serial Analysis in Gene Expression

Article ID: 31590

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Summary of Article

Serial analysis of gene expression (SAGE) is a high-throughput, high-efficiency method to simultaneously detect and measure the expression levels of genes expressed in a cell at a given time, including rare genes. SAGE provides quantitative and comprehensive expression profiling in a given cell population and an overview of a cell's complete gene activity. Let's check-in details.

Introduction

Serial analysis of gene expression (SAGE) is a high-throughput, high-efficiency method to simultaneously detect and measure the expression levels of genes expressed in a cell at a given time, including rare genes. It does not depend on the prior availability of transcript information. The SAGE technique can be used in a wide variety of applications including analysis of the effect of drugs on tissues, identification of disease related genes and elucidation of disease pathways. The SAGE technique produces 9–10 base sequences or 'tags' that identify one (or more) mRNAs. These unique sequence tags are concatenated serially into long DNA molecules for lump-sum sequencing. The frequency of each tag in the concatenated sequence reflects the cellular abundance of the corresponding transcripts.

Serial analysis of gene expression (SAGE) is an approach that allows rapid and detailed analysis of overall gene expression patterns. Gene expression is a process by which information from a gene is used in the synthesis of a functional gene product. These products are often proteins or functional RNA. SAGE was invented at Johns Hopkins University in the USA (Oncology Centre) by Dr. Victor Velculescu in 1995. SAGE provides quantitative and comprehensive expression profiling in a given cell population and an overview of a cell's complete gene activity.

Principles Underlining SAGE

A short sequence tag (10-14bp) contains sufficient information to uniquely identify a transcript provided that tag is obtained from a unique position within each transcript. Sequence tags can be linked together to form long serial molecules that can be cloned and sequenced. Quantitation of the number of times a particular tag is observed provides the expression level of the corresponding transcript.

Steps

Isolation of mRNA of an input sample (e.g. a tumor).

↓

Extract a small part of the sequence from a defined position of each mRNA molecule.

↓

Link these small pieces of the sequence together to form a long chain (i.e. concatamer).

↓

Clone these chains into a vector that can be taken up by bacteria.

↓

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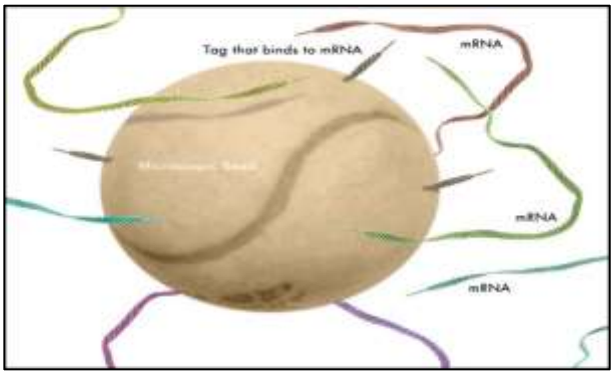
Sequence these chains using modern DNA sequencers.

↓

Process this data with a computer to count the small sequence tags.

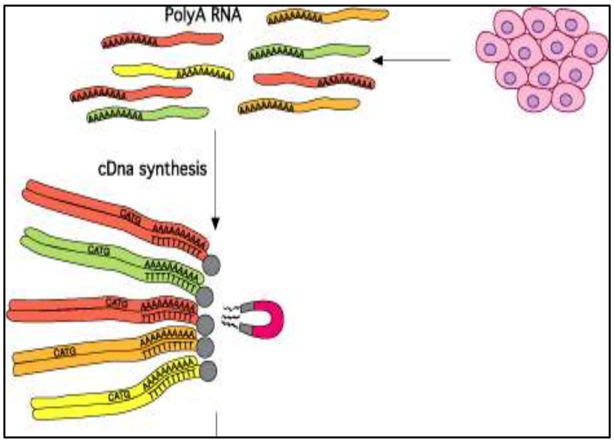
SAGE in Details

1. Trapping of RNA with beads: mRNA's end with a long string of "A" (Adenine) Molecules that consist of 20 or so dT's acts as an attractant to capture mRNAs. Coating of microscopic magnetic beads with "TTTTT" tails is done. A magnet is used to withdraw the bead and the mRNA is isolated.



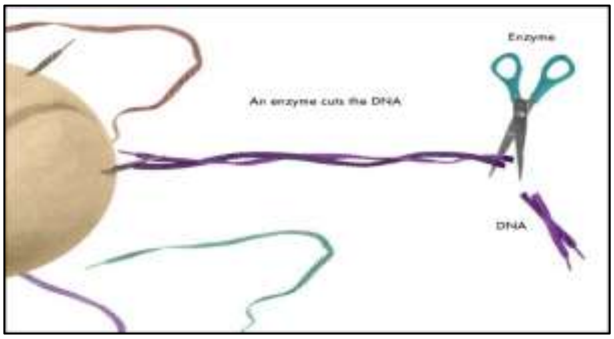
2. cDNA synthesis: ds cDNA is synthesized from the extracted mRNA using biotinylated oligo (dT) primer. cDNA synthesis is immobilized to streptavidin beads.

3. Enzymatic cleavage of cDNA: The cDNA molecule is cleaved with a restriction enzyme. Type II restriction enzyme used (E.g. NlaIII.). The average length of cDNA – 256bp with sticky ends was created.

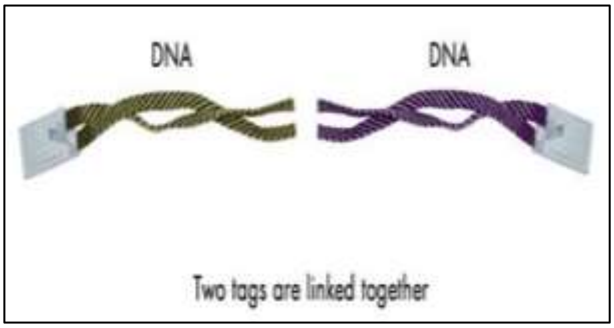


4. Enzymatic cleavage of cDNA: The cDNA molecule is cleaved with a restriction enzyme. Type II restriction enzyme used (E.g. NlaIII.). The average length of cDNA – 256bp with sticky ends was created.

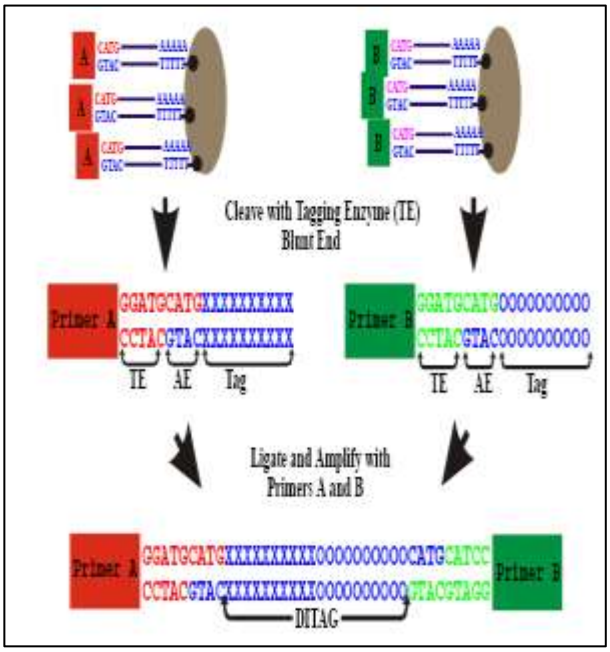
5. Ligation of Linkers to bound cDNA: Captured cDNA is then ligated to linkers at their ends. Linkers must contain NlaIII 4-nucleotide cohesive overhang, type IIs recognition sequence and PCR primer sequence.



6. Cleaving with tagging enzyme: Tagging enzyme, (usually BsmF1) cleave DNA, releasing the linker-adapted SAGE tag from each cDNA. Repair of ends to make blunt ended tags using DNA polymerase (Klenow fragments) and dNTPs.

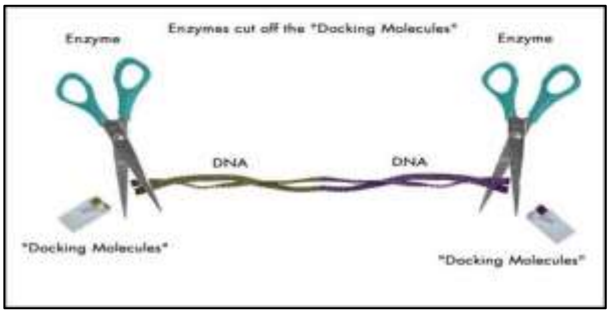


7. Formation of Ditags: The left thing is the collection of short tags taken from each molecule. Two groups of cDNAs are ligated to each other, to create a "ditag" with linkers on either end. Two tags are linked together using T4 DNA ligase.



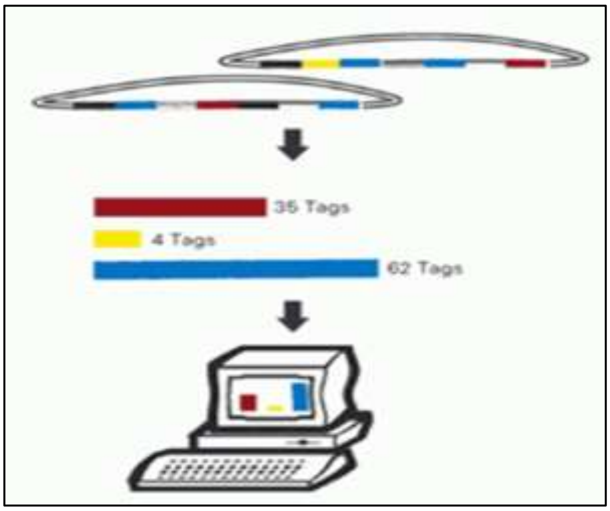
8. PCR amplification of Ditags: The linker-ditag-linker constructs are amplified by PCR using primers specific to the linkers.

9. Isolation of Ditags: The cDNA is again digested by the Anchoring enzyme (AE) • Breaking the linker off right where it was added in beginning. • This leaves a "sticky" end with the sequence GTAC (or CAGT on the other strand) at each end of the ditag.



10. Con-catamerization of Ditags: Tags are combined into much longer molecules, called concatemers. Each ditag is having an AE site, allowing the scientist and the computer to recognize where one ends and the next begins.

11. Cloning Con-catamers and Sequencing: Lots of copies are required so the concatemers are inserted into bacteria, which act like living "copy machines" to create millions of copies from the original. Copies are then sequenced, using machines that can read the nucleotides in DNA. The result is a long list of nucleotides that has to be analyzed by the computer.



The Analysis will do Several Things

It counts the tags, determines which ones come from the same RNA molecule, and figure out which ones come from known, well studied genes and which ones are new. A vast amount of data is produced, which must be shifted and ordered for useful information to become apparent. SAGE reference databases:
1. SAGE map.
2. SAGE Genie.

From Tags to Genes

Collect sequence records from GenBank. Assign sequence orientation (by finding poly-A tail), Assign UniGene identifier to each sequence with a SAGE tag. Record (for each tag-gene pair).

Applications of SAGE

1. To analyse differences between gene expression patterns of cancer cells and their normal counterparts.
2. Studied the tumours of pancreatic and colon tumours.
3. Examining which transcripts are presenting a cell.
4. Allows rapid, detailed analysis of thousands of transcripts in a cell.
5. By comparing different types of cells, generate profiles that will help to understand healthy cells and what goes wrong in diseases.
6. By comparing different types of cells, generate profiles that will help to understand healthy cells and what goes wrong in diseases.
7. To identify downstream targets of oncogenes and tumour suppresser genes.
8. Used colorectal cancer cell lines to discover p53 targets.

Advantages

mRNA sequence does not need to be known prior, so genes of variants which are not known can be discovered. It's more accurate as it involves direct counting of the number of transcripts.

Problems in SAGE

The length of the gene tag is extremely short (13 or 14bp), so if the tag is derived from an unknown gene, it is difficult to analyse with such a short sequence. Type II restriction enzyme does not yield the same length fragments. mRNA levels and protein expression do not always correlate. Does not measure the actual expression level of a gene. The average size of a tag produced during SAGE analysis is ten bases and this makes it difficult to assign a tag to a specific transcript with accuracy. Two different genes could have the same tag and the same gene that is alternatively spliced could have different tags at the 3' ends. Assigning each tag to an mRNA transcript could be made even more difficult and ambiguous if sequencing errors are also introduced in the process. Quantitation bias: Contamination of large quantities of linker-dimer molecules. low efficiency in blunt end ligation. Amplification bias: Depending upon anchoring enzyme and tagging enzyme used, some fraction of mRNA species would be lost.

How SAGE is Different from DNA Microarrays

The general goal of the technique is similar to the DNA microarray. However, SAGE sampling is based on sequencing mRNA output, not on the hybridization of mRNA output to probes, so transcription levels are measured more quantitatively than by microarray. Besides, the mRNA sequences do not need to be known a priori, so genes or gene variants that are not known can be discovered. Microarray experiments are much cheaper to perform, so large-scale studies do not typically use SAGE. Quantifying gene expression is more exact in SAGE because it involves directly counting the number of transcripts whereas spot intensities in microarrays fall in non-discrete gradients and are prone to background noise.

Features	SAGE	Microarray
Detects unknown transcripts	Yes	No
Quantification	Absolute measure	Relative measure
Sensitivity	High	Moderate
Specificity	Moderate	High
Reproducibility	Good for higher abundance transcripts	Good for data from intra-platform comparison
Direct cost	5-10X higher than arrays.	5-10 X lower than SAGE

LongSAGE and RL-SAGE

LongSAGE was a more robust version of the original SAGE developed in 2002 which had a higher throughput, using 20 µg of mRNA to generate a cDNA library of thousands of tags. Robust LongSage (RL-SAGE) Further improved on the LongSAGE protocol with the ability to generate a library with an insert size of 50 ng mRNA, much smaller than previous LongSAGE insert size of 2 µg mRNA and using a lower number of ditag polymerase chain reactions (PCR) to obtain a complete cDNA library.

Micro SAGE

Requires 500-5000-fold less starting input RNA. Simplifies by the incorporation of a ‘one tube’ procedure for all steps. Characterization of expression profiles in tissue biopsies, tumour metastases, or in cases where tissue is scarce. Generation of region-specific expression profiles of complex heterogeneous tissues. A limited number of additional PCR cycles are performed to generate sufficient ditag. little as 1-5 ng of mRNA.

	SAGE	MicroSAGE
Amount of input material	2.5-5 ug RNA	1-5 ng of mRNA
Capture of cDNA	Streptavidin coated magnetic beads	Streptavidin coated PCR tube
Multiple tube vs. Single tube reaction	Subsequent reactions in multiple tubes Multiple PCI extraction and ethanol precipitation steps	Single tube reaction Easy change of buffers No PCI extraction or ethanol ppt step. Fewer manipulations
PCR	25-28 cycles	28 cycles followed by re-PCR on excised ditag (8-15)

SuperSAGE

SuperSAGE is a derivative of SAGE that uses the type III-endonuclease EcoP15I of phage P1, to cut 26 bp long sequence tags from each transcript's cDNA, expanding the tag-size by at least 6 bp as compared to the predecessor techniques SAGE and LongSAGE. The longer tag-size allows for a more precise allocation of the tag to the corresponding transcript because each additional base increases the precision of the annotation considerably. Like in the original SAGE protocol, so-called ditags are formed, using blunt-ended tags. However, SuperSAGE avoids the bias observed during the less random LongSAGE 20 bp ditag-ligation. By direct sequencing with high-throughput sequencing techniques (next-generation sequencing, i.e. pyrosequencing), a hundred thousand or millions of tags can be analyzed simultaneously, producing very precise and quantitative gene expression profiles. Therefore, tag-based gene expression profiling also called "digital gene expression profiling" (DGE) can today provide the most accurate transcription profiles that overcome the limitations of microarrays.

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Bacillus thuringiensis (Bt): An Enormously Effective Microbial Bio-Pesticide

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Introduction

Bt is an acronym for Bacillus thuringiensis, a naturally occurring species of bacteria. *Bacillus thuringiensis* is a micro, rod-shaped, Gram-positive, crystalliferous, aerobic and facultative bacteria found worldwide in the soil, which is used to control the insect that comes in the harmful insect dominance Lepidoptera order. It can infect more than 150 species of pests. Bt is extensively used in agriculture, especially organic farming, as it acts as a bio-pesticide as an organic insecticide. *Bacillus thuringiensis* an endospore producing devastating organism. Bt thuringiensis forms crystals of proteinaceous insecticidal δ-endotoxins, called crystal proteins, which are encoded by cry genes. The cry toxins mainly play an important role in controlling insects. When the cry toxin protein enters the gut's cell membrane of the insect, it paralyzes and perforates the digestive system. The insect stops eating and starves to death. Bt is a fast-acting insecticide that causes infected insects to stop eating food, causing the pest to die within hours. The Bt is used primarily as a Bio-pesticide to control harmful insect pests, as it is a stomach poison or stomach bio-pesticide, which contains organic compounds.

Systematic position of "*Bacillus thuringiensis*"-	
Domain	Bacteria
Kingdom	Eubacteria
Phylum	Firmicutes
Class	Bacilli
Order	Bacillales
Family	Bacillaceae

Table-1. Systematic position of Bacillus thuringiensis

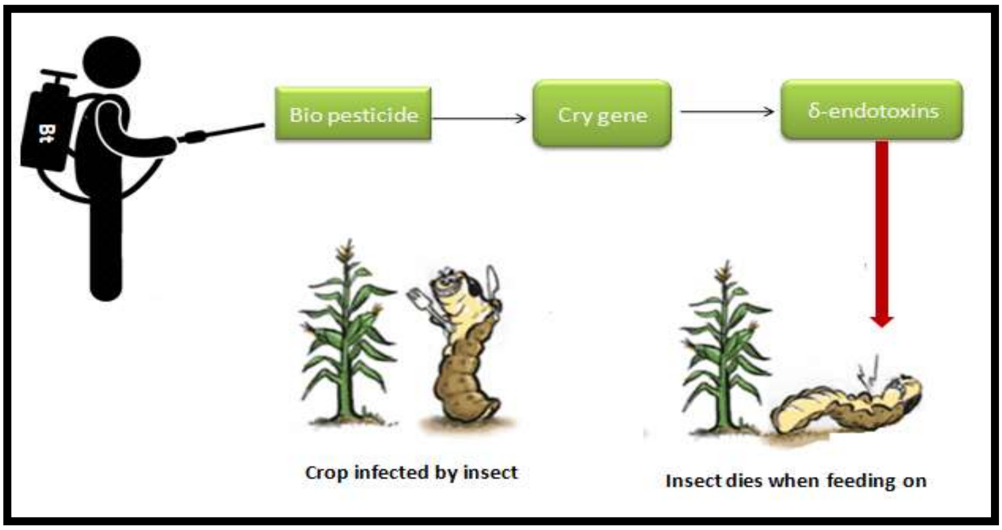
Pic-1.Bacullus thuringiensis Bacteria

Background

Bacillus thuringiensis was discovered by *S. Ishiwata* first isolated from diseased larvae of silkworm in 1902 and rediscovered *Bacillus thuringiensis* was isolated by Berliner in 1915 from diseased larvae of Mediterranean flour moth. *Bacillus thuringiensis* was registered as pesticide to the EPA (Environmental Protection Agency) in 1961.

Mechanism of Insecticidal Action

Bacillus thuringiensis forms crystals of proteinaceous insecticidal δ-endotoxins, called crystal proteins, which are encoded by cry genes. The cry toxins mainly play an important role in controlling insects under the Lepidoptera, Diptera, Coleoptera and Hymenoptera orders. When insects ingest toxin crystals, their alkaline digestive tracts denature the insoluble crystals, making them soluble, and when the cry toxin protein enters the gut's cell membrane of the insect, it paralyzes and perforates the digestive system. The insect stops eating and starves to death.



Pic-2. Show mode of action of *Bacillus thuringesnesis* biopesticide

Application

Bacillus Thuringiensis insecticide is mainly used to control pests, often sprayed in liquid form. In the United States the product was first used commercially as an insecticide spray in 1958, and several different strains of the bacterium are currently used to control for a number of agricultural insect pests and their larvae.

Bacillus Thuringiensis Effect and Symptoms on Insects

1. Stoppage of feeding.
2. Regurgitation.
3. diarrhoea.
4. Paralysis.

Different Strains of Bt are Available in Products Used in Insect Control

The strains of Bt characterized so far affect members of three insect orders:

1. Lepidoptera - butterflies and moths.
2. Diptera – flies.
3. Coleoptera – beetles.

Commercially available & Environmental Protection Agency-registered Bt products include:

1. Bt aizawai (Lepidoptera): frequently used for wax moth larvae.
2. Bt israelensis (Diptera): frequently used for mosquitoes.
3. Bt kurstaki (Lepidoptera): frequently used for gypsy moth, spruce budworm, and many vegetable pests.
4. Bt sandiego and tenebrionis (Coleoptera): frequently used for leaf beetle, Colorado potato beetle.

Bt kurstaki strain is the mostly used in Bt formulation, as it will kill different leaf-feeding larvae on vegetables, shrubs, and fruit trees. There is abundant scientific literature on this bio-pesticide organism.

Advantage of Bt *(Bacillus thuringiensis)* Bio-Pesticide

1. Bt is toxic to a narrow range of insects.
2. Bt does not harmful the natural enemies of insects.
3. Bt integrates well with other natural controls.
4. Bt is used by farmers for organically integrated pest management.
5. Bt prominently widely affects the target insect species.
6. Bt is nontoxic to humans and other mammals.

7. Bt is toxic to caterpillars, some fly larvae, and some beetle larvae but not toxic to other organisms.
8. Bt does not have a bad effect on environment and plants.

Conclusion

Bacillus thuringiensis is a gram positive a bacterium first discovered by Ishiwata is Japan in 1902. It is a facultative bacterium which is found throughout the world in the soil. It is found to be beneficial and controlling insects of Lepidoptera order, due to its insecticidal characteristics products from this bacterium are used in organic farming as a biopesticide. The insecticidal prosperities of this bacteria is due to cry gene which encodes crystal protein and when these protein came to contact with digestive systems of insect which is having alkaline ph, this ph activate the insecticidal properties of crystal proteins, which leads to stoppage of feeding, vomiting, and finally death of insect due to starvation. Not only the order Lepidoptera but other order such as- Diptera, and Coleoptera can also be control by different Bt products from different strains of Bacillus thuringiensis. Another strategy other than use of Bt products as biopesticide is using of the cry gene the transferring it to crop plant and making crops genetically modified.

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Entomopathogenic Fungi: A Boon for Insect Pest Management

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Keywords: Entomopathogenic, Insect cuticle, Infection, Haemocoel.

Introduction

Insects are the most diverse arthropods and destructive pest group to agricultural commodities. Management tactics for these insect pests can be tailored by various means, viz., cultural, mechanical, physical, biological and chemical. Biological control method involving the use of pathogens is called microbial control and the pesticides as microbial pesticides. Approximately 80% of the diseases caused in insects are attributable to fungi. The species of fungi capable of causing the diseases in insects are termed as Entomopathogenic fungi. The practice of using the fungal pathogens in insect pest management has been yielding good results in recent past.

Steps in the Development of the Fungal Infection

Entomopathogenic fungi display a sequence of steps in establishing pathogenic relationship with host insect. These can be grouped into three broad phases:

1. Adhesion of spores to the host cuticle and spore germination: The first step in the infection process is the adsorption of fungal spores to host The contact of fungal spores with the host body may be due to non-specific interaction between the proteins located in the conidia and the hydrophobic surface of the exoskeleton of the susceptible insects.

It occurs by recognition of specific glycoprotein receptors in the insect (Boucias et al., 1988) consolidation of the interface between the pre-germinated spores and the epicuticle, Germination and appressorium formation initiating the penetration phase.(Vega et al,2012)

2. Haemocoel Penetration: To establish a successful infection, the fungus must penetrate the insect cuticle, composed of a network of polysaccharide polymers incorporated into a protein matrix (up to 70%). The cuticle must be breached by mechanical pressure (Zacharuk, 1970) and by the production of cuticle-degrading enzymes which include proteases, chitinases, and lipases, needed to degrade proteins, chitin, and lipids, respectively which help the fungus to obtain nutrition and eventually colonize the insect and finally spreads its mycelium into the haemocoel.

3. Haemocoel Replication: After reaching the hemocoel, most of the fungi carry out a dimorphic transition from mycelium to yeast (Entomophthorales) and often develop in to protoplasts (blastospores) without cell wall formation, avoiding recognition by circulating haemocytes in hemocoel.

Once they evade the immune system of the insect, septicaemia occurs. (Eilenberg, 1989) Mycosis induces physiological symptoms of abnormalities in the insect such as seizures, lack of coordination, altered behaviour and paralysis.

The fungus must overcome the insect's defence mechanisms to complete the infection process by synthesizing other proteases that degrade the humoral immune system. Finally, when temperature and humidity conditions are favourable, the hyphae can cross the integument of the insect, causing the emergence of the fungus on the outer surface which occurs in the less sclerotic regions of the integument, such as the intersegmental membrane or spiracles, but also depend on the host and stage of development. The hyphae crossing the integument can remain in the vegetative phase and begin the sporulation process (reproductive phase) within 24 to 48 hr.(Srivastara et al., 2009).

Symptoms of Fungal Infection in Insects

After the penetration and establishment of fungus within the body, the insects develop various symptoms such as:

1. Loss of appetite.
2. Complete/ partial paralysis.
3. Discoloured patches on the integument.
4. Hardening of the body.

Examples of Few Insect Pests and Mites Controlled by the Fungal Pathogens

S. No	Fungal Pathogen	Insect Pest/ Mites Controlled
1.	*Beauveria bassiana*	Bruchid, *Callosobruchus maculates*
	(Dosage - 1 x 10^7-1 x 10^{13} conidia/ ml)	Yellow mite, *Polyphagotarsonemus latus*
		Chilli thrips, *Scirtothrips dorsalis*
		Onion thrips, *Thrips tabaci*
		Fruit flies, Ash borer
2.	*Metarhizium anisopliae*	Red palm weevil, *Rhynchoporus ferrugineus*
	(Dosage - 1.5 X 10^6 -1 x 10^8 conidia / ml)	Diamond back moth, *Plutella xylostella*
		Pink mealy bug, *Maconellicoccus hirsutus*
3.	*Verticillium lecanii/ Lecanicillium lecanii* (Dosage -1 x 10^8 spores/ ml)	Against sucking insect pests of groundnut, okra and cabbage.


Plant bug infected by *Beauveria bassiana* (Surendra Dara, 2012) and Mummified larva by *Metarhizium anisophilae* (Wikipedia).

Conclusion

Due to the intensified agricultural practices, producers became more dependent on agrochemicals as a relatively reliable method of crop protection. However, increasing use of chemical inputs causes several negative effects, causing worldwide contamination of the food chain and water by persistent pesticide residues and also increasing in the number of pesticide resistant species. Hence, there is a need for better and safe alternatives. The application of entomopathogenic fungi in biocontrol has immense significance as they are environmentally safe and nontoxic to human and non-target pests.

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Desert Locusts Management in India

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Introduction

Desert Locust plagues can be an important contributing factor to famines and a threat to food security in many regions of the world. The Desert Locust plague of 1986–1989 and subsequent upsurges during the past two decades demonstrate the continuing capacity of this historic pest to threaten agriculture and livelihoods over large parts of Africa, the Near East and South- West Asia. In 2004–2005, a major upsurge caused significant crop losses in West Africa, with a negative impact on food security in the region. These events emphasize the need to strengthen and maintain a permanent system of well-organized surveys in areas that have recently received rains or been flooded, supported by a control capability to treat Desert Locust hopper bands and adult swarms efficiently in an environmentally safe and cost-effective manner.

Desert Locusts

Locusts are members of the grasshopper family Acrididae, which includes most short-horned grasshoppers. Locusts differ from grasshoppers because they have the ability to change their behaviour and physiology, in particular their morphology (colour and shape), in response to changes in density, when meteorological conditions are favourable. Adult locusts can form swarms that may contain millions or billions of individuals that behave as a coherent unit.

(Figure 1). The non-flying hopper (or nymphal) stage can form cohesive masses that are called hopper bands. Desert Locusts *(Schistocerca gregaria)* are always present somewhere in the deserts between Mauritania and India. When numbers are low, they behave as individuals (Solitarious phase); when high, they behave as a single mass (gregarious phase). Colour and shape are an indication of how they been behaving but may not be a reliable guide as to how they will behave in the future. When plentiful rain falls and annual green vegetation develops, Desert Locusts can increase rapidly in number and, within a month or two, start to concentrate and become gregarious. Unless checked, this can lead to the formation of small groups or bands of wingless hoppers and small groups or swarms of winged adults. This is called an outbreak and usually occurs within an area of about 5 000 km2 (100 km by 50 km).

Life Cycle of Desert Locust

A Desert Locust lives about three to five months, although this is extremely variable and depends mostly on weather and ecological conditions. The life cycle comprises three stages: egg, hopper (Nymph) and adult (Figure 2).

Weather and Locust Control Operations

For locust control, as well as swarm movement, it is important to know the weather conditions and wind fields because these affect the concentration of potential control targets and the suitability of conditions to carry out effective spraying. In planning Desert Locust surveys, the following principles should be borne in mind (WMO, 1991):

1. Locust populations move downwind.
2. The hotter the wind, the greater the distance travelled per day.
3. Highly turbulent (correspondingly hot) winds disperse populations (reduce their area density).

4. Downwind movement eventually brings locusts into zones of wind convergence, where they accumulate; As opposed to steady wind conditions, where turbulence disperses populations, convergent winds have been shown to concentrate populations at least to the order of 10000-folds.

5. Locust populations are trapped in zones of wind convergence and participate in the diurnal and daily cycle of movement of such zones. In some places and seasons, these movements are relatively small and the locust population is correspondingly relatively stationary.

6. Waiting for locusts to concentrate and form high-density populations is the most important strategy for efficient and economic control of locusts, so that the concentrating effect of zones of convergence must be utilized in control techniques.

7. In addition to their influence on locust development and migration, weather conditions are also important in locust control operation.

8. Individual farmers developed a variety of cultural and physical controls before the availability of chemical ones.

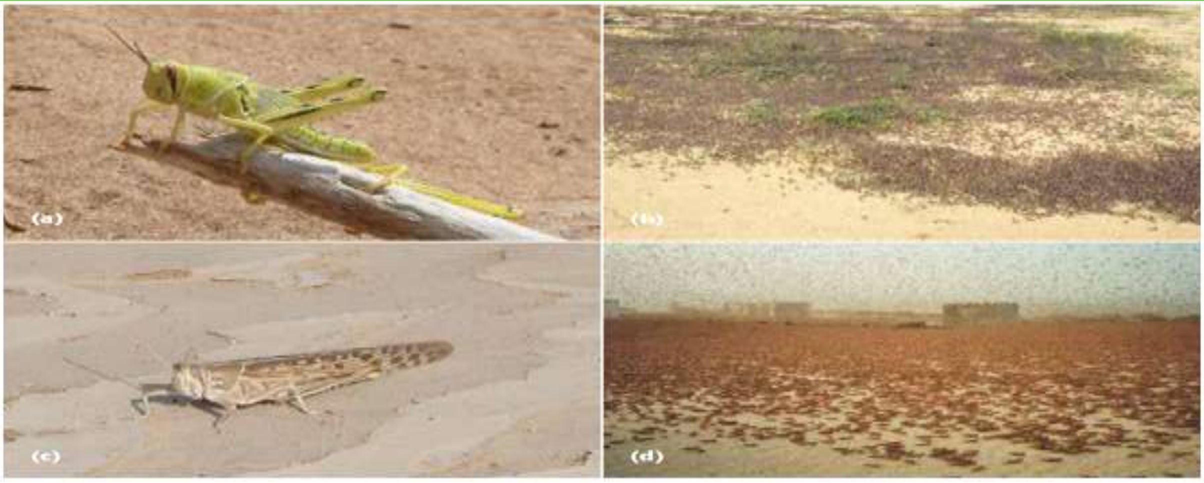

Figure 1. Desert Locust (a) hopper, (b) hopper band, (c) adult and (d) swarm. Hoppers are the wingless juvenile stage, while adults can fly and reproduce. Under optimal conditions, hoppers can form bands and adults can form swarms.

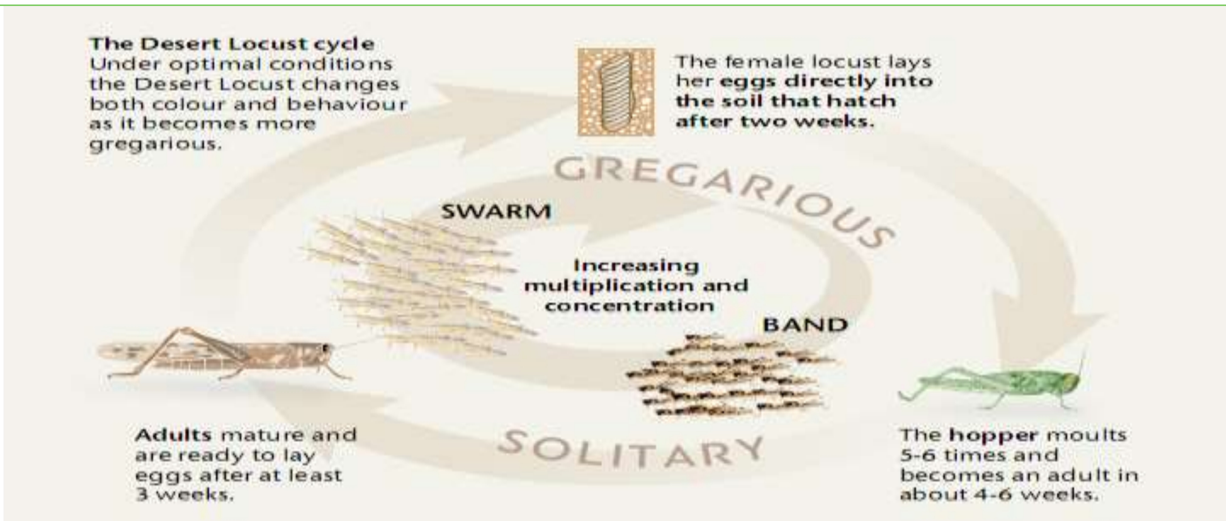

Figure-2: Desert Locust life cycle.

Locust Management Strategies

1. Traditional desert locust control methods:

a. Beating or trampling on the hoppers.

b. Digging up egg pods or plowing fields infested with egg pods.
c. Scattering straw over roosting sites and then burning it.
d. Lighting fires or making noise to prevent swarms from settling in crops.
e. Driving hoppers into trenches and burning, drowning, or crushing them.
f. Use of fame throwers.

2. Biocontrol / Biopesticides: The biopesticide developed from entomopathogenic fungus *Metarhizium acridum,* the microsporidian *Paranosema locustae (Nosema locustae). Beauveria bassiana* (Bals.) and *Sorosporella* sp. are found effective and their powder formulations are available in India.

3. Chemical control measures:

a. Organophosphates: Include the two most widely used locust insecticides, fenitrothion and malathion. They are moderately fast-acting (2-8 hrs), relatively non-persistent, but non-selective compounds. Malathion has the advantage of very low mammalian toxicity. Malathion 96% ULV is used in Desert Locust control in India.

b. Synthetic pyrethroids: Deltamethrin and lambdacyhalothrin, which are fast-acting ("knock-down" within minutes), varying levels of persistence and broad-spectrum.

Conclusion

It is expected that the desert locust will also adapt to new environment as it has done in past to survive in adverse conditions. The preventive control method encompassing early intervention for desert locust bands and swarms' control is best suited to maximize agricultural production. This has been made possible by the use of latest technological developments in the form of ULV spraying technique, GPS and GIS tools and e-locust. Support includes procuring pesticides and equipment, contracting aircraft, providing logistics services, establishing operational bases, intensive training on the safe administration of chemical pesticides, and raising community awareness on issues related to desert locust upsurge and suitable control measures need to be adopted.

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Interaction of Plant Viruses with Whitefly

Article ID: 31594

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Interaction is a communication between two or more organisms which start when any organism comes in contact with other organisms and their activities are affected.

Three main types of interactions viz., parasitic, commensalism and mutualism normally exist in nature:
1. Parasitic relationship: One organism is benefited whereas another organism is harmed.
2. Commensalism: Only one organism is benefited whereas another organism remains unaffected.
3. Mutualism: Both the organisms are benefited.

Apart from these, some specialized interactions also have been seen in plant virus and other organisms. Plant viruses being obligate parasite do not have symbiotic relationship with any organism; however, have other forms of interactions.

The interaction may be two-way, three way or multi way such as:
1. Two-way pathogenic interaction between Virus and Plant.
2. Commensalism: Two-way interaction between Virus and Vector.
3. Molecular Parasitic interaction between Virus/Satellite viruses or sat RNAs and Plant.
4. Virus – Virus interaction: Aided effect.
5. Virus-virus interaction: Cross protection.
6. Commensalism between Virus v/s Bacteria v/s Vector v/s Plant.

Whitefly: *Bemisia tabaci* Gennadius

Whitefly is a small tiny insect having milky white coloured wings and light-yellow body. Belongs to insect order Hemiptera. They have piercing and sucking type of mouth parts. The sweet potato or cotton whitefly, *Bemisia tabaci* Gennadius (Hempitera: Aleyrodidae), was first described in 1889 from Greek tobacco (Gennadius, 1889). Approximately 1500 described whitefly species (Family: Aleyrodidae) (Martin et al., 2000). However, only B. tabaci and the greenhouse whitefly *Trialeurodes vaporariumare* are considered significant.

Insect as Virus Transmitters

Vector: Various biological agents which introduce the virus into plant tissue are called vectors.

Insects are the most important group and about 400 spp. has been reported to transmit plant viruses. About 70% of insects belong to Homoptera in which Aphididae are the most important group. Whereas, other insects such as leafhoppers, plant hoppers, whiteflies, beetles, mealy bugs thrips, mites also act a vector of different viruses. In general plant viruses transmitted by one group of vectors are not transmitted by other group except: TRSV which can be transmitted by nematodes, thrips and spider mites.

There are Two Types of Plant Virus Transmission

1. Horizontal Transmission: Horizontal transmission is by vectors, human pruning shears and tools, and other direct, external contamination.

2. Vertical Transmission: Vertical transmission occurs when a plant gets it from its parent plant. Either through asexual propagation (cuttings) or in sexual reproduction via infected seeds.

Virus Vector Relationship is Also Based on

1. Site of retention of the virus in vector.

2. Stylet borne.
3. Circulative.
4. Propagative.
5. Transovarial transmission.

Plant Viruses

Most plant viruses have very simple particles with a 'core' of nucleic acid enclosed in a protein coat or shell called a capsid. The capsid is made up of many protein subunits of one or more types called capsomeres and protect the nucleic acid from enzymatic degradation. The viral nucleic acid surrounded by protein subunits is called a nucleocapsid while the term virion is used to describe the complete infectious virus particle. The nucleic acid component of the virus makes up its genome.

Viruses Can Exist in Two Phases

1. Extracellular: Virion, the extracellular phase, possess few if any enzymes and can't reproduce independently of living cells.

2. Intracellular: In the intracellular phase, viruses exist primarily as replicating nucleic acids that induce host metabolism to synthesize virion components; eventually complete virus particles or virions are released.

Transmission of Viruses Through Whitefly

1. The majority of whitefly species, *B. tabaci* has the ability to acquire and transmit over 200 different viruses, mainly begomoviruses.

2. It causes significant yield losses in important crops such as tomato, bell and hot peppers, beans, and various cucurbits including melon and squash.

3. *Bemisia tabaci* can rapidly disseminate viruses in the field even when populations are not appreciable, and cause severe crop damage in susceptible plantings.

4. Hence, economic thresholds are not recommended for whitefly vectors of plant viruses.

5. As expected due to the high levels of biodiversity inherent to the neotropics, there are many endemic whitefly-borne viruses yet to be discovered and named.

6. In fact, any one of these crops may be affected by several types of viruses either in different countries or different areas within a given country.

Virus Transmitted by Whitefly

1. Begomovirus:

a. The genus Begomovirus currently includes about 200 formally accepted virus species, and it is the largest genus in the family Geminiviridae.

b. Begomoviruses have a very wide host range but are limited to the dicotyledonous plants. The viruses cause a lot of economic damages to important crops such as tomatoes, beans, squash, cassava, and cotton in the world.

c. Begomoviruses are mostly restricted to the phloem of plants and induce disease symptoms, e.g. mosaic, yellowing, leaf curling, crinkling, and even stunting on plants.

d. Tomato yellow leaf curl disease is the most devastating disease caused by begomoviruses that affects tomato crops in tropical and temperate areas worldwide.

2. Sources of viruses:

a. Most important elements of pathogen factor in the epidemiology of all the plant diseases.
b. Being strictly obligate so require a biotic source for their survival during off season.

c. The number of virus sources and their distance from the cultivated plants determines the intensity and distribution of virus infection in the field.

d. There are different sources of survival of plant viruses.

e. Different parts of the host e.g. seed or vegetative propagative organs.

f. Weeds and wild plants.

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Enriched City Compost: A Boon to Urban Growers

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Municipal Solid Waste Management (MSWM) is serious issue to be tackled especially in rapidly urbanizing cities of the developing countries. Conversion of urban waste to compost is foremost solution to meet the objectives of disposal of waste and providing an organic fertiliser for agriculture. The acceptability of city compost produced at mechanical composting plants is poor, mainly because of low nutrient content. Hence enrichment is necessary for improving nutrient status and quality of compost and it can be achieved by enriching the urban solid waste compost with agricultural and industrial waste products such as composted poultry litter, diluted spent wash, rock phosphate and microbial inoculants.

Challenges and Opportunities

1. Urbanization and industrialization.
2. High population density.
3. Lack of new management systems and waste management facilities.
4. Inefficiency of existing SWM systems.

Maximum permissible limits stipulated by various countries for heavy metal contents of compost (mg/kg dry compost).

Heavy Metal	India
Zn	1000
Cu	300
Cd	5
Pb	100
Ni	50
Cr	50

(Source: ECN Report 2008)

City Compost for Swachh Bharat

1. 'Swachh Bharat Abhiyan or clean India mission' is an initiative by GOI during 2014-2019 for improving solid waste management.

2. Conversion of urban waste to compost is solution to meet the objectives of disposal of waste and providing an organic fertiliser for agriculture.

3. Honble Supreme Court of India constituted a Task Force in 2003 on Integrated Plant Nutrient Management using city compost in response to a public interest litigation (Chander, 2016).

4. On the recommendation of Task Force, the Supreme Court directed in 2006 that city compost be co-marketed along with the chemical fertilisers.

5. Fertiliser companies started marketing city compost and reached a level of sale of 1.87 lakh tonnes in 2011-12.

6. Development provided capital investment subsidy. As a result, a capacity of about 0.8 million tonnes of making city compost was built.

Effect of Application of MSWC on Crop Growth and Yield

Application of 75 % inorganic fertilizers along with 25 % enriched MSWC has recorded higher growth parameters and grain yield (5.22 t/ha) in rice (Kavitha and Subramanian, 2007). In tomato combined application of composted MSW + mineral fertilizer appeared to be the best strategy for the reutilization of municipal solid waste, as it did not compromise crop yield or fruit quality (Ribas-Agustí et al., 2017).

Effect of Application of MSWC on Soil Enzyme Activity and Microbial Biomass

Kasthuri et al. (2011) reported that application of MSWC has a significant influence on soil enzyme activity as well as microbial population. Higher amylase and invertase activity were recorded with application MSWC compared to control and same trend followed in case of bacterial and fungal population.

Advantages of Municipal Solid Waste Compost

1. Improve the growth and yield of crop along with restoration of ecological and economic functions of land.
2. Improves the water retention capacity, soil structures.
3. Improvement in soil physical, chemical and biological properties of soil.
4. Increases the microbial activity of plant and soil.
5. Land reclamation.

Disadvantages of Municipal Solid Waste Compost

1. Increased risk for Nitrate contamination (surface and ground water).
2. Presence of heavy metals can reduce the microbial activity of soil.
3. Persistence of undesirable object such as plastic, glass etc. are difficult to biodegrade in the soil.
4. Presence of xenobiotic (Phthalate esters) in MSW compost.
5. The concentrations of dioxin/ furans and polychlorinated biphenyls (PCB) were higher in MSW compost.
6. Higher concentration of Polychlorinated dibenzo-p-dioxin (PCDD) and polychlorinated dibenzofuran (PCDF) in MSW compost compared to surrounding soils.
7. Environmental risk.

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Cultivation of Baby Corn in West Bengal - The Key of Success

Article ID: 31596

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Summary of Article
Baby corn is high yielding, fast growing crop with high demand and low production cost and the cultivation support to local economy and increase income. So, now-a –days, the cultivation of baby-corn is very trending. But in West Bengal, the farmers are not cultivating the vegetable commercially. If the vegetable is cultivated in proper way, then the Bengal farmers can get the opportunity of employment in the form of cultivation, marketing, exporting. Even they can meet the international market demand by exporting. So, in this article, the proper cultivation practice is described with improved varieties having so many advantages.

Introduction
Through green revolution, India has been self-sufficient in cereal cultivation, pulses, vegetables cultivation etc. Now-a-days, in business field, International organizations' participation in import-exporting may change the food habits of Indian. For this reason, baby corn is one of the valued vegetables gaining popularity throughout India including in West Bengal. Now-a-days, it is gaining attention among farmers for its low cost of production, high demand, promising market, scope of value addition, support to local economy and increased income.

It is eaten by raw or cooked. Soft, sweet baby-corn is used as salad, fresh vegetables in curries, soup, snacks, pickle etc. It is also used as forage, livestock feed and in making silage. According to its food value, baby-corn is rich in fibre and phosphorus, vitamin-c, protein, carbohydrate. This vegetable is low in calories and free cholesterol. It helps in weight management and controlling blood sugar levels.

What is Baby-Corn?
Baby-corn (young corn, cornlet, sweet corn) is a cereal grain taken from maize harvested early while the stakes are still small and immature. Actually, it is husked/ unhusked ear harvested 2-3 days after silk emergence. It is a crop with high-yield and fast growth.

Climate
This crop requires good sunlight with temperature range 220-280 C for optimal growth. It does not grow well in high temperature region where temperature exceeding 300 C.

Soil
Well drained, sandy loam soil with pH value 6-7 will be suitable for this cultivation.

Land Preparation
Land preparation should be incorporated in FYM of 15t/ha. Disc plough is used for plough the land followed by cultivator ploughing twice for good aeration.

Sowing
It can be cultivated throughout the year like mature corn or maize. For good yield the seeds are sown in April-May for kharif purpose, Oct-Nov for rabi purpose and Feb-March for pre-kharif season purpose. But it is noticed that for many reason and weather condition, yield of rabi corn is better than yield of kharif crop.

Improved Variety in West Bengal

There are some improved varieties developed for good yield and short duration in West Bengal weather condition.

Baby-corn: C.L.-42, Early composite, Prakash, Vivek, HM-2, PEHM-1.
Sweet corn: Madhuri, Priya, Composite.

Seed Rate and Spacing

Selection of good qualities seeds is important for baby-corn farming. Seed rate for baby-corn cultivation should be 40kg/ha. Plant to plant distance should be 15-20cm. and row to row spacing should be 45 cm.

Seed Treatment

Seed need to be protected from seed borne and soil borne diseases. So, they should be treated with fungicide and insecticide.

1. Carbendazim @ 3gm/kg of seeds to control seed rot and seedling blight.
2. Bavistin: Captain in 1:1 ratio @ 2gm/kg of seeds for leaf or sheath blight.
3. 3-4 packets of Azospirilum before sowing would increase the quality and yield of baby-corn.

Fertilization

Baby-corn is fast-growth crop. So, supply of fertilizer at optimum level is very important. Full dose of P and K and 1/3 of N is applied at the time of land preparation. Rest 2/3 of N is applied equally two time at 20-25 DAS and secondly at 40-45 DAS before tassels are emerged. The fertilizer rate of baby-corn is 75:60:20 kg/ha N:P:K as basal.

Weed Management

Weed control is an important operation in baby-corn cultivation. 2-3 manual weeding would be enough to control the weeds. But in the case of kharif season and when the soil is wet, herbicide may help to control weeds. Simazine or Atrazine should be applied immediately after sowing @ 1.50kg/ha in 500-650 ltr of water depending upon the soil type.

Water Management

In kharif season 1-2 time and in rabi season 3-4-time irrigation is good for better yield. It is noticed by examination that yield of baby-corn may decrease 3-6.7 % even 13 % for lack of proper irrigation.

Pest and Disease Management

Like other crops, pest and diseases are also attack in baby-corn field. But it is not important that attack of pest and disease may not reduce the yield rate of this crop. It is basically depending on the rate of attack.

Shoot fly, pink borer, stem borer is the common serious pest in baby-corn. To prevent stem borer, single application of Deltamelthrin @ 175ml in 250 litres of water at 15 days after germination is recommended.

Need based spray of Mancozeb @ 2.5ltr of water may manage the fungal blight disease. 5 % neem seed karnel extract should be applied as precautionary management.

Detasseling

Detasseling is the process of removal of male inflorescence or tassel. It is an important operation in the cultivation of baby-corn. The tassel emergence takes place between 45-55 days after sowing. Silks emergence takes place after 5 days of tassel emergence. Detasseling is done soon after it emerges from the flag leaf and before it starts shedding pollen grains. This method is essential for getting good quality, unfertilized small baby-corn which is acceptable in the market. The removed tassels can be fed to the cattle as it has good amount of food value.

Harvesting of Cobs and Yield

Usually harvesting of baby-corn starts after 7 weeks of sowing when 2-4 cm. long silk emerge and the average size of the baby-corn turn 8-10 cm. long with golden yellow colour.

The baby-corn is harvested by hand picking. The plucking process should be done carefully without damaging the other cobs as well as the plant. After first harvesting (7-10 days), other cobs are ready for second and third time plucking.

Yield of baby-corn depends on the cultivation practices. Normally the yield of the tender cobs is 6700 kg/ha and the yield of green fodder is 35 t/ha. After harvesting, the fresh cobs with husks must be sent to the market immediately to avoid weight loss.

Conclusion

If baby corn is cultivated in proper way then it has so many advantages. As it can be grown throughout the year, it provides employment in the form of cultivation, marketing, processing and exporting. Farmers can earn money in the shortest possible time. Foreign exchange can be earned by exporting baby corn and its product by meeting international market demand. Green fodder obtained after harvesting the baby-corn use for the feeding purpose of the livestock throughout the year.

Image of baby corn

Spacing of baby corn cultivation

Harvested baby-corn

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Biodegradation of Plastic

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Introduction

The word plastic comes from the Greek word plastikos, which means 'able to be molded into varied shapes. Plastic is defined as the polymers which become mobile on heating and they can be cast into moulds. The plastic is made up of carbon, hydrogen, silicon, oxygen, chloride and nitrogen. For extraction of the basic materials of plastics oil, coal and natural gas are used. Plastics are made up of linking of monomers together by chemical bonds. Polyethylene comprises of 64% of total plastic, which is a linear hydrocarbon polymer consisting of long chains of the ethylene monomers (C2H4). General formula of polyethylene is CnHn, where 'n' is the number of carbon (Sangaleet al. 2012).

Recalcitrant nature of plastic is due to its high molecular weight, complex three-dimensional structure, and hydrophobic nature, all of them hampers its availability to microorganisms (Hadadet al. 2005). Plastics include polythene, propylene, polystyrene, polyurethane, nylon etc. Polyethylene either LDPE (low density polyethylene) or HDPE (high density polyethylene) is a thermoplastic polymer made by monomers of ethylene, used mostly as thin films and packaging sheets. Among these LDPE materials are strong, light-weight and durable thus are having wide uses.

From last three decades uncontrolled use of the plastics for packaging (e.g. fast food), transportation, industry and agriculture in rural as well as urban areas, has elevated serious issue of plastic waste disposal and its pollution. Light-weight, inertness, durability, strangeness and low cost are the main advantages of plastic while it has disadvantages such as, it is recalcitrant to biodegradation and difficult to degrade naturally. The global use of plastic is growing at a rate of 12% per year and around 0.15 billion tons of synthetic polymers are produced worldwide every year. Accumulation rate of plastic waste in the environment is 25 million tons/year and is consequently considered a serious environmental danger (Sivan et al. 2006).

In the year 1999-2000, India imported more than 120,000 tons of plastic. Annually, India generates 5.6 million metric tonnes of plastic waste with Delhi accounting for a shocking 689.5 metric tonnes per day. According to Central Pollution Control Board (CPCB) of India, total plastic waste which is collected and recycled in the country is likely to be 9,205 tonnes per day (approximately 60% of total plastic waste) and 6,137 tonnes remain uncollected and littered. Major offender in generating such waste are four metros with Delhi contributing 689.5 tonnes a day, followed by Chennai (429.4 tonnes), Kolkata (425.7 tonnes) and Mumbai (408.3 tonnes). The figures only serve to confirm the common areas of masses of plastic in industrial, residential and slum areas of Indian cities and towns (CPCB Annual report 2011-12). The efficient decomposition of plastic bags takes about 1000 years (Pramila and Vijaya Ramesh, 2011). Plastic causes pollution and global warming not only because of increase in the problem of waste disposal and land filling but also release CO2 and dioxins due to burning. The burning of waste plastic material produces toxic gases posing health hazard by causing lung diseases and cancer after inhalation (Pramila and Vijaya Ramesh, 2011).

Biodegradation

Microorganisms are not able to transport the polymers directly through their outer cell membranes into the cells where most of the biochemical processes take place due to the lack of water-solubility and the length of the polymer molecules. In order to use such materials as a carbon and energy source, microorganisms have developed a special strategy. The microbes excrete extracellular enzymes which depolymerize the polymers outside the cells. Extracellular and intracellular depolymerases enzymes are actively involved in biological degradation of polymers. Anaerobic and aerobic biodegradation mechanism pathways are given in Fig. 1 (Gu, 2003).

During degradation, exoenzymes from microorganisms break down complex polymers yielding short chains or smaller molecules, e.g., oligomers, dimers, and monomers, that are smaller enough (water soluble) to pass the semi-permeable outer bacterial membranes and then to be utilized as carbon and energy sources (Gu, 2003).

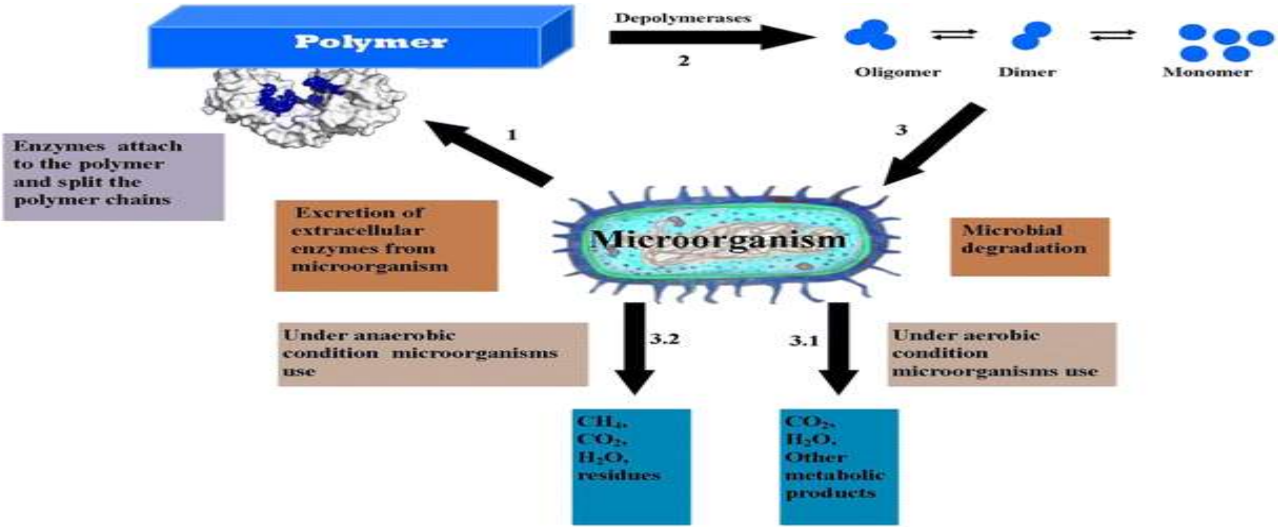

Fig. 1 : Anaerobic and aerobic biodegradation mechanism pathways

This initial process of polymer breaking down is called depolymerization. When the end products are inorganic species, e.g., CO2, H2O, or CH4, the degradation is called mineralization. When O2 is available, aerobic microorganisms are mostly responsible for destruction of complex materials with microbial biomass, CO2, and H2O as the final products. In contrast, in the absence of O2 i.e. under anoxic conditions, anaerobic consortia of microorganisms are responsible for polymer deterioration. In this case the primary products will be microbial biomass, CO2, CH4 and H2O under methanogenic conditions or H2S, CO2 and H2O under sulfidogenic conditions. Since thermodynamically O2 is a more efficient electron acceptor than SO4− and CO2, aerobic processes yield much more energy and are capable of supporting a greater population of microorganisms than anaerobic processes. It is important to understand that biodeterioration and degradation of polymer substrate can rarely reach 100% because a small portion of the polymer will be always incorporated into microbial biomass, humus and other natural products.

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Process of Biodegradation of Plastic

Article ID: 31598

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Introduction

Biodegradation of plastic is defined as exoenzymes from microorganisms break down complex polymers yielding short chains or smaller molecules, e.g., oligomers, dimers, and monomers, that are smaller enough (water soluble) to pass the semi-permeable outer bacterial membranes and then to be utilized as carbon and energy sources. Several steps occur in the plastic biodegradation process and could be identified by specific terminology (Lucas et al., 2008):

1. Bio-deterioration defines the action of microbial communities and other decomposer organisms responsible for the physical and chemical deterioration that resulted in a superficial degradation that modifies the mechanical, physical and chemical properties of the plastic.

2. Bio-fragmentation refers to the catalytic actions that cleave polymeric plastics into oligomers, dimers or monomers by ecto-enzymes or free-radicals secreted by microorganisms.

3. Assimilation characterizes to the integration of molecules transported in the cytoplasm in the microbial metabolism.

4. Mineralisation refers to the complete degradation of molecules that resulted in the excretion of completely oxidized metabolites ($C0_2$, N_2, CH_4 and H_20).

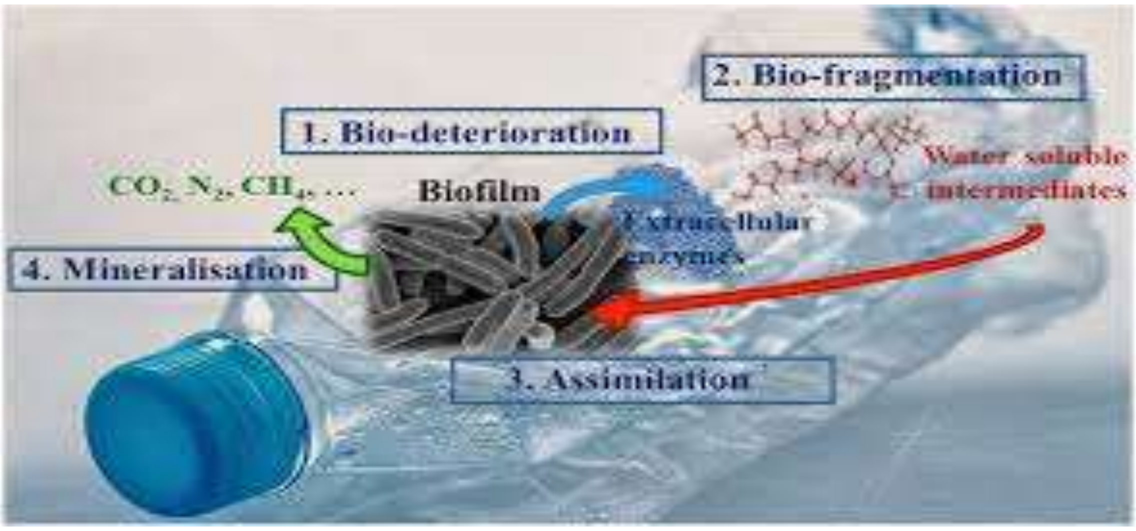

Fig.: Different steps of plastic biodegradation

Bio-Deterioration

Deterioration is a superficial degradation that modifies mechanical, physical and chemical properties of the plastic. In most cases, abiotic parameters contribute to weaken the polymeric structure. Sometimes, these abiotic parameters are useful either as a synergistic factor, or to initiate the biodegradation process.

The bio-deterioration seems to be triggered by the formation of a microbial biofilm growing on the surface and inside the plastic. The development of the biofilm is dependent on the composition and the structure of the plastic, but also on the environmental conditions (Lugauskaset al., 2003). Since plastic polymers such as PE and

PS are hydrophobic, forming a stable biofilm requires that the bacterial surface will also be hydrophobic. For example, the biofilm of *Rhodococcus rubber* C208 formed on polyethylene showed high viability and even after 60 days of incubation adhered to the polyethylene without any supplementation of external carbon (Figure).

The microbial biofilm provokes serious physical and chemical deterioration:

1. Physical deterioration: the formation of the microbial biofilm is associated to the secretion of extracellular polymeric substances (EPS) that reinforce the cohesion of the biofilm and the adhesion to the plastic surface. The EPS enters the pores, microorganisms can then grow inside, thus increasing the pore size and provoking cracks that weakened the physical properties of the plastic (Bonhommeet al., 2003).

2. Chemical deterioration: the microbial communities that developed on plastic may be highly diverse and the development of a biofilm may release acid compounds such as nitrous acid (e.g. *Nitrosomonas* spp.), nitric acid (e.g. *Nitrobacter* spp.) or sulphuric acid (e.g. *Thiobacillus* spp.) by chemolithotrophic bacteria. Organic acids such as oxalic, citric, fumaric, gluconic, glutaric, glyoxalic, oxalic and oxaloacetic acids may also be released by chemoorganotrophic communities. The pH inside the pores is then modified, resulting in a progressive degradation that changes the microstructure of the plastic matrix.

Bio-Fragmentation

The fragmentation of plastic polymers into oligo- and monomers can be of various origins, i.e. mechanical, UV radiation, thermal, chemical and/or biological. Here we focused on the biological aspect, but other reviews are providing more details about the abiotic fragmentation.

Plastic polymers are molecules with high molecular weight that cannot cross the cell wall. Microorganisms secrete extracellular enzymes (exoenzymes) that can catalyze reactions principally at the boundaries of the plastic polymer. They can perform many chemical reactions, but they generally need imbalance of electric charge to perform lysis. The main limit of bio-fragmentation is the stability of the plastic polymers, which are constituted by; long chain of carbons and hydrogens that contains very balanced charges. To destabilize the local electric charge, bacteria that can break down plastics usually contain enzymes called oxygenases, which can add oxygen to a long carbon chain. For instance, mono-oxygenases and di oxygenases incorporate, respectively, one and two oxygen atoms, forming alcohol or peroxyl groups that are less recalcitrant for biodegradation. Other transformations are then catalysed by lipases and esterases after the formation of carboxylic groups or by endopeptidases for amide groups (Lugauskas*et al.* 2003).

Some of the well-known microbes, which have the capacity to degrade plastic polymers into their respective simple monomeric.15 bacterial genera which have the capacity to degrade various types of plastics. Among them, Pseudomonas is dominant. It can degrade polythene, PVC, PHB, poly(3-hydroxybutyrate-co-3-mercaptopropionate), and poly(3-droxypropionate). *Bacillus brevis* can degrade only polycaprolactone while *Streptomyces* can degrade PHB, poly(3-hydoxybutyarate-co-3-hydroxyvalerate), and starch or polyester. Ochrobactrum TD is also able to degrade PVC. Majority of the strains that are able to degrade PHB belong to different taxa such as Gram-positive and Gram-negative bacteria, *Streptomyces*, and fungi. It has been reported that 39 bacterial strains of the classes Firmicutes and Proteobacteria can degrade PHB, PCL, and PBS, but not PLA. Other bacterial species identified having the properties of degrading plastics were *Bacillus sp., Staphylococcus sp., Streptococcus sp., Diplococcus sp., Micrococcus sp., Pseudomonas sp.,* and *Moraxella sp*. (Kathiresan 2003).

Assimilation and Mineralisation

The formation of monomer does not guaranty their assimilation by microorganisms. They have to use specific carriers to cross the cell wall and/or cytoplasmic membrane. Some monomers may stay in the surrounding of microbial cells without being assimilated. Inside cells, the plastic monomers are oxidized through catabolic pathways to produce energy, cell structure and new biomass. Depending on the microbial abilities to grow in aerobic or anaerobic conditions, there exist three essential catabolic pathways to produce the energy to maintain cellular activity, structure and reproduction: aerobic respiration, anaerobic respiration and fermentation. The assimilation refers to the integration of atoms inside microbial cells, but the degradation of the monomers may not be complete. The assimilation result in numerous secondary metabolites that can be transported outside the microorganism that do not have the metabolic capability to transform it or that do not need to metabolize or store it. The secondary metabolites excreted may be used by another cell that can perform further degradation, or can stay further in the pool of non-assimilable compounds. The mineralization refers to the complete degradation of primary and secondary metabolites that resulted in the excretion of completely.

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Benefits of Panchgavya Products in Human Life

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Introduction

Panchgavya products widespread used against several disorder of human being. There are a number of countless substances taken directly or indirectly from plants as well as animals and containing anti-oxidant and anti-microbial drugs. Utilization of those things that are considered sacred and sacred taken by an animal: the urine of a cow, which has these properties. It is known as "Kamdhenu" and "Gaumata" because of its nutritious nature like that of a mother, who gives generously to all humanity, and is a drugstore. Every Panchgavya product has distinctive marks and is used in health, agriculture and other fields. Historically, Maharshi Vasishtha worshiped the Divine "Kamdhenu" Cow and Maharshi Dhanvantari who gave mankind the wonderful medicine "Panchgavya". The cow, with the scientific name 'Bos symbol', is considered by the Vedas to be a sacred and precious animal and is nicknamed the 'mother of mankind'. The composition of cow's urine, faeces, milk, curd and ghee is aptly known as "Panchgavya". This is given to women during childbirth. Panchgavya is the largest region of almost all Ayurvedic preparations.

In space all living things are composed of five natural elements, namely Earth, Water, Fire, Wind and Space that come together like Panchabhootas and their lives are affected by Tridoshas, viz., Vadha (wind), Pitha (fire) and Capha (Phlegm). Any disruption in the harmony of the natural five-factor ratio can cause the disease. On the basis of these basic principles of health, different remedial strategies were introduced i.e. Vrikshayurveda of plants, Mrigayurveda of animals and human Ayurvedic.

Benefits

Panchgavya therapy or cowpathy uses these five products, because these areas have medicinal value and used with alone or in mixed with other herbal, animal or mineral drugs to treat disorders and diseases such as colds, flu, colds, coughs, arthritis, rheumatoid arthritis, leucorrhoea, leucoderma, hyperlipidemia, kidney disorders, eating disorders and gastrointestinal track, acidity, ulcer, wound healing, heart disease, asthma, skin / diseases, tuberculosis, pox, hepatitis, leprosy and other viral infections. Aging, chemical intoxication, worm abuse, obesity etc. These remedies seem to be effective even for those who are frightened, such as cancer, which have developed immunodeficiency syndrome (AIDS) and diabetes.

Panchgavya's immunostimulatory, immunomodulatory and anti-inflammatory activity are described in Ayurveda. Indigenous cattle breeds varied with different breeds, in appearance and features. Due to emergence of antimicrobial / pathogen resistance especially conditions such as emergence of antimicrobials, residual toxins and food safety concerns, and also concerns about the harmful effects of allopathic drugs, but modern novel and safe methods of protection, bacteriophage, herbal and others include Panchgavya therapy and immunomodulatory diets are gaining popularity and require special attention in their dissemination and public awareness. Cattle urine, dung, milk, ghee and curd as all known as Panchgavya. The traditional cow is known by the same name Kamdhenu ie. Which can fulfill all human desires and Gaumata means mother. It has high social and cultural values, plays a major role in the local economy, and represents cattle wealth and bio diversity.

Essential Panchgavya Products and their Use

1. Kamdhenu Medohar Ark: was used for medical problems such as obesity.
2. Kamdhenu Harde Churna: it is effective in treating GIT-related problems such as acidity, gas and constipation.

3. Kamdhenu Malish Oil: refreshes various types of arthritis. It is also used as a body Massage.
4. Kamdhenu Ashtamangal Ghrut: it was effective to improve memory. It also works as a good health strategy
5. Kamdhenu Jatyadi Ghrut/Ghee: very much effective in cut wounds, ulceration, bed sore and fistula.
6. Kamdhenu Kshar Churna: Effective in respiratory disorder like cough, bronchitis and asthma. It is used in treatment of gastro intestinal disorders.
7. Kamdhenu Chandanadi Yamak: most useful in burns treatment and also skin related disease especially allergy condition.
8. Kamdhenu Kushmandavaleh: relief from acidity and gastric ulcer. Also act as liver tonic.
9. Kamdhenu Hingawadya Ghrut: helpful in acidity and also used in curative agent for parasitic infestation particularly thread worm.
10. Kamdhenu Kasisadi Tela: effective on both type of piles and helps in fistula healing.
11. Kamdhenu Arshohar Marham: effective on both type of piles and helps in fistula healing.
12. Kamdhenu Asava: useful in respiratory tract infection, asthma and leucoderma.
13. Kamdhenu Bal Pal Rasa: Acts as nervine tonic, promotes health and proper growth for children.
14. Kamdhenu Nari Sanjeevani: helpful in menstruation related problems.
15. Kamdhenu Pramehari: used for generalized weakness.
16. Kamdhenu Tela: useful for against infection of nose, ear and eye.
17. Kamdhenu Vibhitikavaleha: Effective against Respiratory tract infection.
18. Kamdhenu Pathyadi Vatika: eliminate bad breath and mouth ulcers.
19. Kamdhenu Panchagavya Ghrit: effective against chronic fever, anaemic conditions and psychosomatic disorders.
20. Kamdhenu Tikiya: it helps in improvement skin complexion and adds Luster to the skin.
21. Kamdhenu Isab Tikiya: Useful in all skin disease.
22. Kamdhenu Dant Rakshak: Very useful for dental disorders like gingivitis, pyorrhea and protects gums.
23. Kamdhenu Ubatan (Face-pack): Improves luster of skin and tones up face look.
24. Kamdhenu Keshnikhar: Highly effective in alopecia and dandruff, regular application improves condition of hair and prevents premature graying of hair and falling.
25. Kamdhenu Dhup: Purifies air in the room. Used during 'Puja' and at any other time whenever desired.
26. Ashtamangal Ghrita: Contain Cow's Ghee, Brahmi (calamus bach), saindhave (chloride of sodium), sayssurea (kuth), mustard, anatmul (Indian sarsaparilla), long pepper and a few more herbs: enhances their memory power in children. It is also useful as a therapy for senile dementia.
27. Kamdhenu Shwitranashak Vati and Lepa: used as curative agent for leucoderma and alopecia.
28. Kamdhenu Ghanvati / Arka: it is effective against skin related problem and kidney problems.
29. Kamdhenu Takrarishta: It is used in constipation, useful in piles, parasitic infestation, diarrhea and dehydrated condition. Very much effective against micro-organisms which cause food poisoning.

Conclusion

It may be concluded that the Panchgavya product are very much useful in human life. It is used in treatment of countless disorders related to human with no adverse side effects. They are prepared from cow milk, ghee, cow urine, dung and curd. These are safe and not affect the environment or surroundings. It is inexpensive products and no chemical residue in those products.

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Millets as Climate Resilient Crops

Article ID: 31600

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In recent years climate change and its variability are emerging as major challenges to Indian Agriculture. The projections of global climate change include altered average temperatures, rainfall, and increased extreme events (e.g., heat and cold waves, flooding), enhanced atmospheric carbon dioxide and ground-level ozone concentrations and rise in sea level leading to inundation of coastal areas etc. In recent past it is more evident, as one or the other part in the country is affected by droughts, excessive rains, floods, cyclones, frost, heatwave and other climatic events.The 4th and 5th IPCC reports clearly outlined the global and regional impacts of projected climate change on agriculture, water resources, natural ecosystems and food security. Although, climate change impacts are being witnessed world over, the countries in which larger population is dependent on agriculture, such as India, are more vulnerable. The risks are likely to be experienced more by small and marginal farmers of rainfed and other risk prone regions with poor coping mechanisms. India's semi-arid regions have expanded by 10% in recent decades, which include swathes of Rajasthan, Gujarat, Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu, making the inhabitants most vulnerable to climate change. In addition to its impacts, rural India is witnessing growing agrarian distress despite bountiful harvests.

Increasingly erratic rainfall patterns and crop losses due to climate change factors has forced farmers who were following the conventional agriculture to return to sorghum, little millet and foxtail millet cultivation, having realized that these crops are much more resilient to environmental stress, gives an assured yield in both low and excess rainfall conditions, while keeping input costs low.

Millets are small - seeded grasses that are hardy and grow well in dry-zones as rainfed crops under marginal conditions of soil fertility and moisture. They are possibly the first cereal grain to be used for domestic purposes, the commonly grown millets are sorghum, pearl millet, Finger millet, Barnyard millet, Foxtail millet, Kodo millet, Proso millet and little millet. They are highly nutritious, non - glutinous, rich in fibre and easy to digest. The revival of millet cultivation in the southern provinces of Karnataka, Andhra Pradesh and Telangana, agronomics say, is a step towards sustainable cropping practices that respects biodiversity in nature. There are many factors that make millets as more sustainable crops. This is exemplified by comparing the amount of water needed to grow rice with that for millets. One rice plant requires nearly 2-5 times the amount of water required by a single millet plant of most varieties, according to the Crops Research Institute for Semi-Arid Tropics (ICRISAT) a global research organization helping to make millets more popular.

"The green revolution, despite its many benefits, ignored millets and instead concentrated on rice and wheat. Now, there is no diversity in our food in terms of nutritional value. Our food habit is going in the negative direction".(Vilas A. Tonapi). In this era of climate change, which has distorted our weather pattern, millets come as a redeemer for farmers.

Climate Resilient Features

Millets are known for their climate-resilient features including adaptation to a wide range of ecological conditions, less irrigational requirements, better growth and productivity in low nutrient input conditions, less reliance on synthetic fertilizers, and minimum vulnerability to environmental stresses (Kole et al., 2015). Also, millets are nutritionally superior to other major cereals as they are rich in dietary fibers, resistant starches, vitamins, essential amino acids, storage proteins and other bioactive compounds (Amadou et al., 2013). These attributes have made millets a crop of choice for cultivation in arid and semi-arid regions of the world.

Millets have higher efficiency in absorbing and utilizing carbon dioxide. Most varieties of millets are well known for their hardiness and have the capacity to withstand prolonged periods of drought, high temperatures and still produce grains and fodder.

Millets possess several morpho-physiological, molecular and biochemical characteristics which confer better tolerance to environmental stresses than major cereals. Primarily, the short life-cycle of millets assists in escaping from stress as they require 12–14 weeks to complete their life-cycle (seed to seed) whereas rice and wheat requires a maximum of 20–24 weeks. However, the prevalence of stress conditions and their consequences are circumvented by several traits such as short stature, small leaf area, thickened cell walls, and the capability to form dense root system (Li and Brutnell, 2011). Also, the C4 photosynthetic trait is highly advantageous to millets. In the C4 system, carbon dioxide (CO_2) is concentrated around ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO), which in turn suppresses ribulose 1,5-bisphosphate (RuBP) oxygenation and photorespiration (Aubry et al., 2011). Thus, C4 mechanism enhances the concentration of CO_2 in bundle sheath, which suppresses photorespiration (around 80%) depending on the temperature and increases the *in planta* catalytic activity of RuBisCO (Sage et al., 2011). Since RuBisCO of C4 plants works at elevated CO_2 levels, millets have enhanced photosynthetic rates at warm conditions and confers immediate water use efficiency (WUE) and nitrogen use efficiency (NUE) which are ~1.5 to 4-fold higher than C3 photosynthesis (Sage and Zhu, 2011). For instance, foxtail millet requires just 257 g of water to produce a dry biomass of 1 g, whereas maize and wheat require 470 and 510 g, respectively (Li and Brutnell, 2011). In addition to conferring WUE and NUE, C4 photosynthesis provides secondary benefit to millets including improved growth and ecological enactment in warm temperatures, enhanced flexible allocation patterns of biomass and reduced hydraulic conductivity per unit leaf area (Sage and Zhu, 2011). These attributes of millets make them next-generation crops holding the potential for research to explore the climate-resilient traits and exploit the information for the improvement of major cereals.

Conclusions

It is realized that millets hold great promise for food security and nutrition amid ever-increasing agricultural costs, climate change and burgeoning mouths to feed worldwide. They are nutritious, possess additional health benefits, requires significantly fewer input costs for cultivation and are naturally tolerant to most biotic and abiotic stresses. These features accentuate millets as crops of choice for the world population amid growing concerns about climate change. With advantages loaded in its favour such as low-maintenance, disease and pest resistance, nutritional benefits, market demand, fodder value and ecological benefits, millet is being considered as a smart crop.

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Bael *(Aegle marmelos)* – Nature's Gift to Mankind

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Bael, *Aegle marmelos* (Linn.) Correa ex Roxb., a plant of Indian origin having tremendous therapeutic potential is not fully utilized. It belongs to family Rutaceae, the family of citrus fruits. It is known with different names in different languages (Purohit and Vyas,2004). *Bel, Beli, Belgiri* (Hindi); *Bilva, Shivadruma, Shivaphala, Vilva* (Sanskrit); Bael, Bengal quince, Golden apple (English); *Bel, Bel Kham* (Urdu); *Bel* (Assamese and Marathi); *Bilivaphal* (Gujrati); *Marredy* (Malyalam); *Belo* (Oriya); *Vilvama, Vilva marum* (Tamil); and *Bilva, Bilva pandu* (Telugu).

Bael is known in India from pre-historic time and has been mentioned in the ancient system of medicine (Bose, 1985). It has a great mythological significance also. Every part of plant such as fruit, seed, bark, leaf and root are important ingredients of several traditional formulations. Due to its curative properties, it is one of the most useful medicinal plants of India. It is utilized in day-to-day life in various forms. The products obtained from bael, being highly nutritive and therapeutic are getting popularized in Indian as well as in international market. The foundation for revitalization of local health traditions (FRLHT), Bangalore, India listed bael *(Aegle marmelos*) as RET (Rare, Endangered and Threatened) species specifically endangered species. This underutilized tree is generally propagated through seeds.

Distribution

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

Cultivars

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

Chemical Composition

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

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

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

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

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

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

Nutritional Value of Bael Fruit (Parichha, 2004)

Components	Value (% per 100 g)	Components	Value (% per 100 g)
Water (moisture)	64.2	Potassium	0.6
Protein	1.8	Iron	0.3
Fat	0.2	Vitamin A (IU)	186
Mineral	1.5	Vitamin B1	0.01
Fibre	2.2	Nicotinic acid	0.9
Carbohydrate	30.6	Riboflavin	1.2
Calcium	0.09	Vitamin C	0.01
Phosphorus	0.05	Calorific value	129

Medicinal Importance

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

Cultivation

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

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

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

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

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

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

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

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

Conclusion

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

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Potential Crops and Varieties for Contingent Crop Planning

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Introduction

In agricultural productivity the changing climate is the major concern; i) The rains start at early or late monsoon, ii) Irregular "breaks" occurs in cropping season, iii) the spatial and temporal variations and iv) Early termination of rainfall or continuous wet spells for longer period are the most important rainfall aberrations which influence the agricultural productivity in rainfed areas. In the irrigated ecosystem, the late release of water from the reservoir is the major concern to affect the normal cropping system in delta and catchment areas. The increased level of natural disasters like cyclones, heavy downpour and failure of monsoon and others has leads to make this situation. For this reason, the alternate technique should be prepared to sustain the agricultural productivity which postulates the contingent crop plan concept (Subramanian et al., 2020).

In India, 75 per cent of the rainfall received during South-West monsoon and exerts a strong influence on the food grain production during Kharif season and on the economy in terms of agricultural output and farmers income. The commencement of South-West monsoon and the amount of rainfall and its distribution are key factors which influence the performance of crops. In rainfed areas, as a general rule early sowing of crops with the onset of monsoon is the best-bet practice that gives higher reliable yield. But the crop productivity is affected due to delay in monsoon or prolonged dry spell during cropping season and also with early withdrawal or continuation of monsoon for longer periods. These aberrant situations often lead to poor crop performance or total crop failures in major crops (Rajender Reddy et al., 2014).

Contingent Cropping

Contingent crop planning is defined as arrangement of cropping system under aberrant weather conditions such as delayed onset of monsoon, early onset of monsoon, prolonged dry spell, early cessation of rainfall, extended monsoon and erratic rainfall distribution to the requirement of food, fodder and grain of the farm family or making plan for providing alternate crop or cultivar or varieties choice in tune with the aberrant weather conditions in a given location (Raj Singh and Anil Kumar, 2016). A field experiment was conducted to study the alternate crops for Kuruvai (1st crop) season as contingent plan in Periyar Vaigai Command area under limited water resources during kharif 2017 and 2018 at Agricultural College and Research Institute, Madurai, Tamil Nadu. The experimental site is situated at 9°54' N latitude and 78°54' E longitude with an altitude of 147 m above mean sea level. The experimental field soil is sandy clay loam in texture which is taxonomically known as Typic haplustalf with low in available N and medium in available P and high in K. From this study the following crops and its varieties are more promising for contingent crop planning.

Greengram - CO 8

This variety is suitable for rainfed area. It also matures in a short period of time (55 to 60 days), escapes drought and gives staple yield. Determinate growth with synchronized maturity is other characteristics of this variety. Synchronized maturity reduces the labour requirement and harvesting time. Resistant to yellow mosaic virus, stem necrosis and moderately resistant to root rot and also resistant to stem and pod borer. It gives yield of 545 and 900 kg/ha under rainfed and irrigated conditions.

Sesame - TMV 7

It is a high yielding sesame variety with brown colour seed. It matures in 85-90 days. Erect, indeterminate with profuse branching and resistant to root rot disease. It gives 850 and 920 kg/ha yield under rainfed and irrigated conditions.

Proso Millet - CO 5

It is suitable for rainfed lands as it matures in 70 days. It has high tillering capacity and fit well in the double cropped rainfed situation. This variety is not only drought tolerant but also used as a tasty hay fodder for cows. It gives 2400 kg/ha yield under rainfed conditions.

Barnyard Millet - CO 2

It is a short duration variety and matures in 95 - 100 days. This variety has profuse tillering capacity. This variety is not only drought tolerant but also resistant against lodging. It yields 2100 to 2200 kg/ha in rainfed area.

Conclusion

It is concluded that, these varieties are suitable for contingent cropping due to their drought tolerant capacity. Besides, when choosing alternate crops everyone should avoid choosing the same crops, uniformly matured crops and only high demanding crops should be cultivated.

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A Review: Classification and Harvesting of Vegetables

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Introduction

Fruits and vegetables are the parts of our daily meal. They provide energy in the form of minerals, proteins, vitamins, fibres, carbohydrates, iron, zinc, magnesium, calcium etc. to our body. Various types of fruits and vegetables are full of different features such as test, proteins, minerals or colour, size, shape, etc. Vegetables are the usable and edible part of the plants with some cooking recipe or without cooking. Mostly the vegetables need to do some process for making them tasty and delicious. Leaves, fruits, roots, flowers and stem are included in the vegetables which are the various parts of the plants. Because of the unique, characteristics and structures of the vegetables, they can be classified into: leafy, fruiting/flowering, root, non-vegetable and perennial vegetables. The storage process and harvesting process of vegetables are depending on the type of a vegetable, climate, environment etc. Classification of the different vegetables and some examples are shown in figure 1.

A. Leafy Vegetables

Leaves are the edible part of the plants; such type of vegetables is known as leafy vegetables or succulent vegetables. The time duration of freshness of leafy vegetables is minimum one day and maximum two or three days after harvesting; using some preservation methods it can be increased. In many cases, the freshness of green leafy vegetables depends on the type of a vegetable, climate, environment, storage process and harvesting process. These vegetables are called succulent because they are having juicy nature. All vegetables are not sweet or having full of flavors like fruits, but after making some recipe, they become delicious and tasty. Spinach, fenugreek, mint, dill, cilantro, cabbage and spring onions are easily available in Indian markets. All over the World, many types of leafy vegetables are used in daily meal for example, brussels sprout, rapini, epazote, broccoli, arugula, ceylon spinach, chinese mallow, bitterleaf, amaranth, bok choy, cabbage, cauliflower, lagos bologi, samphire, land cress, chicory, cress, etc.

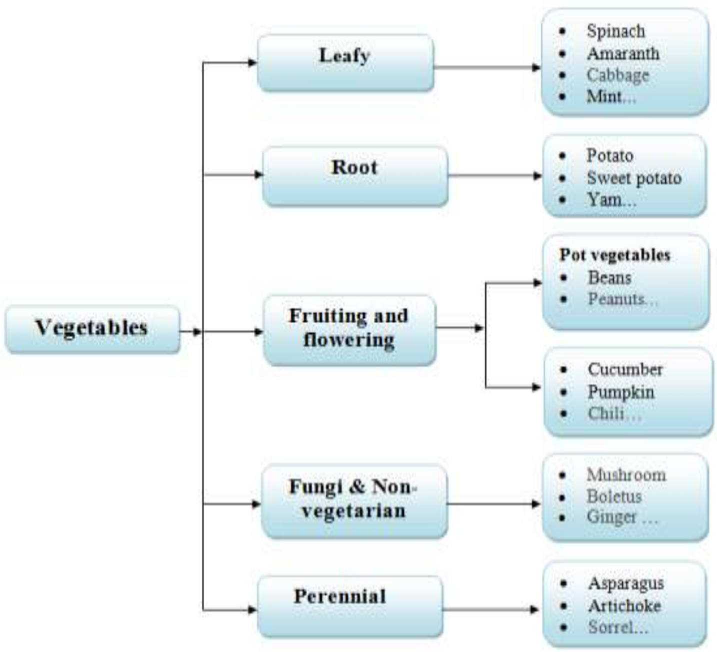

Fig. 1 Classification of vegetables

B. Root Vegetables

A variety of plants having the tasty and edible roots are called as root vegetables. Naturally, roots are available under ground or at the bottom of the plants and are rough and strong in nature. It can be used for long time after harvesting or cropping and classified into true rots and some non-roots, but agriculturally and generally both are included in root vegetables. Taproots and tuberous roots are the subtypes of true roots, alternatively rhizomes, corms, tubers and bulbs are subtypes of non-roots. Garlic, onion, shallot, carrot, daikon, beet, turnip, potato and sweet potatoes are some examples of the root vegetables. Whereas, potatoes are considered as a root vegetable or it is included in the steam vegetables.

C. Fruiting and Flowering Vegetables

Fruits and flowers of plants are used as vegetables and for eating with preservation. These are included in the fruiting and flowering types of vegetables. Fruiting vegetables contain fruits of any plants. Because of the lesser amount of sweetness, they can be included in the vegetables. On the other hand, the flowers are used as a food or vegetable. These are generally known as flowering vegetables. For example, cauliflower, artichoke, dok kae flower, courgette flowers, broccoli, artichoke, etc. Pod vegetables are subtype or included in the fruit vegetables also. Beans and pea are edamame bean pod vegetables. Tomatoes, pumpkin, chili, cucumber, squash, bitter gourd, bottle gourd, brinjal and pepper – bell are some of the fruiting vegetables commonly used in home for daily meal.

D. Fungi and Non-Vegetarian Vegetables

Some fungus or yeast is used as a food or with some preservation methods for eating like boletus mushroom. This type of fungus is generally called as fungi vegetables. Truffle, honey mushroom, cultivated mushroom, morel, shiitake mushroom, oyster mushroom, cantharelle are some examples which are included in fungi and non-vegetarian vegetables [3].

E. Perennial Vegetables

The perennial plants are available and live more than one-two years. These types of food or vegetables are perennial vegetables, e.g. rhubarb, asparagus, artichoke, etc. These types of vegetables are vital or essential food for wherever there is a steamy crop growing and for various civilizations around the world [4].

Fig 2. Cabbage harvesting

More Examples of Vegetables

Out of these vegetables, we have selected particular vegetables for this study because these are easily available in Solapur and are cheap. Typically, cabbage, tomato and onion are easily available in market for all seasons.

1. Cabbage: Basically, cabbage is a leafy type of vegetable and is included in the Brassica oleracea var. capitata family. It is green, red, or white colour plant having dense-leaved heads. 75 gm cabbage contains 17% calories, 81.5 micrograms of vitamin K, 11 milligrams of magnesium, 22 micrograms of folate. It takes 70-80 days for harvesting from planting [5].

2. Onions: Agriculturally, onions are classified into the root vegetables but onion springs are included into the green vegetables. Onions are also included in allium and perennial vegetables. Storage or freshness time of onion is larger than its green leafy vegetables. Onions are also used for antiseptic purposes. They have a white, yellow, red or purple colour skin. If onions are with dried skin, they are also fresh or edible onions [6]. Onions coupled with various vegetables are used for test purpose. They can be classified into good and bad (rotten) quality onions.

3. Tomato: As per the classification chart and agricultural classification, tomatoes are included in the fruit vegetables type. Normally, tomatoes are available over all the year. For diabetes patients, eating tomatoes is like eating medicine. It can be helpful to improve blood sugar insulin levels and lipids. On the other hand, it can also be used for lower blood glucose level with high fibre diets [7]. Tomatoes provide vitamin C which is vital for hair, skin, connective tissues and nails. Also, it contains fibres, choline, and potassium, which are good for heart health care. Vitamin C is a powerful antioxidant present in tomato [8, 9].

Conclusion

Thousands to ten thousand of varieties of fruits and vegetables are accessible in all over the World. All vegetables are having dissimilar quality, structure, features (like colour, size, toughness, smell, taste etc) and availability. Basically, some vegetables in particular groups are repeated into other groups, because of the characteristics and individuality of these vegetables. The classification of vegetables is a big issue and very important part in the storage. In the case of food storage or the food preservation, some aspects are dependent on the classification, availability, quantity, need and environmental conditions of those regions.

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Minor / Under Exploited Vegetables: Source of Major Nutrients

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Introduction

Vegetables are rich and comparatively cheaper source of vitamins. Consumption of these vegetables provides taste, palatability, increases appetite and provides fibre for digestion and to prevent constipation. Most of the vegetables contain the minerals and vitamins which boost the immunity system. Vegetables are the key component of balanced human diet and also the main drivers in achieving global nutritional security by providing nutrients, vitamins and minerals. Several minor vegetables are there which have less importance and more nutrients and minerals and these are considered as underexploited vegetable crops. They are the sources of important minerals and nutrients. although having these advantages in some places consumption of these plants is not socially acceptable by some community sectors because they are considered to be food for the poor (Jaenicke and Hoeschle, 2006).

Anil Kumar Jena et, al. 2018 reviewed that to be considered as an 'underutilized vegetable crops', a plant must have the following features: Crop must have a scientific or ethno botanical proof of food value. Crop must have been cultivated, either in the past or only being cultivated in a specific geographical area. It must be currently cultivated less than other conventional crops. Crop must have weak or no formal seed supply system. Crops are recognized to have indigenous uses in localized areas. May be highly nutritious and/or have therapeutic medicinal or therapeutic properties or other multiple uses. here are some examples of the minor vegetable crops which have high nutritious value.

Asparagus

Asparagus is an herbaceous perennial and the tender shoots called spears are used as vegetables and in preparation of soup. It is also eaten as salad. The origin of asparagus is temperate Europe and Asia, where it has been in cultivation for over 2000 yrs.

Asparagus

Lettuce

Lettuce

Lettuce is probably a native of Europe and a Minor and has been in cultivation for over 2,500 years. Lettuce is grown in almost all the states of India. It is a popular salad crop mostly in cities. It is rich in vitamin A and minerals like calcium, phosphorus, sodium, sulphur, magnesium and potassium. It also contains protein, carbohydrates and vitamin C. Lettuce is a very good salad vegetable with low nutrient density. it has a crisp texture. In India, lettuce is grown nearly in all Kitchen gardens and to some extent by large number of commercial growers to meet the growing demand of continental hotels. The important uses of Lettuce are: Known for its diuretic in nature. Stem lettuce, eaten raw or cooked is widely used in Chinese cookery.

Celery

Celery stalks have only moderate levels of vitamins, but have a low percentage of carbohydrate and negligible fat, it is popular with dieters because it is 94% water and has only 21 calories/100 g portion consumed. Sliced stalks are also used as an ingredient in soup or stews. The main use of celery is as a salad dish. Celery is cultivated for its succulent flavored leaves, seeds and essential oils the leaf stalks & petioles are eaten as salad, in soups, in sauce, in puree, fried & spiced In India, it is mostly grown for seed to export for culinary sauces, oleoprotein & tonics. These beverages are anti flatulents, diuretic, nerve builder etc.

Celery

Leek

Leek

It is a non bulbing biennial grown for its blanched stem and leaves to be taken as salad or cooked with other vegetables or used in flavouring soups. The long white stem and leaf base and green tops which are edible are good source; of carbohydrate (5%), protein (1.8%), phosphorus (70 mg/100 g), iron (2.3 mg/100 g) and Vitamin C (11 mg/100 g). Like all other alliums, leeks are rich in potassium, calcium, phosphorus, iron, vitamins C, thiamin (B1) and riboflavin (B2) and are very therapeutic. They are usually more expensive than other member of the family. Leek contains allicin and diallyl disulfide, that block or suppresses cancer causing agents, boost immunity and prevent infections. It Is a non-bulb bearing crops grown for its blanched stem & leaves . It is milder & more delicate flavour though of course texture. Eaten as raw alone or mixed in salad . The edible parts are highly nutritious and rich in medicinal properties.

Parsley

Parsley leaves are ready for use about 3 months after seeding.A few leaves at a time may be removed from each plant, or the entire bunch of leaves may be removed for use. Although parsley leaves are used most commonly in the fresh green condition as a garnish, their characteristic flavor and green color can be retained if the leaves are dried rapidly. Dehydrated parsley flakes are produced from parsley grown in commercial fields. Green parsley leaves have a mild, agreeable flavor, and are an excellent source of vitamin C, iodine, iron, and other minerals. Quite often parsley is left on the plate to become the last bite, as it tends to sweeten the breath.

Parsley

Other Examples of Underexploited Vegetables

		
Gogu	**Sorrel Leaves**	**Turnip**
		
Kale	**Pointed Gourd**	**Lima bean**

		
Winged Bean	**Basella**	**Broccoli**

	
Rhubarb	**Buckwheat**

Conclusion

Due to Lack of awareness about minor vegetables most of the farmers are not able to cultivate the minor vegetables and it has many advantages as well as medicinal properties. Production technology and cultivation aspects almost same as vegetables (sometimes differs crop to crop). Underexploited vegetables play an important role in the national economy. The climate and soil of India are well suitable for the production of different minor vegetables. Thus, the government of India has been taking some steps towards highlighting the underexploited vegetables.

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Rabi Maize Cultivation- An Untapped Potentiality in Dakshin Dinajpur District of West Bengal

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Introduction

Maize (*Zea mays* L.) is an important cereal crop in world after wheat and rice. The importance of maize lies in its wide industrial applications besides serving as human food and animal feed. It is the most versatile crop with wider adaptability in varied agro-climates and has highest genetic yield potential among the food grain crops. As the demand for maize is growing globally due to its multiple uses for food, feed and industrial sectors, we need to produce more from same or even less resources. New production technologies offer great promise for increasing productivity to meet the growing demands of world consumers.

Maize is called 'Queen of Cereals' as it is grown throughout the year due to its photo-thermo-sensitive character and highest genetic yield potential among the cereals. In India, maize is cultivated throughout the year in most of states of the country for various purposes including grain, feed, fodder, green cobs, sweet corn, baby corn, popcorn and industrial products. Corn area, production and productivity in India has shown a steady upward trend in recent years. In India, current consumption pattern of maize is poultry, pig, fish feed 52%, human consumption 24%, cattle feed and starch 11% and seed and brewery industry 1%.

In India, the area of maize is sticking to around 6-7 million hectares since last three decades, and the overall increase in maize is realised largely from increasing productivity in favourable ecologies. Rabi maize is grown on an area of 1.2 million ha with the grain production of 5.08 million tonnes, with an average productivity of 4.00 t ha-1 (DACNET, 2012). The predominant rabi maize growing states are Andhra Pradesh (45.5%), Bihar (20.1%), Tamil Nadu (9.3%), Karnataka (8.5%), Maharashtra (7.7%) and West Bengal (5.3%). In Dakshin Dinajpur district of West Bengal maize area is about 340 ha with a productivity of 3528 kg ha-1 whereas wheat area is 32300 ha with productivity of 2725 kg ha-1 and boro rice area 37450 ha with productivity 4996 kg ha-1 (2011-12).

Yield obtained during winter season is invariably higher (>6 t ha-1) than the kharif season yield (2-2.5 t ha-1) due to long duration of growth and least infestation of pests and diseases. In West Bengal, maize can be taken up in all the three seasons. In recent years, significant changes have occurred in maize production and utilisation due to increasing commercial orientation of this crop and rising demand for diversified end users, especially for feed and industrial uses. A sizable area of West Bengal has potential for growing winter maize.

Opportunity and Challenges

Maize is traditionally a monsoon crop (June-October) in India, but is extensively cultivated in large parts of eastern and southern India in winter (October-April) season. To increase the trend of Rabi maize, opportunities to be searched and strategies to be made to meet the challenges.

Area Expansion

Cultivation during winter season spreads in entire plain region of the country where temperature during the growth periods does not go below 100C. The sensitivity of a crop species to low temperature and chilling frequently restricts the environment in which it can be cultivated. Hence, Rabi maize cultivation is possible in Dakshin Dinajpur district of West Bengal.

Diversification of Agro-Ecosystems

Under the changing climate scenario maize being a photo-insensitive crop has better options for adaptation and mitigation of these climatic changes. The limitation of rising temperature during grain filling of wheat particularly in eastern India, and declining yield of boro rice in West Bengal affecting yield of boro rice has shown a path to maize as better option. Therefore, it is emerging as a potential driving force for diversification i.e. diversification of rice-rice with rice-maize and other maize based high value cropping systems in water scarcity or lowering of water table is a major concern in rice growing belt of West Bengal and making rice cultivation non-remunerative. Hence, maize has emerged as a potential as well as profitable crop in the areas. The boro rice in Dakshin Dinajpur district is becoming non remunerative due to high cost of irrigation and water scarcity. Therefore, maize is the only suitable alternative crop and more area is likely to shift towards maize cultivation in near future in these non-traditional areas. Wheat crop adversely affected with terminal heat due to sudden rise in temperature during crop growth and maturity but this favors maize crop positively. Rice-rice is common in tropical climate with distinct dry and wet seasons such as in South India, and in subtropical areas with mild cool winter climate in Dakshin Dinajpur district of West Bengal. Rice wheat systems is extensive in the district now-a-days. Rice-maize systems, however, are less extensive as compared to Rice-Wheat or Rice-Rice if total area under these cereal systems is considered. The productivity level of winter maize is higher as compared to kharif sown maize because of comparatively favorable environmental conditions in the study area. Rice-maize systems are practiced mostly in the northeast parts of India like Bihar and West Bengal with acreage of more than 0.5 mha. Maize is considered to be a better alternative to wheat or boro rice due to several reasons: (a) wheat encounters several biotic stresses, and most importantly, abiotic stresses due to terminal heat stress in the area, wheat is often vulnerable to temperature fluctuation resulting in shriveled grains and poor yield, (b) evidences of declining yield of boro rice in Dakshin Dinajpur of West Bengal, and (c) water scarcity in some parts of Dakshin Dinajpur district of West Bengal affecting yield of boro rice. In particular, maize has fewer pest and disease problems than boro rice and wheat. The medium and uplands where subsistence yield of wheat, Rabi rice and other winter crops is obtained, could be substituted by winter maize in West Bengal. Winter maize (170-180 days duration) has the clear-cut comparative advantages of low incidence of diseases and insect pests, is not affected by temperature rise during winter (as the wheat is) and do not suffer on account of heavy rainfall.

Contributing Factors for High Yield in Rabi Maize

Though the crop favourably responds to better crop management both in kharif and rabi season, the erratic rainfall pattern of the south-west monsoon comes in the way of timely field operations of kharif season. In absence of any major environmental impediments in rabi, the desired field operations can be planned and executed at the most desired time. Moreover, the various environmental factors, including absence of any major disease and insect-pest in this season, helps in realizing better profits from every additional unit of monetary inputs. Some of the important factors favouring maize cultivation in rabi are briefly discussed below:

1. Better water management: In absence of erratic rainfall, the crop during rabi season does not suffer from waterlogging, hence damage from rots is less. As there is no leaching of fertilisers, their utilisation is maximum leading to high yield. The important advantage is the possibility of undertaking various field operations at the most desired time. The rabi crops does not suffer from overcast sky which is a regular phenomenon during kharif season.

2. Mild and favourable temperature: Maize plants in rabi season tend to be more efficient in view of lower photo respiration losses due to lower night temperature as well as larger leaf surface for effective photosynthetic activities. The other advantage in rabi season is availability of 7-9 or more hours of sunshine against 3-5 hours in kharif crop season due to cloudiness. Moreover, the longer growing duration of the crop helps further raise in yield levels.

3. Better response to nutrients: In view of more favourable growing conditions, response to application of nitrogen and other nutrients is better in rabi than kharif season. The losses during rabi can be checked effectively through appropriate soil and water management practices. With better response from every unit of fertilisers, which is the major component of cultivation cost, it is possible to reduce the production cost during this season.

4. Less incidence of disease and insect-pests: In rabi season due to low temperature, low humidity and brighter shunshine in rabi season, level of infestation of various diseases and insect pests is quite low, resulting in higher yields.

5. Better plant stand: Because of better soil and water management and less damage from diseases and pest, establishment of desired plant population density can be assured in rabi season.

6. Better weed management: In rabi season, due to effective water management and low temperature, weeds can be controlled effectively. This indirectly helps in improving the fertiliser-use efficiency. But, in kharif, weeds pose a major problem, particularly in years when continuous rain occurs, which fail to provide adequate opportunity for manual weeding.

Conclusion

In view of the changing farming scenario in the country, maize has been emerging as one of the potential crop that addresses several issues like food and nutritional security, climate change, water scarcity, farming systems and biofuels. Rabi maize cropping can provide insights on intensive agriculture and other strategies for meeting future food production challenges and will be one of the important cereals in food security of the country. To do this, we need new ways of working, new non-traditional crop like maize crop may be introduced and cultivated in large areas may be more remunerative instead of cultivation of less remunerative crops like wheat and boro rice in Dakshin Dinajpur district of West Bengal.

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Advances in Micronutrient Fertilizer Product Research for Enhancing its Use Efficiency

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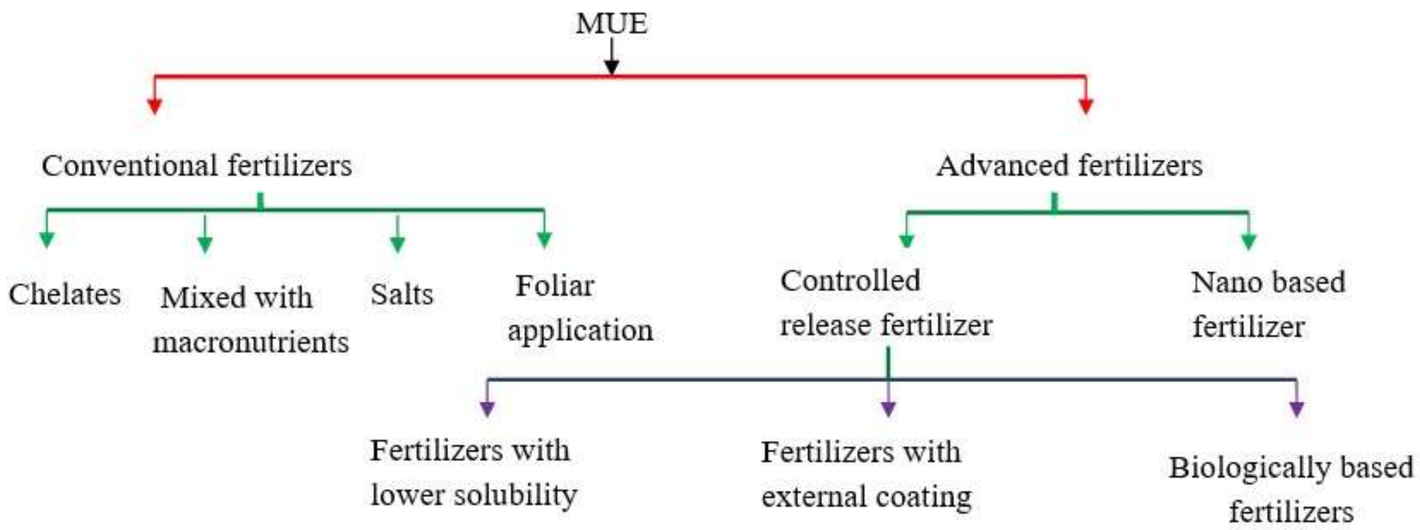
Besides macronutrients, micronutrients are also required for plant growth and sustenance of soil health. Fertilization of soil with micronutrients is essential to achieve optimum crop yield. However, use efficiency of traditional micronutrient fertilizers are very low due to continuous use of macronutrients without proper substitution and exclusion of micronutrients in fertilizer schedule have resulted in accelerated appearances of multi-micronutrient deficiencies in soils and crops. Therefore, precise fertilization techniques are utmost important in modern agriculture to maintain soil health and productivity with increased crop yield.

Micronutrient Use Efficiency (MUE)

MUE can be defined as the relative proportion of micronutrient fertilizer added to the soil that is absorbed by crops. It mainly depends on the nutrient transport within the plants, uptake, accumulation and micronutrient fate in the environment. Main objective of MUE is to increase the overall performance of cropping systems by providing economically optimum nourishment to the crop while minimizing nutrient losses from the field.

Ways to Increase Micronutrient Use Efficiency



Conventional Fertilizers

1. Chelated micronutrients: In fertilizer technology, chelate refers to inorganic nutrients that are enclosed by an organic molecule. Synthetic chelates are EDTA and DTPA and natural chelates are organic acids, amino acids, phenols, poly flavonoids, siderophores and phyto siderophores.

2. Micronutrient mixed with macronutrients (Fortification): It is the mixing of micronutrient fertilizers with the macronutrients especially when the application of conventional NPK fertilizers is not efficient. Ex: Urea coated Zn and Boron superphosphate.

3. Micronutrient salts: These are the chemically synthesized fertilizers which are composed of micronutrients. Ex: $ZnSO_4$, MnO and $CuSO_4$

4. Foliar application: Response to the applied nutrient is almost immediate, so deficiencies can be corrected during the growing season. Ex: $FeSO_4$ and $Ca(NO_2)_3$

Advanced Micronutrient Fertilizers

1. Controlled release fertilizers (CRFs): The conscious management of fertilizers is based on adjustment of doses to the needs of cultivated plant species. The application of traditional fertilizers is toxic at higher doses, excessive fertilization may lead to environment pollution by leaching to groundwater and concentrate in root zone which is also toxic to plants. Thus, it is significant to supply them in a precise way to the plant, so the quantity lost would be minimal.

a. Fertilizers with lower solubility: These are the products with a slowdown release of nutrients. Characterized by low solubility, making it harder to leach out of the soil. Co-granulated products of MAP with BPO_4 synthesized at 500 and 800˚C for 1h shows potential slow release property (Abat *et al*., 2015).

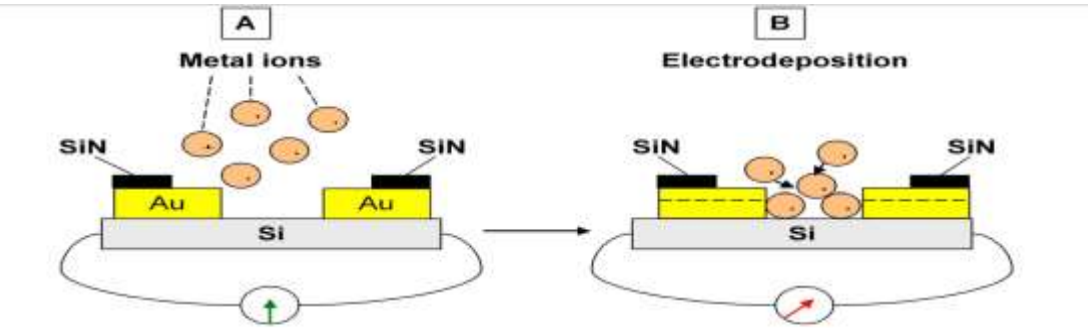
b. Fertilizers with external coating: The nutrients granules coated with a special coating material composed of readily available forms of nutrients and the nutrients are released at a slower rate through diffusion process this is due to coating material acts as a physical barrier that hinders their transport. Ethylene vinyl acetate polymer coated microcapsules with matrix structure of Compritol 888 ATO, can slowly release Fe ions in water and soil (Koupai *et al*., 2012).

c. Biologically based fertilizers: the above mentioned CRFs coatings used so far is not environmentally friendly and economically fissile so new solutions are still being sought to improve this technology. A promising alternative may be use of biological materials that have a natural ability to bind ions of micronutrient through biosorption process. They are characteraised by higher bioavailability, slowed nutrients release, biodegradable and reduces the negative impact of fertilizers on the environment. Skrzypczak *et al*.(2019) reported that biocomposites (alginate-carboxymethyl cellulose-eggshell) have a good potential as controlled release fertilizers fitting into the concept of sustainable development and precision agriculture.

2. Nanobased micronutrient fertilizers: Nanotechnology is a new trend in the fertilizer industry, which uses nanoparticles. The word “nano” refers to the dimension of one-billionth of a meter (m) or one-millionth of a millimeter (mm). Nanotechnology refers to the constructing and engineering of the functional systems at very micro level or we can say it atomic level.

Nanotechnological Strategies to Enhance Micronutrient Use Efficiency

1. Quick on-site detection of micronutrients using sensors:



An example of how nanoscience can be applied to the sensing technology is shown in figure.

a. A drop of a sample solution containing metal ions is placed onto a pair of nanoelectrodes separated with an atomic scale gap on a silicon chip.

b. Holding the nanoelectrodes at a negative potential, electrochemical deposition of a single or a few metal atoms into the gap can form a nanocontact between the two nano-electrodes and result in a quantum jump in the conductance. The operational principle includes, the sensor is made of an array of electrode pairs fabricated on a silicon chip and separated by few nanometres (nm). When the electrodes are exposed to a solution of water containing metal ions, these deposit inside the nano-gap in between the electrodes. Once the deposited metal bridges the gap a 'jump' in conductance between the electrodes is registered. The size of the gap, being only few nm, allows the detection of a very low concentration of metal ions. This type of sensor is called 'nanocontact sensor'. Soil solution can be allowed to react with nano-sensors that will give accurate measurement of availability of nutrients in the soils.

2. Nano-formulations to enhance micronutrient use efficiencies: Nano formulations includes nano fertilizers, micronutrients encapsulated with core shell , carbon sphere and zine oxide. Yuvaraj and subramanian (2015) proved that a manganese hollow core shell with nano dimensions can improve Zn use efficiency, besides the sustained release of Zn that may considerably economize Zn use in crops, with the added advantage of prevention of groundwater contamination. Ashfaq et al. (2016) reported that carbon nano fibres (CNFs) served as a carrier for the Cu micronutrient, with a controlled release of the Cu nano particles. The foliar application of nano-boron and nano-molybdenum increased yield, agronomic efficiency and elements use efficiency by potato plants due to its slow release property, small size and its distinctive behaviour have made it be the most efficient in absorption (Juthery and Maamouri., 2018).

3. Smart delivery system: Smart treatment delivery system is exploited in health sciences to deliver required quantities of medicine to the place of need in human system. Similarly, implanting nano particles in the plants could determine the nutrient status in plants and take up suitable remedial measures well before the malady causes yield reduction in crops. Such devices may be capable of responding to different situations by taking appropriate remedial action. If not, they will alert the farmer to the problem. In this way, smart devices will act as both a preventive and an early warning system.

Nanobiotechnology Based Intelligent Micronutrient Nano Fertilizers

The technology deals with the development of a model intelligent nano fertilizer delivery platform for micronutrients. This nutrient delivery model is based on the recognition or binding of specific plant metabolites exuded in response to deficiencies of specific micronutrients in soil by a nano biosensor which is housed in a polymer film loaded with fertilizer nano particles. Upon binding, the fertilizer nanoparticles are released in a synchronized fashion in response to a root signal indicating the deficiency of micronutrients (Monreal et al.,2015).

Conclusion

Traditional fertilizers cause over-fertilization and leaching of microelements to deeper soil layers, soil fixation, ground water and surface water pollution. The application of controlled release fertilizers has enhanced the nutrient use efficiency of micronutrients. Nano sensor or Nano biosensor helps to create awareness about the plant performances and better crop management. Nano formulation has significantly increased crop growth, nutrient uptake, yield and nutrient use efficiency.

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Importance of Breeding in Artemisia

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Introduction

The genus *Artemisia* belongs to a useful group of aromatic and medicinal plants. It is one of the largest and most widely distributed genera of the family Asteraceae comprised over 450 diverse species. In India, the genus is represented by about 30 species and most of these are restricted to Himalayan belt excepting a few species growing in the tropical and subtropical plains.

These species are perennial, biennial and annual herbs or small shrubs. In the literatures, artemisinin has been reported in *A. annua*, *A. apiacea* L., *A. lancea* L., *A. cina* L., *A. sieberi* L., *A. absinthium* L., *A. dubia* L. and *A. indica* L. Among all, *A. annua* is suitable for cultivation and has been described as containing 0.5 to 1.2% artemisinin in the dried plant material. *A. annua* is economically the only natural botanical source for artemisinin production.

Davana is an important aromatic crop of India commercially cultivated in Karnataka and to a lesser extent in Maharashtra, Kerala, Tamil Nadu and Andhra Pradesh. Attempts have also been made to raise this crop have been made in North Indian agro climatic conditions with limited success.

Floral Biology

Davana belongs to the family Asteraceae and is endemic to India. It is an aromatic, erect, about 60 cm tall, annual herb with small, much divided leaves and small inconspicuous yellow flowers. The inflorescence is a capitulum which is shortly peduncle to sessile, axillary or forming lax racemes.

The capitulum consists of heterogamous flowers, i.e., bisexual disc florets in the center and few pistilate ray florets on the periphery. Outer pistillate florets are glabours except for a few cottony hairs, tubular with generally 2 lobed (rarely 3 lobed) stigma.

Inner florets are also glabours except for a few cottony hairs, tubular, 5 lobed and bisexual. *Artemisia pallens* does not occur wild. It is grown as a garden plant in south India.

The Davana requires 110-115 days to come to flowering and the flower head requires 19 days to complete the bud stage with a gradual increase in the bud size.

Anthesis occurs between 7.30 AM. and 12.30 PM., and its peak period is at 10.30 AM. Anther dehiscence is observed between 7.30 AM. and 12.30 PM with the peak at 9.30 AM. Stigma is found to be receptive after anthesis and the maximum receptivity is observed at 7 AM.

The pollen grains are spherical in shape and 19.67 µ in diameter. Studies on breeding behavior and seed setting pattern has revealed little difference in percent of seed setting under open pollinated, bagged and isolated conditions. It indicates that Davana to be a self-pollinated crop, which is contrary to other species in asteraceae family characterized generally for cross pollination.

Meiotic studies revealed that the chromosome number of Artemisia is 2n=16. The chromosomal behavior during diakiness is found to be abnormal with seven bivalents and two univalent. This could be one of the reasons for low pollen fertility and seed set in the species.

Crop Improvement

Races which are the result of indirect human and natural selection over a long period of time and maintain their own seed. Five such accessions collected from Karnataka and Tamil Nadu states were grown at Bangalore for evaluation of yield and its contributing characters

Evaluation of Germplasm

There is no systematic attempt have been made to develop varieties through crop improvement. local types are being cultivated. It was evident that these accessions did not vary significantly among themselves for most of the characters, suggesting that, in this crop, simple selection from germplasm pool is not enough for improvement of oil productivity.

Breeding for Increasing Artemisinin Content of *A. Annua*

A new breeding strategy of comprehensive integration of biotechnology and DNA marker applications with conventional backcross breeding techniques for Artemisia improvement should be developed. For making breeding programs in Artemisia germplasm collections are one of the important sources of genetic diversity and this diversity should exploit for artemisinin improvement. Wild Artemisia are also existed in artemisinin enhancing alleles.

Furthermore, this breeding technique used us to select potential parent lines of *A. annua*. Three approaches are considered in this review. These are:

1. Conventional breeding programs.
2. Mutation breeding.
3. Molecular breeding approaches.

Conventional Breeding Programs

The scientific studies have shown that artemisinin content can vary widely among different genotypes of *A. annua* from different origins, hence, breeding for this trait may be feasible. The genetic basis of this variation has been investigated by many researchers. Additive genetic components were predominant, resulting in a high narrow-sense heritability estimate. This trait exhibits high heritability therefore it appears possible to breed *A. annua* with a higher level of artemisinin. For breeding purposes, crosses can be made only between individuals of *A. annua* that those have high artemisinin content.

Mutation Breeding

It is evident the tiny florets borne over the capitulum in Davana plant limit its improvement through conventional breeding methods. Attempts have, therefore, been made to induce mutation using gamma rays and ethyl methyl sulphonate. The gamma radiation affected not only the seed germination but also reduced the rate of germination conspicuously. The LD-50 for germination was found to be between 50 and 70 kr and for ethyl sulphonate at 1.0 per cent with 6 hours treatment. The EMS treatments have also resulted in the pollen sterility to an extent of 72 per cent (Farooqi, 2010).

Molecular Breeding Approaches

Molecular marker technology has so far failed to be extensively used as a breeding tool by Artemisia breeders, because of the fact that no QTL responsible for a large enough effect on leaf yield has been discovered. In *A. annua*, there are now attempts to employ markers linked to leaf artemisinin content, trichom density and flowering delay. Only a very small fraction of the available *A. annua* germplasm has been assayed for alleles that might improve artemisinin content.

It is likely that *A. annua* from many areas regarded as a wild plant and such plants have rarely been used as parents in QTL mapping studies. One of the objects of the molecular breeders is to develop an efficient marker system to be used in breeding *A. annua* for high artemisinin content. This marker system can distinguish plant tending to synthesize high amount of artemisinin when the biosynthetic system of the plant is functional.

Other objective of the invention should generate a breeding and selection method using the marker assisted breeding to increase the content of artemisinin in the plants. Individual loci with large effects on artemisinin content should be identified. The characterization of such genes and their anatomical, physiological, and molecular genetics effects, will be key factors in the application of molecular marker technology to the development of high artemisinin varieties.

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Ethylene Synthesis and their Role in Horticultural Crops

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Introduction

Dimitry Neljubow (1876-1926), a Russian Botanist is believed to be the first to recognize the growth regulatory properties of ethylene. In 1901, ethylene in illuminating gas was identified by him and showed that it causes a triple response on pea seedlings. He reported that the oranges should not be stored with bananas on ships because the emotions from the oranges caused the bananas to ripen prematurely. The biosynthetic pathway of ethylene via S-adenosyl methionine from methionine (Yang and Hoffman, 1984). Ethylene has been recognised as a plant hormone which has many effects in plant from seed germination to senescence and death of the plant.

Chemistry of Ethylene

Ethylene is a simple unsaturated hydrocarbon that is a gas at room temperature. It is produced in most of the higher plants. Ethylene is particularly synthesized in the tissues which are undergoing senescence or ripening. Its biosynthesis is also induced by occurrence of various physiological stresses such as flooding, chilling, wounding, diseases, drought and temperature stresses. Its molecular weight is 28 which is higher than air under physiological conditions. Being a gas, ethylene moves by diffusion from site of synthesis to site of action. 2-chloroethylphosphonic acid (Ethephon / Ethrel) is a synthetic form of ethylene which is in liquid state at the proper pH does not yield ethylene.

Biosynthesis of Ethylene - Physiological Responses of Ethylene

Ethylene breaks seed and bud dormancy: In addition, application of ethylene increases the rate of germination in several species. The exposure of dormant iris, narcissus, tulip and gladiolus propagules to ethylene at appropriate time can hasten shoot and root growth, shorten the time to flowering and increased the number of small propagules which successfully flower. Ethylene treatment is sometimes used to promote bud sprouting in potato and other tubers. The effect has been found to be associated with increased respiration and mobilization of carbohydrates.

Ethylene Stimulates Seedling Growth and Triple Response

The first effect of ethylene shown on plants involves the behaviour of etiolated pea seedlings. They show a characteristic triple response to ethylene, i.e. elongation of growth is inhibited, radial growth is promoted and orientation of shoots to gravity is disturbed. For example, when pea seedlings emerge through soil and encounter a barrier such as crust or rock, elongation growth slows, radical growth increases and shoot grows horizontally. The epicotyl of pea seedlings forms a natural hook with the apical bud folded over back towards the shoot.

Ethylene Inducing Flowering

In most cases, ethylene inhibits flowering but in pineapple, mango and litchi, it has stimulatory effect. Flower induction in pineapple by ethylene is used commercially to synchronize the fruit set. Plants can be treated with ethylene directly or by using ethylene releasing compound like Ethrel (2-chloroethylphosphonic acid) or indirectly with auxins which stimulate ethylene production naturally.

To Promote Flowering & Fruit Set

Ethephon can also be used to synchronize flowering and fruit set in pineapple. It can also be used to induce fruit thinning or fruit drop in cotton, cherry and walnut. Ethephon also helps to promote female sex expression in cucumber. Silver (Ag^+) an inhibitor of ethylene biosynthesis is used extensively to increase the longevity of cut carnations and several other flowers. AVG, another inhibitor, retards fruit ripening and flower.

Ethylene Promotes Fruit Ripening

The stimulation of fruit ripening was one of the earliest reported effects of ethylene. Fruit ripening refers to the changes in the fruit that make it ready to eat. The term climacteric refers to fruits, which ripe in response to ethylene. Apples, bananas, avocados and tomatoes are the examples of climacteric fruits. In these fruits' ethylene concentration goes from undetectable level to 0.1 to 1 µl 1-1 which stimulates ripening of fruits to exhibit a climacteric rise in respiration. In contrast, non-climacteric fruits like citrus, grapes and cherries synthesize very little ethylene and are not induce to ripen. In tomatoes, several genes have been identified that are highly regulated during ripening.

In apple, it can be used to accelerate fruit softening and to advance the colour development of fruits. Ethephon has also been found to promote colour development with decreasing total fruit acidity in grapes. Ethephon treatment may also be useful when natural fruit colour development is poor.

To Increase the Latex Flow in Rubber

When ethephon is applied near the tapping cut of rubber trees it causes latex flow to increase in duration, resulting in an increase in the volume of latex collected. Use of ethephon can increase the rubber yield by 50-100%.

To Promote Fruit Abscission

Mechanical harvesting in cherry and olive fruit limited because the force used to remove the fruits also damages the trees. Application of ethephon at 10-15 days before anticipated harvest cause fruit abscission and thus, reduces the fruit removal force to allow mechanical harvesting of crop without tree injury.

Ethylene Stimulates Abscission

Abscission refers to the separation of an organ or plant part (leaves, fruits, flowers etc.) from the parent plant. It occurs in specific layers of cells called abscission layers. The abscission is important to enhance the yield and efficiency of harvesting operations. First, ethylene production increases prior to abscission in many abscising plant organs. Second, treatment of a wide range of plant species with ethylene stimulates abscission and third, inhibitors of ethylene biosynthesis or action will inhibit abscission.

Ethylene Induces Leaf Epinasty

Ethylene and high concentrations of auxin are caused to induce epinasty. There are evidences indicating that auxin acts indirectly by inducing ethylene production. Water logging, salt stress or anaerobic conditions around the roots enhances the synthesis of ethylene in the shoot, which results in epinasty response.

Commercial Uses of Ethylene

Use of ethylene in agriculture has been limited because of the impracticability of field treatment with a gas. However, certain ethylene releasing compounds are available and used widely that decomposes on or within a plant to release ethylene. Ethephon (2-chloroethylphosphonic acid) is one of such compounds that are stable at pH values of 4 or less, but at higher pH values, the compound decomposes to produce ethylene, chloride and phosphate ions. Since the cytoplasmic pH is greater than 4, once ethephon is absorbed, cleavage to ethylene inside the cell begins. Two other compounds, also (2-chloroethyl-tris-ethoxymethoxy saline) and sailaid (2-chloroethyl-bis-phenylmethoxy saline) also decompose to ethylene, but much more rapidly than ethephon, and are less sensitive to change in pH. Recently, 1-methylcyclopropane (MCP) is being developed for use in a variety of post-harvest applications.

In addition,
1. Ethylene application can induce adventitious root formation in leaves, stems and other roots.
2. Ethylene promotes induction of female flowers in cucurbitaceous vegetables.
3. Ethylene enhances leaf senescence.
4. Ethylene acts as a wound hormone.

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Lubrication: Purpose, Properties, and Use in Agri-mechanics

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Introduction

Internal combustion engines are composed of various types of moving parts. One can observe a constant wearing of moving pieces because of the continuous and rigorous movement of various metallic surfaces over one another. Lubrication helps to smooth the process and thus reduce wear and tear on the parts of the machinery. So, a component can break down due to excessive heat and destructive damage, without proper lubrication. The lubrication system is necessary and highly recommended to prevent all those harmful effects.

Role of Lubricants in Agri-Mechanics

For agriculture, the machinery is of immense importance for increasing productivity. Various tractors, Power tillers, combine harvesters, silage harvesters, and grape harvesting machines are occupied with several very high-performance engines that work with different gearbox types: high-level power changes or continuously variable transmissions. It is important to keep equipment going during crucial times when you are using tractors, bailers, trucks, air compressors, vacuum pumps, or other farm machinery. It can be difficult due to the harsh environmental and operational conditions, such as ice, heat, dirt, and water, which can degrade the output of a lubricant in your equipment (Anonymous[1] 2020. *Industrial Lubricants | Asset Reliability Solutions | Lubrication Engineers*). An efficient and good agricultural equipment lubrication system ensures reduced maintenance of the machinery, decreased operating costs along with extended life of the machinery. Lubricants help in an efficient maintenance of a wide range of agricultural equipment like tractors, power tillers, maize pickers, silage harvesters, combines harvesters, round balers, big balers, round spike harrows, stone grinders, slurry tankers, beet harvesters, potato harvesters, fodder mixers, silage spreaders, straw blowers, mowers and mower conditioners, hay tedders, sprayers, fertilizer spreaders etc.. (Anonymous[2], 2020. Lubricants - CONDAT, Specialist in Industrial Lubricants, Greases, Oils).

Engine Lubricating System

In an engine the lubricating system is seen as an arrangement of an efficient mechanism which generally maintains the supply of lubricating oil to the mechanical rubbing surfaces of the engine at an accurate pressure and temperature. The engine parts which are to be lubricated are internal surfaces of cylinder walls, piston pin, ignition mechanism, piston rings, crankshaft, the big and small end of the crankpin, valve operating mechanism, connecting rod, camshaft bearings, water pump and cooling fan.

Types of Lubrication Systems Used in Engine

Four methods of lubricating systems used in the engine are:

1. Petrol-oil Lubrication System: For this lubrication process, the lubricating oil is mixed with the petrol and fed in during the suction stroke to the engine cylinder .Partial droplet allows the engine cylinder to have lubricating effect .The lubrication process is used in tiny engines such as motorcycles and scooters. In this large engines this method isn't very effective. For scooters and motorcycles the lubrication system is used ,particularly for two stroke engines about 3 to percent of the lubrication oil is added with petrol being the petrol tank .Once the engine is running the fuel evaporates .In the type of mist the lubricating oil is left behind .The

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engine parts such as piston, cylinder walls and connecting rod is lubricated with the oil mist left behind waiting. When the oil added is less, insufficient lubrication will occur and even engine seizure will occur. If the added oil is more, excess exhaust smoke and car on deposits in the exhaust port cylinder and spark plugs will be caused.

2. Splash Lubrication system: For this method the lubricating oil is placed at the bottom of the crankcase in the sump or trough. Scoops (it's like a spoon) are placed on the connecting rod's wide end. This pan receives its oil supply, either using a gear pump or by gravity, from the oil sump. At the bottom end of the connecting rod is the dipper given. The dipper works like it splashes oil out of the pan and sinks into the oil trough. Oil's splashing action helps in maintaining a fog or mist of oil which drains the engine's inner parts such as cylinder walls, pistons, bearings, timing gears, piston pins, etc. Instead, the splash oil drips down into the sump. This device is commonly used with the sealed crankcase in a single-cylinder engine. The required amount of oil is maintained in the oil pan for successful functioning of the engine. Lubrication mainly depends on the size of the oil holes and clearances. If the oil is clean this device is very successful.

3. Forced feed or pressure lubrication system: Through this system, the oil is pumped directly through correct oil paths to the timing gears, connecting rod, piston pin, crankshaft, and camshaft of the engine. Then the oil reaches the main gallery first, which could be a pipe or a channel in the casting of the crankshaft. From this pipe it passes through holes to each of the main bearings. From main bearings, connecting rod through drilled holes in the crankshaft goes to wide end bearings. And there the walls, the pistons and the rings are lubricated. There is a separate oil gallery where timing gears are lubricated. The lubricating oil pump is a positive displacement pump, usually of the form of gear or vane. The oil also goes through an oil gallery to the valve stem and to the rocker arm shaft under load. The excess oil flows back to the crankcase from the cylinder head. The pump discharges oil into oil tanks, oil galleries, or ducts, which leads to various engine parts. This system is widely used in tractors, trucks, and cars with multi-cylinder high speed engines.

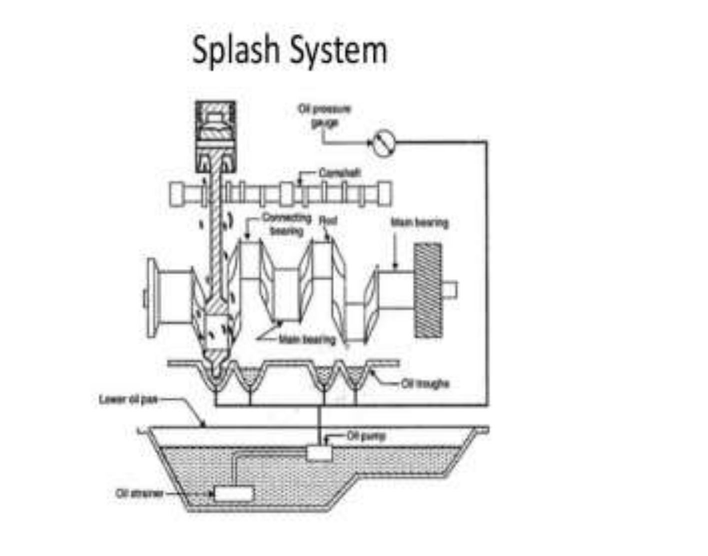

Fig 1. Splash Lubrication system

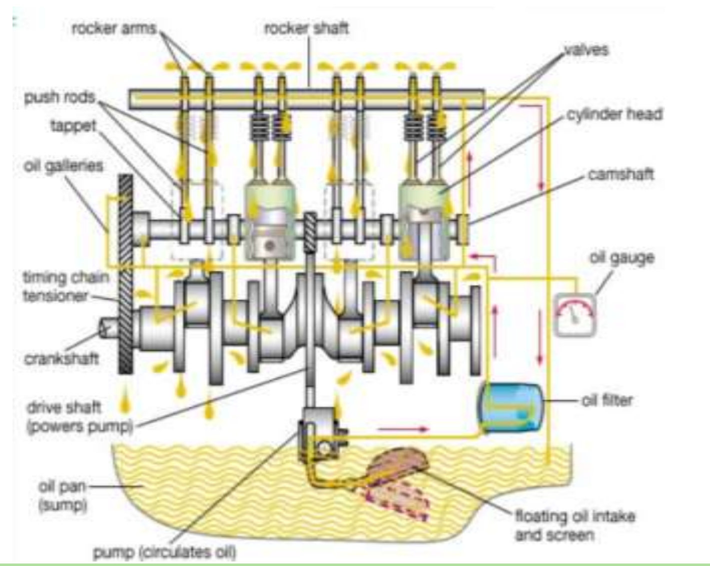

Fig 2. Forced feed or pressure lubrication system

4. A Combination of splash and forced feed system: In this system the engine component, which is subjected to very heavy load, is lubricated under forced pressure, such as connecting rod, bearing, main bearing, and camshaft bearings. All the remaining pieces that are cams, cylinder liners, tappets etc are generally lubricated with splashed oil.

Purpose of Lubrication

The primary lubrication purpose is to decrease the friction that leads to a strong wear and tear of the two rubbing components. When applying proper lubrication, this friction can be minimized as it creates a thin layer of oil between the moving surface and prevents direct contact. The heat is generated by piston, cylinder, and a large amount of lubricant is removed from the bearing. It can also reduce the noise produced by moving two metal surfaces. This also produces a cooling effect on several parts of the engine system, and serves as a coolant. The lubricant enters the gap between the piston and piston rings and cylinder liner, as a result acts as a seal that prevents the gas from leaking out. It also helps to clean the inside of the engine from dirt or oil.

Property of Lubricating Oil

The different properties of the lubricating oil:

1. Viscosity: The is a lubricant 's property under which it resists flux. The oil should be sufficiently viscous to hold a layer of fluid between the two matting surfaces. The viscosity is measured using an instrument called the viscometer and expressed in terms of the amount of viscosity. This is inversely proportional to temperature, i.e. since the temperature decreases the viscosity, and vice versa.

2. Flashpoint and Fire point: Flashpoint is the lowest temperature at which oil is to be heated until sufficient inflammable vapour come off which produces a momentary flash when brought to the flame. So, when the vapours are released continuously and the flame persists for a longer period, then that temperature is called fire point. A good lubricant has its flash and fire point above the temperature at which engine work, so that fire hazards are reduced.

3. Cloud point and Pour point: When lubricating oil is cooled, the temperature at which wax and other substance in the oil crystallize and separate from oil is called cloud point. The lowest point temperature at which the oil ceases to flow when cooled is called cloud point. These points indicate the suitability of lubricant for use in cold conditions. A good lubricant required to give service at low temperature should possess low pour point and cloud point.

4. Oiliness and wettability: The ability of the lubricating oil to adhere to the surface is known as oiliness which depends upon on its wettability and surface tension. A good lubricant should have oiliness enough to adhere to the surface even at very high pressure.

5. Vitality: The volatility of a lubricant is the property that defines its evaporative loss characteristics. A good lubricant should have low vitality at working temperature.

6. Carbon residues: Lubricating oil has a higher percentage of carbon in the combined form. A good lubricant should not deposit carbon when used at high temperature.

Problems in the Lubricating System

There are certain problems which are commonly faced in the common lubrication systems that are listed below:

1. High consumption of oil: More oil goes into the combustion chamber, and is burned. Some leakage occurs in some sections of the pipe through the ventilating system, and loss of oil in the form of vapour. Oil will travel into the combustion chamber through rings and cylinder walls, worn piston rings, and worn bearings.

2. Low oil Pressure: This results in bad relief valve springing, broken oil pump, bent oil thread and bearings breaking out. For increasing the oil pressure in a lubricating system great care should be taken in removing these defects as much as possible. Indicator of default oil pressure frequently shows low oil pressure, and should be checked regularly.

3. High oil pressure: This results in a jammed relief valve, a solid valve spring and an obstructed oil lime. These type of defects needs to be removed for reducing an excessive oil pressure in the engine lubricating system. A high oil pressure is also reported by the unreliable Oil pressure meter.

Care and Maintenance of Lubricating System

The following care should be taken to work lubrication system properly:

1. A correct design of the method of circulation of oil should be taken into effect.
2. A long and trouble-free service can be assured by Good lubricant grade.
3. The Oil in the oil chamber should be kept at the amount desired.

4. Oil should be washed annually, and new filters should replace old filters frequently after specified time of usage.
5. Connections, peeping, valves, and a pressure gage should be periodically tested.
6. The oil should be changed periodically after a specific point of time.
7. Before bringing in the new oil the crankcase should be washed and well flushed with a flushing oil.

Conclusion

A lot of heavy work in agricultural operations with all Agri-machineries face a big loss due to the friction generated. Lubrication reduces friction and allows for smooth movement. The key task in the engine is to provide the moving parts with oil to decrease friction between surfaces that rub each other continuously. Lubrication plays a key function in improving an engine's life expectancy. Without oil a motor will succumb very easily to overheating and seizure. Lubricants help solve these problems, and if properly monitored and maintained, they can extend the life of different Agri-based machinery's motors and engines.

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The Impact of Temperature on Yield and Other Physiological Traits of Wheat

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Summary

Wheat (*Triticum aestivum* L.) is the world's most important widely cultivated food crop. India is second largest wheat grain producer next to China (126 million tons) but with maximum area under wheat (31.47 million ha) and production of 97.44 million tons (2016-17), 97.50 million tons (2017-18). (DES, 2018).

In India it is cultivated mainly in the states of Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan, Haryana, Bihar, Gujarat and Maharashtra. Among the different states of India, Uttar Pradesh ranks first in area and total production, while Punjab ranks first in productivity.

Most of the wheat growing areas of the world experience many environmental stresses including drought (water stress) and high temperature (heat stress) that adversely affect yield (Lott et al., 2011). According to world estimates, an average of 50% yield losses in agricultural crops is due to different abiotic stresses under these changing climatic conditions (Trnka et al., 2004).

Normal date of sowing i.e. 15th October to 15th November and optimum date of delayed sowing up to 15th December should be followed for obtaining higher yield. In delayed sowing, the crop gets exposed to higher ambient temperature at the time of grain filling, which causes significant reduction in productivity.

Introduction

Wheat origin is in South West Asia. Wheat belongs to family *Gramineae* (*Poaceae*) and the genus is *Triticum*. India is among very few countries where three species of wheat namely Bread wheat (*Triticum aestivum*), Durum wheat (*Triticum durum*) and Emmer wheat (*Triticum dicoccum*) are cultivated.

In India, it is consumed as food by millions of people Therefore; it is called as "king of cereals". Wheat is an excellent source of nutrition in terms of carbohydrates, minerals and proteins. It contains more protein than other cereals. Wheat has a relatively high content of niacin and thiamine.

Wheat is grown in India under sub-tropical environment during mild winter. The duration of the wheat crop is highly dependent on the temperature. It is basically a short-day crop. In North western plains and north eastern hilly zone, wheat is sown at late on considerable area due to cropping intensity and delayed harvest of previous crops viz. rice and maize and up to the middle of January particularly in North-west India.

As a result, the crop gets exposed to higher ambient temperature of the summer as well as hot spells, at the time of grain filling, which cause significant reduction in productivity. Variability in climate is one of the major environmental threats to agriculture particularly wheat crop (Levitt, 1980). According to Levitt (1980) abiotic stress is, any change in environmental conditions that reduces or adversely affects plant growth and development.

Heat stress is the increasing temperature over the optimum range of temperature during the growth and development of plant. This high temperature at the time of grain development limits the yield and quality of wheat. Future climates will also be affected by larger variability in temperature and more incidences of hot days (Pittock, 2003). The global mean temperature is steadily rising which may result in significant decline in wheat yield in South Asia by 2050. In India around 135 million ha of wheat is heat stressed (Joshi *et al.,* 2007).

Main Body

The sowing time plays an important role in influencing the quality and yield of wheat. Its time of sowing is one of the most important factors that govern the crop phenological development and efficient conversion of biomass into economic yield. Normal sowing has longer growth during which consequently provides an opportunity to accumulate more biomass as compared to late sowing hence manifested in higher grain and biological yields.

Whereas, in case of delayed sowing the wheat crop is exposed to sub-optimal temperature at establishment and supra-optimal temperature at reproductive phases that leads to forced maturity and reduction in grain yield (Saradana et al., 1999). (Zende et al., 2005) reported that the higher protein yield, grain protein content, dry gluten content, beta carotene content and sedimentation index in late sown wheat. The growth and yield of wheat crop is adversely affected by high temperature (Joshi et al., 2007).

Physiological investigations for tolerance against heat stress have shown that every additional 1ºC rise in ambient and temperature beyond 30 ºC reduces the yield by 3-4 percent (Gautam et al., 2008). Terminal heat stress is a major abiotic stress affecting yield in wheat. The photosynthetic process is affected under heat stress conditions which disintegrate the PS-II causing turmoil in the source to sink ratio; effect is more pronounce during grain-filling stage.

Yield models show an optimal temperature of 25ºC or lower for wheat from anthesis to maturity. (Acevedo et al., 1991) reported a 4% reduction in grain weight for each 1°C increase in mean air temperature during grain-filling. Terminal heat stress caused by high temperature during wheat grain development is an important constraint during wheat production (Sharma and Dubey, 2007).

Terminal heat stress causes an array of physiological, biochemical and morphological changes in plant, which effect plant growth and development. Ideally the best temperature regime for optimum growth and yield of wheat crop is 20-22°C at sowing, 16-22°C at tillering to grain filling and slow rise of temperature to 32 ºC at harvesting (Sharma, 2000). High temperature particularly during November sowing accelerates its growth by making the crop enter in to jointing stage too early, thus reducing tillering period (Harrison et al., 2000).

This results in reduced number of tillers and lastly reducing total crop yield. Likewise, high temperature at flowering and grain filling stage shortens the duration of grain filling period, resulting in early maturity, thus reducing the crop yield. The grain filling in wheat also depends on remobilization of stored carbohydrates from stem and leaf sheath, particularly the dependency on reserved carbohydrates increased, when existing photosynthetic supply from leaf and ear decline during biotic and abiotic stress condition (Plaut et al., 2004).

High temperature between flag leaf stage and flowering reduces sink period, reducing the grain size. High temperature after flowering hastens leaf senescence, thereby reduces grain filling stage and thus decrease grain yield. Since high temperature episodes appear to be more severe around anthesis these may affect the pollination process. Grain set is reduced by temperatures warmer than 300 C. The production and transfer of viable pollen grains to the stigma, germination of the pollen grains and growth of the pollen tubes down the style and fertilization and development of zygote are necessary for successful seed set. Although, all these phases are temperature sensitive and high temperatures can cause both male and female sterility in wheat.

One of the most obvious impacts of temperature increase on wheat is earlier occurrence of phenological stages (Porter and Gawith, 1999). Heat stress decrease the duration of developmental phases leading to fewer and smaller organs, reduced light perception over the shortened life cycle and perturbation of the processes related to carbon assimilation (transpiration, photosynthesis and respiration) which significantly contribute to loss of yield.

Post-anthesis hyper thermal stress can result in complete sterility. The main effect of heat stress after/during floral initiation is observed on the kernel number. High temperature stress during ripening phase reduces grain yield and yield contributing factors to a varying extent among the cultivars. Other physical properties of the seed including seed size, seed coat, and the appearance of the seed are also affected by high growth temperature.

Conclusion

The sowing time may play a crucial role in the yield improvement of wheat crop. Delay in sowing may result poor vegetative growth of the crop and it may face high temperature at its later growth stages leading to forced maturity and low productivity. Hence normal date of sowing i.e. 15th October to 15th November and optimum date of delayed sowing up to 15th December should be followed for obtaining higher yield.

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Protected Cultivation of High Value Cut Flower: Carnation

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Summary
The technique of Growing/Cultivation of crops in a protected/Closed area is known as protected cultivation. It provides favourable environmental or growth conditions to the plants. In greenhouses, the growing environment is altered to suit the specific requirements of plants. It is rather used to protect plants from the adverse climatic conditions by providing optimum conditions of light, temperature, humidity, CO2 and air circulation for the best growth of plants to achieve maximum yield and best quality.

Principle of Greenhouse Cultivation
1. The greenhouse is covered with a transparent material such as plastic, PVC sheet or polycarbonate sheet or FRP (Fibre reinforced plastic) or glass.
2. Based upon its transparency the greenhouse cover transmits most of the sunlight.
3. The crop, floor and other objects inside the greenhouse absorb the sunlight admitted inside the greenhouse.
4. These objects in turn emit long wave thermal radiations for which the greenhouse covering material has lower transparency and as a result of this the solar energy is trapped thus leading to increased temperature inside the greenhouse.
5. This is known as greenhouse effect.

Advantages of Growing Flower Crops in Greenhouses
1.This technology allows the production of any plant at any place.
2. Quality of the protected cultivation raised products are always superior.
3. The management of the biotic and a biotic factor are always easy under protected cultivation.
4. As the evaporation losses can be minimised by the use of mulching under the protected cultivation the requirement of water is less as compared to the open field.
5. Less input of labour as it allows the mechanical approaches under protected condition.
6. The production of the high value products can be taken throughout the year and crop duration is also less under these structures.

Advantages of Protected Cultivation Under Indian Context
1. Location of India on the glob allow abundance of shun rays throughout the year even in the autumn and winter months.

2. The average radiation received at Quito-Equator and Nairobi is 434 and 462 cal/cm2 /day, respectively at 1800m AMSL the best centres in the world producing quality cut flowers, which is at par with radiation received at Bangalore (450 cal/cm2 /day at 1000m AMSL)
3. The prevailing temperature in the Indian condition is ideal for the flowers.
4. Shorter production cycle
5. Good production during the main international events when demand for flowers is high in Europe and USA.

Carnation is the leading cut flower grown in 52 ha area during 2009-10 under greenhouses in Himachal Pradesh. This has become popular on account of its following qualities:
1. Excellent vase life.
2. Wide range of flower colours and forms.
3. Ability to withstand long distance transportation.
4. Rehydrate easily.
5. Lighter weight.

Florist Carnations

1. Standard: The standard carnation has one big flower on a single stem. It is cultivated for large-scale production.
2. Spray: Spray Carnations varieties has many shorter branches with more prominent blossom on every branch.
3. Micro: These carnations have shorter stems and greater production than spray varieties. Micro carnation is used for as ornamental pot plants.

Popular Carnation Cultivars

Dona, Pink Dona, Malaga, White Dona, Rony, Rhodos, Lipstick, Empire, Romana, White Tendra, Corleone, Design, Natila, Dark Tempo, Bagatel 11 silvery pink, Solar, Cobra, Pendy, Lorella, Cabaret, Tanga, Sonsara, Dakar, Liberty, Solar, Green Lady, Tempo, Varna, Sun Shine and Charment.

Environmental Factors

1. Light: Photoperiod (long days over 16 hours) and intensity (100 watts bulb spaced at 10.5m at 1.5m height).
2. Temperature: Night (winter: 10-11o C, spring: 12.7o C and summer: 13-15.4o C) and day (18-23o C).
3. Ventilation: Free circulation of air.
4. Relative humidity: 50-60%.
5. CO2: 500-1500 ppm.

Propagation

1. Terminal stem cuttings (8-10 cm long with 4-6 leaf pairs).
2. Micro-propagation, Tissue culture is getting popularity in carnation.

Soil and Growing Medium

1. Light texture loam or sandy loam soil which is well drained and aerated.
2. Soil pH: 6-7.

Planting Time

1. N.I. plains: Sep.-Oct.
2. Low hills: Sep.-Nov.
3. Mid hills: Jan.-Feb.
4. High hills: Mar.-April
5. Staggered planting at 15 days interval ensure regular supply of cut flowers.

Planting Density and Spacing

1. Ordinary: 25-32 plants/m2 (The spacing usually followed by the growers).
2. High: 40 plants/m2 (Maximum number of plants and highest production are obtained with this spacing).
3. Standards: 20 x 20 cm.
4. Spray: 30 x 30 cm.

Optimum Nutrition

1. Nitrogen: 5.4%, Phasphorus: 0.31%, K2O: 3.8%.
2. Standards: FYM: 5 kg, N: 30g, P: 20g, K: 10g/ m2.
3. Spray: FYM: 5 kg, N: 40g, P: 20g, K: 10g/ m2.
4. Now commercially nutrition is given through fertigation.

Soil Moisture and Irrigation

1. Optimum soil moisture is 300-500 cm tension.
2. Irrigation is done through drip irrigation with three lines in five rows in a bed.
3. Daily water requirement varies with the outside temperature from 2 to 3 litres/m2 .
4. Water soluble fertilizers are also given along with irrigation.
5. During vegetative phase irrigation through sprinkler/ mister/ fogger is beneficial.

Pinching

In pinching terminal growing shoot about 2-3 cm long is removed to overcome apical dominance and to promote side branching when the plants are at 6-8 leaf pair stage.

Pinching Types

1. Single: It is done at five node stage by retaining 4-5 shoot for obtaining an early crop
2. Pinch and half: The main stem is pinched and later when the resulting shoot are long enough, half of largest shoot on each plant is pinched.
3. Double: First by doing single pinch followed by another pinching of all the shoots when they are 6-8 cm in length.

De-Shooting

1. When the side shoots after pinching are 3-5 cm long then retain 3-5 shoots per plant in standard cultivars.
2. When the side shoots after pinching are 3-5 cm long then retain 6-10 shoots per plant in spray cultivars.

Staking

1. Wire mesh, plastic nets, string or bamboo canes are used to support plants.
2. Wire mesh or plastic nets having inner size of 10-15 cm squares are placed on the ground in three layers, which are erected at 20, 35 and 50 cm above the ground level with the growing plants.
3. String or rope is erected in three rows at the same distance along the rows.

Disbudding

1. Disbudding is the removal of visible (5-10 mm diameter) undesirable buds.
2. In standard cultivars terminal bud is retained and all the lateral buds are removed.
3. In spray cultivars terminal bud is removed and lateral buds are retained.

Weeding

1. Three-four hand weeding.
2. Chemicals viz., oxidiazon and napropamide @ 2.2 and 4.5 kg a.i. per hectare are good in greenhouse.
3. In open fluchloralin (basalin) and pendimethalin (stomp) @ 1.0 a.i. per hectare each are effective.

Stages of Flower Harvesting

1. Standard cultivars for local market are harvested when flowers are half opened or at painting brush or outer petal is perpendicular to stem, while for distant market cross is developed on buds and colour is visible.
2. Spray cultivars are harvested for local market when two flowers have opened and others have shown colour, while for distant market when 50% flowers have shown colour.

Managing High Temperature

1. Using Naturally ventilated polyhouses with side (1.5m) and top (1m) ventilation.
2. Use of fan and pad system for cooling.
3. Use of 50% intensity shade nets (12 noon to 4 pm) installed inside the polyhouses.
4. Use of forgers / misters during afternoons once/ twice only in vegetative phase of flower crop.
5. Photo-selective shading paints with less reduction of PAR allowing 69% light and are useful in late spring and summer@ 450kg/ha in a ratio of 1:3 (paint : water) says Evans, 2009. Important flower crops commercially grown in greenhouses.
6. Cut flowers (Rose, Carnation, Chrysanthemum, Lilium, Gerbera, Tulip, Anthurium, Orchids, Alstroemeria, Eustoma, Gypsophila, Statice, etc.).

Grades in India

1. A: over 45 cm (length of stick).
2. B: 30-45 cm (length of stick).
3. C: less than 30 cm (length of stick).

Packaging

1. In bundles of 10, 12, 20 or 25.
2. In corrugated card board boxes of 120 x 60 x 30 cm (L x W x H) accommodates about 800-1000 cut flowers of carnation.
3. Wrap flower bunches in cellophane sleeves.

Diseases

1. Wilt (*Fusarium oxysporum* f. sp. dianthi).
2. Foot- rot *(Phytophthora, Pythium, Rhizoctonia solani, Sclerotinia sclerotiarum)*.
3. Stem rot (Fusarium roseum).
4. Flower bud rot *(Alternaria dianthi)*.
5. Bacterial wilt *(Pseudomonas caryophylli)*.
6. Rust (*Uromyces caryophyllinus* or *U. dianthi*).
7. Flower blight *(Botrytis cinerea)*.
8. Fairy ring spot *(Heterosporium echinulatum).*
9. Viral diseases.

Insect-Pests

1. Red spider mites: This is a quite serious insect on carnations. Red Spider Mite feed on the undersides of their leaves, suck the sap and the leaves turn pale, withered, bronze and also reveal severe webbing.
2. Thrips: Thrips suck the sap out of the leaves, causing them to turn yellow and patchy frequently with black specks and minor wrinkling and thrips make streaks on flowers which makes them unmarketable damaged.
3. Nematodes: Leaves are yellowish in severe infestations and Stunted development of plants
4. Aphids: Aphids suck the sap in the leaves and disfigure the young development. In acute attacks, they abandon tacky residue on the leaves and flower buds. Aphids may be responsible for the transmission Of viruses.

5. Helicoverpa / Heliothis / Spodoptera caterpillars: Caterpillars are largely an issue of this carnation bud. They damage carnation bud completely.

Physiological Disorders

1. Calyx splitting.
2. Grassiness.
3. Sleepiness.
4. Splitting at nodes and bushiness.
5. Small narrow leaves and tied tips.

Tinting in Carnation

A concentrated liquid or powder colour is mixed in small amount of warm pure water (37oC) and stems are placed in it. The colour develops in different patterns on the petals after 10-24 hours. 15.

Average Yield

200-300 flower stems/m2 /year.

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Integrated Pest Management: Approaches, Strategies and Benefits

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Introduction

The green revolution in India has brought huge change in crop production with cultivation of high yielding varieties. But to achieve larger production we had to rely on intensive use of inorganic chemicals (pesticides, insecticides etc.) that in turn led agriculture to face several challenges such as soil pollution, pest resurgence, developed resistance of pest/insects to pesticides / insecticides and diseases of plants. A change in pattern of agriculture has been suggested to overcome these problems. Integrated pest management (IPM) in this regard, might be a good choice. The goal of IPM in agriculture is to produce safe, abundant and affordable food, feed and fibre. The target pests generally are weeds, insects, and disease-causing organisms such as fungi, bacteria, viruses and nematodes. Integrated pest management provides the most acceptable method of controlling pest and managing diseases, weeds etc. as it uses the best combination of cultural, biological and chemical measures of pest control in agriculture. With the principles of pest control, IPM consists of series of steps that are effective as well as the best methods of control without disturbing the natural ecosystem. It uses a series of steps to understand pests and decide the best methods of control.

Outcomes Due to Use of Synthetic Insecticides

1. Development of toxicity.
2. Destruction of natural enemies.
3. Resistance to insecticides.
4. Resistance to host-plant.
5. Differences in susceptibility.

What is IPM?

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach of pest management that relies on using the best combination of cultural, biological and chemical measures. The aim of IPM programmes is to reduce pest damage on crops as well as maintaining sustainability of environment for which current and comprehensive information on the life cycles of pests and their interaction with the environment in combination with proper knowledge of available pest control methods is required. The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace and natural spaces such as national parks; and in schools (Cloyd et al., 2004).

Are IPM and Organic Methods Similar?

It is not mandatory that IPM and organic methods practiced in agriculture have to be similar. Organic food production being more restrictive is based on limited use of pesticides and fertilizers produced from natural sources unlikely use of synthetic chemicals to some extent in case of IPM. However, IPM can be used in every type of production.

Principles of IPM

Integrated pest management is dedicated to develop pest control strategies that take into account all relevant control tactics and locally available methods. The major principles of IPM include:

1. Prevention of pest to infect and spread.
2. Limited use of inorganic chemicals only if it is needed.
3. Maintaining balanced ecosystem.
4. Assuring better crop production without compromising quality.
5. Conservation of non-renewable resources.

How IPM Programmes Work?

IPM is not a single pest control method but, rather, a series of pest management evaluations, decisions and controls. In practicing IPM, growers who are aware of the potential for pest infestation follow a four-tiered approach. The four steps include:

1. Setting of action thresholds: IPM sets an action threshold, a point at which types of pest, pest populations and level of pest infestation are important before taking any pest control measure. It is also important to see whether the pests have crossed the economic threshold level (ETL) after which control measure should be taken.

2. Monitoring and identifying pests: IPM is supposed to identify and differentiate the beneficial and harmful pest and their specific effects on crops so that proper control measure is taken with right selection of pesticides for the harmful pest.

3. Prevention: IPM here targets to prevent the pest build-up through use of appropriate cultural practices such as crop rotation, selection of pest-resistant varieties, and planting pest-free rootstock. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment.

Intervention

When prevention methods taken fail to be effective continuously or become unavailable for control of pest, IPM programmes then evaluate the proper control methods both for effectiveness and risk. Effective, less risky pest controls such as using highly targeted chemicals like pheromones to disrupt pest mating, or mechanical control, such as trapping or weeding are chosen. Additional pest control methods are to be adopted if less risky control measures further become ineffective.

Strategies of IPM

The strategies or methods used in IPM include one or a combination of the following:

1. Cultural methods – these methods work on creating environment that is less favourable for pests, such as crop rotation, inter-planting, use of locally adapted or pest resistant/tolerant varieties, sanitation, adjusting planting/harvest dates and cultivation techniques which expose pests to predation or destroy their food, shelter and breeding habitats.

2. Physical and mechanical methods – these methods are adopted to prevent pests from entering the area through trapping, weeding, tillage, heavy flow of irrigation, heat treatment, pest exclusion etc.

3. Genetic methods – Genetic methods include selection of pest-resistant varieties developed by genetic engineering.

4. Biological methods – biological methods are based on the aim of protecting, enhancing or importing natural enemies.

5. Chemical methods – use of insect growth regulators, pheromones, less toxic chemical pesticides only when those are needed to apply.

6. Regulatory methods – they prevent the entry or spread of pests using quarantine regulations and restrict the movement of materials including crops and livestock (Frank et al., 2018).

Benefits of IPM

1. In effectivity of pesticides leads to use of IPM.
2. Number of pest population decreases.
3. Reduced crop loss and enhanced crop yield on existing land.
4. Reduced host-plant resistance of pests.
5. Eco-friendly approach.
6. Easy to practise.
7. Cost-effective (USDA, 2018).

Precautions to be Taken Before Selecting Pesticide to be Used in IPM

The pesticide should have the following criteria:

1. It should be toxic to the pest to be controlled.
2. Non-selective to crops growing.
3. Non-toxic to natural enemies, animals and human beings.
4. Wide range of compatibility.

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Nutrient Use Efficiency and its Measurement

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Introduction

It is the fraction of fertilizer nutrients removed from the field with the crop harvest. Based on the nutrient supplying power of soils as determined by soil test values, fertilizer recommendations are made. The aim is to get maximum economic yield with minimum inputs. Of the various inputs, fertilizer is the costly input. This costly input must be efficiently used and utilized.

NUE = (Crop Nutrient removal / Nutrient input) x 100

Invariably, many agricultural soils of the world are deficient in one or more of the essential nutrients needed to support healthy plants. Additions of fertilizers and /or amendments are essential for a proper nutrient supply and maximum yields. Nutrient use efficiency (NUE) in general is low in India. In the case of nitrogen, 30-40% of applied nitrogen is utilized by crops and the balance is lost through leaching and volatilization etc. NUE of Phosphorus (15 to 20%), Potassium (50 to 70%), Sulphur (8-10%) and Micronutrients (1-2 %). Low NUE not only affects crop yields and farmers profitability, but is also emerging as an environmental issue. It was also suggested that efficiency of P and K over time (multiple growing seasons) could also be taken into account for realistic estimate. Nutrients that build-up in soil such as P and K, can certainly be viewed over the long term, while N efficiency is viewed on the short term because of its transient nature. Where there is potential for building soil C reserves, long term N efficiency is appropriate because soil C balance also affects N balance. Plants that are efficient in absorption and utilization of nutrients greatly enhance the efficiency of applied fertilizers, reducing cost of inputs, and preventing losses of nutrients to ecosystems. Inter- and intra-specific variation for plant growth and mineral nutrient use efficiency (NUE) are known to be under genetic and physiological control and are modified by plant interactions with environmental variables. There is need for breeding programs to focus on developing cultivars with high NUE. Identification of traits such as nutrient absorption, transport, utilization, and mobilization in plant cultivars should greatly enhance fertilizer use efficiency. The development of new cultivars with higher NUE, coupled with best management practices (BMPs) will contribute to sustainable agricultural systems that protect and promote soil, water and air quality.

Common Measures of NUE and their Application

An excellent review of NUE measurements and calculations was written by Dobermann (2007).

Partial factor productivity (PFP) is a simple production efficiency expression, calculated in units of crop yield per unit of nutrient applied. It is easily calculated for any farm that keeps records of inputs and yields. It can also be calculated at the regional and national level, provided reliable statistics on input use and crop yields are available. However, partial factor productivity values vary among crops in different cropping systems, because crops differ in their nutrient and water needs.

Agronomic efficiency (AE) is calculated in units of yield increase per unit of nutrient applied. It more closely reflects the direct production impact of an applied fertilizer and relates directly to economic return. The calculation of AE requires knowledge of yield without nutrient input, so is only known when research plots with zero nutrient input have been implemented on the farm.

Partial nutrient balance (PNB) is the simplest form of nutrient recovery efficiency, usually expressed as nutrient output per unit of nutrient input (a ratio of "removal to use"). Less frequently it is reported as "output minus input." PNB can be measured or estimated by crop producers as well as at the regional or national level. Often the assumption is made that a PNB close to 1 suggests that soil fertility will be sustained at a steady state.

Internal utilization efficiency (IE) is defined as the yield in relation to total nutrient uptake. It varies with genotype, environment and management. A very high IE suggests deficiency of that nutrient. Low IE suggests poor internal nutrient conversion due to other stresses (deficiencies of other nutrients, drought stress, heat stress, mineral toxicities, pests, etc.).

Physiological efficiency (PE) is defined as the yield increase in relation to the increase in crop uptake of the nutrient in above-ground parts of the plant. Like AE and RE, it needs a plot without application of the nutrient of interest to be implemented on the site. It also requires measurement of nutrient concentrations in the crop and is mainly measured and used in research.

Conclusions

Increased NUE in plants is vital to enhance the yield and quality of crops, reduce nutrient input cost and improve soil, water and air quality. Plant species and cultivars within species differ in absorption and utilization of nutrients and such differences are attributed to morphological, physiological and biochemical processes in plants and their interaction with climatic, soil, fertilizer, biological and management practices. An improved NUE in plants can be achieved by careful manipulation of plant, soil, fertilizer, biological, environmental factors and best management practices.

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Is Pomegranate Cultivation Worthy for Maharashtra Farmers?

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Introduction

Pomegranate is an important fruit crop of Maharashtra. It is cultivated in an area of 43,151 hectares with a total production of 4, 31,510 ton's producing about 85% of the total Indian production, there by Maharashtra is leading in Pomegranate production in the country (NRCP 2007). Within Maharashtra, production of Pomegranate is mainly concentrated in the Western Maharashtra region and the Marathwada region. Pomegranates are commercially cultivated in Solapur, Sangli, Nashik, Ahmednagar, Pune, Dhule, Aurangabad, Satara, Osmanabad and Latur districts. The variety Ganesh, Bhagwa (Red Ruby) cultivated in Maharashtra is suitable for export purposes. At present fair amounts of exports of Pomegranate takes place from the state in Reefer containers by sea. In Maharashtra there are four main varieties of pomegranate available which are like Ganesh, Rubby, Arakta, and Bhagwa. These wonderful varieties of Pomegranate are known for its sweet taste, plentiful juice and health benefits that may help with Heart disease, Cancer and problem associated with Aging.

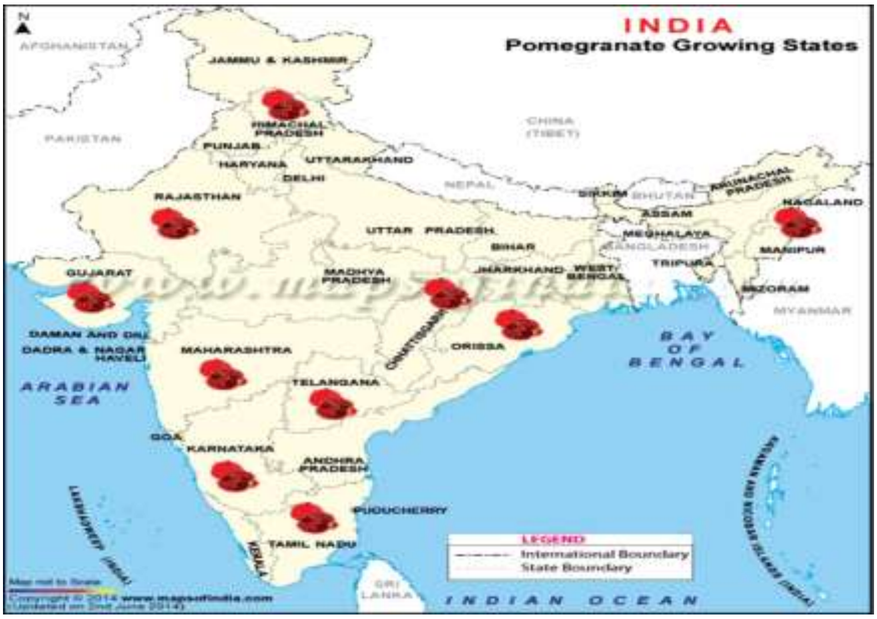

Fig: Pomegranate Growing States in India

Source: www.mapsofindia.com

An Agricultural Economic Zone (AEZ) for Pomegranate has been set up in districts of Solapur, Sangli, Ahmednagar, Pune, Nasik, Osmanabad and Latur for integrated development of this crop. Most of the pomegranate is marketed as a fresh fruit, although some quantity of its produce is also stored in cold stores since it has good shelf-life. If we see year's quantity of last ten years arrivals of pomegranate at different markets of Maharashtra then it shows a continuous rise in the quantity. Pomegranate is the fruit available throughout the year. Pomegranate is a popular fruit due to its low price high nutrient value, and availability unabated. It is considered as ancient fruit. In ancient times the Pomegranate marketing is related only to Pomegranate fruit, but in modern marketing, Pomegranate marketing related to various product of Pomegranate. To reduce post-harvest losses substantially and supply quality produce to consumers both domestic, and international level, we need marketing of Pomegranate.

Solapur District from Maharashtra state is known as the "Pomegranate city" for its enormous production of Pomegranate. Pomegranate is a favourite dessert fruit, popularly known as "Anar" or "Dalimb" in local language. Solapur District is producing about 85 percent of the total Maharashtra's production of Pomegranate. Solpaur is foremost in Pomegranate cultivation in Maharashtra. According to Agriculture Department, in Solapur District during the year of 2018-19 the area under Pomegranate cultivation was 11,500 ha. In the recent years the area under Pomegranate cultivation of Solapur District is increasing rapidly.

Pomegranate becoming an export-oriented crop for last one decade. With the export market for pomegranates picking up, farmers across Maharashtra are switching to the fruit, which is more remunerative than grapes. Exports have also picked up and Indian pomegranates are now going to Colombo, West Asia, Russia and Europe. The UK, UAE, Saudi Arabia, Netherlands, Egypt, Turkey, Bahrain and Kuwait are other important markets for pomegranates.

Conclusions

Maharashtra contributes 90% of the country's total pomegranate production. Farmers making a shift to pomegranates since this fruit commands a better price in the market. This is being seen as a more remunerative crop than other fruit crops of Maharashtra. With the exception of Vidarbha, farmers in Gadchiroli, Konkan and Marathwada are also shifting to pomegranate cultivation.

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Health Benefits of Turkey Berry

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Introduction

Turkey berry *(Solanum torvum)* is a bushy, erect and spiny perennial plant belonging to Solanaceae. It is propagated by seed or branch cuttings taken from high yielding shrubs. Turkey berry also known as a popular traditional vegetable but can't cultivate like other vegetables. It grows best in full sunlight and does well under light shade but cannot survive under a closed forest canopy. It is an important medicinal plant in tropical and subtropical countries, is widely used like food and in folk medicine around the world. All parts of turkey berry plant, including its roots, stems, leaves, and fruit are used for medicinal and culinary purposes throughout the world. The fruit is often fried in oil or ghee and consumed whole, whereas the leaves, stems, and roots may be dried and consumed as a powder, tea, or tincture.

Fig.1 Turkey berry fruit

Fig.2 Turkey berry flower

Other Names

1. Prickly nightshade.
2. Devils fig.

3. Shoo shoo bush.
4. Wild eggplant.
5. Pea eggplant.
6. Susumber.
7. Turkey berry (English).
8. Katai (Hindi).
9. Chundanga (Malayalam).
10. Sundakkai (Tamil).
11. Kundene kayi (Kannada).
12. Usthikaya (Telugu).

Nutritional Value

For every 100 g of young turkey berry fruit there is:

85.4 g	Water
2.4 g	Protein
0.4 g	Fat
10.7 g	Carbohydrate
6.1 g	Fibre
104 mg	Ca
70 mg	P
4.6 mg	Fe
390 µg	β – carotene
4 g	Ascorbic acid

Health Benefits

Turkey berry has some amazing uses and benefits that are helpful for a human body and are stated below:
1. Protection from cancer
2. Treatment of diabetes
3. Treatment of indigestion and diarrhoea. The berries are also capable of neutralizing the acid in the stomach making them important for healing gastric ulcers.
4. Prevention of cardiovascular diseases and strokes
5. Prevention of pains, redness, gout
6. Prevention and healing of colds and flu
7. Treatment of phlegm and mucus
8. Prevention and treatment of kidney diseases
9. Regulate menstruation
10. Treatment of anaemia
11. Prevents intestinal worms
12. People underweight can also blend raw turkey berries with water and take half a glass last thing before going to bed.
13. It is helpful in stopping the excessive cell growth in the body.
14. The leaf of Turkey berry is anti-inflammatory in nature. It is rich in Soasoline.
15. Soasoline is a natural steroid. It is good for treating Arthritis, lower back pain and general swelling and pain.
16. Dry berry powder helps to treat Asthma, cough and lung inflammation.
17. Turkey berries is antibacterial and antifungal in nature.
18. Seeds of Turkey berry can be smoked for curing toothache.
19. The leaves are dried and powdered then used as medicines for diabetic patients. It is also used as antidote to insect stings and snake bite.

20. Treatment of rheumatism, infections.
21. Therapeutic use of the plant is that it helps to improve eyesight.
22. The berry leaves can be used to treat skin diseases like pimples and sores.
23. Pounded roots are applied in cracks in the feet.

Conclusions

Vegetables plays a vital role in providing nutritional security to eliminate malnutrition of the global concern. Turkey berry is the best vegetable which has lots of health benefits and medicinal values. Analgesic, antipyretic, anti-rheumatic, anti-infectious, diuretic, anti-inflammation, and antiphlogistic are some of the benefits that traditional medicine practitioner used the plant for. Along with its sedative, diuretic and digestive properties the herb is used in various Ayurvedic treatments.

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Biosynthesis of Strigolactone and its Functions

Article ID: 31616

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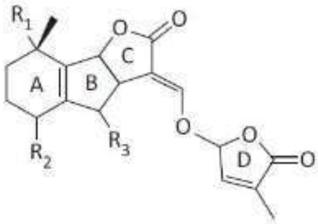
Introduction

About >40% of Africa's arable savanna regions infested with Striga, leading to crop and economic losses close to US$13 billion every year (Joel et al., 2007). One key for parasitic plants to complete infections successfully is the sensing of a suitable host plant. Normally parasitic plant seeds remain dormant in the soil. Once a crop is planted, the parasite germinates and infects the roots of the host. The germination cue for parasite seeds is a small group of structurally related compounds called strigolactones (SLs) that are exuded from the host's roots. Strigolactones (SLs) are a class of terpenoid lactones that were initially characterized as root- derived signals that induce the germination of parasitic plants such as Striga and Orobanche species (Cook et al., 1966). SLs were later identified as symbiotic signals for arbuscular mycorrhizal fungi, which facilitate the uptake of inorganic nutrients by plants (Akiyama et al.,2005). In 2008, SLs were shown to act as endogenous hormones, or their precursors, that regulate shoot branching by using enhanced shoot-branching mutants of pea, Arabidopsis and rice. In addition to the shoot branch-regulating function, SLs also act as phytohormones inside the host plants and are involved in the inhibition of axillary bud outgrowth (Gomez-Roldan et al., 2008).

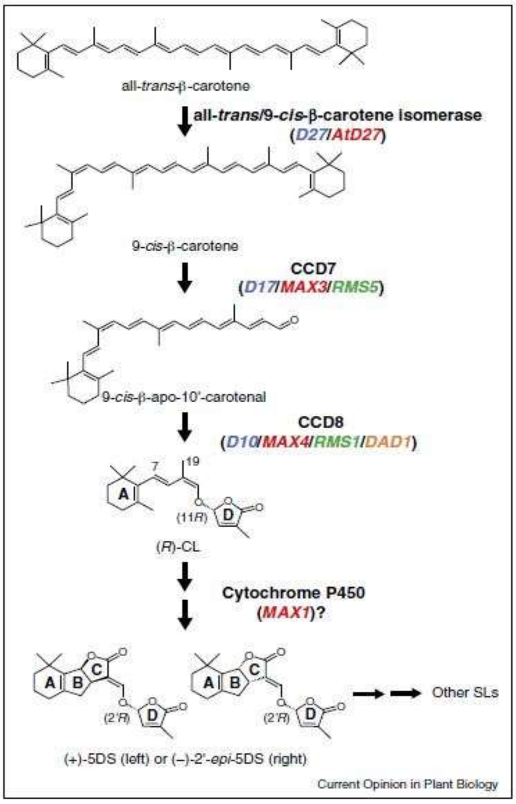
General Structure

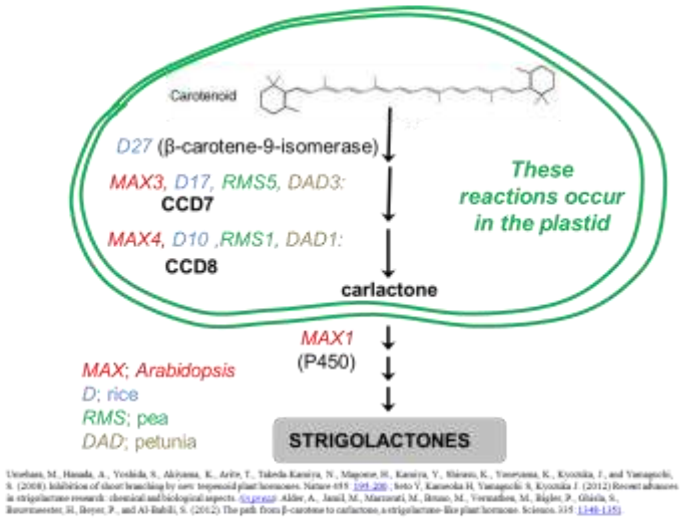
First natural strigolactone is strigol, which was isolated as a germination stimulant of the root parasitic plant Striga lutea (witchweed) by Cook (1972) in cotton the name strigolacatone came from strigo means striga and lactone means cyclic ester. All-natural SLs identifi ed so far contain a tricyclic ring system (ABC part) connected to a butenolide (D ring) via an enol ether bridge. Extensive studies on the structure activity relationships of SLs in germination stimulation of parasitic plant seeds have revealed that the C–D ring moiety is the essential structure for exhibiting germination stimulation activity. Indeed, all-natural SLs contain this essential structure, and have different substituents on the A ring and/or B ring. These substitutions affect not only the germination stimulation activity but also the stability of SLs.



Biosynthesis of Strigolactones

In 2005, Matusova et al. reported that SLs might be biosynthesized from a carotenoid pathway by using a carotenoid biosynthetic inhibitor, fluridone, and some carotenoid metabolism mutants. In 2008, two mutants of rice, d17 and d10, defective in carotenoid cleavage dioxygenase 7 (CCD7) and CCD8, respectively, and the ccd8/rms1 mutant of pea were shown to be SL-deficient mutants. These results support the hypothesis that SLs are synthesized from carotenoid. In addition to these two CCDs, a cytochrome P450, MAX1, was shown to function in SL biosynthesis. Furthermore, D27, a novel class of Fe-containing protein, was also found as a SL biosynthetic component. Recently, CL, which has a SL-like carbon skeleton, was identified as a product of sequential reactions by three biosynthetic enzymes, D27, CCD7 and CCD8 using all-trans-b-carotene as a substrate in vitro. In these sequential reactions, D27 was demonstrated to catalyse the reversible isomerization of all-trans-b-carotene at C-9 position to yield 9-cis-b-carotene. It was initially reported that CCD7 uses all-trans-b-carotene as a substrate and catalyses a 9,10 oxidative cleavage to produce all-trans-b- 100-carotenal. However, Alder et al., 2012 demonstrated that CCD7 preferentially cleaves 9-cis-b-carotene to produce 9-cis-b-apo-100-carotenal, which is then cleaved by CCD8 to give CL. In the final step catalysed by CCD8, intramolecular rearrangement occurs to synthesize the D-ring part, the characteristic portion of SLs. Alder et al., 2012 proposed the reaction mechanism of CCD8; however, it has not yet been clarified. Intriguingly, CL suppressed the shoot branching of rice SL biosynthetic mutants such as d10 and d27, as well as stimulated the germination of Striga hermonthica LC–MS/MS, possibly due to low abundance. Instead, another SL-like compound called SL-LIKE1 was found from Arabidopsis root extracts. Intriguingly, feeding experiments of CL using Arabidopsis SL-deficient mutants such as max4 and max4 max1 double mutants demonstrated that CL is converted into SL-LIKE1 in a MAX1-dependent manner. These results demonstrate that MAX1 is involved in the metabolism pathway of CL.





Functions of Indigeneous Strigolactone

1. Seed germination stimulant of root parasitic plants ex: Striga and Orobanche.
2. Symbiosis between plants and arbuscular mycorrhizal fungi (AMF) by trigger hyphal branching in AMF.
3. Inhibition of axillary bud outgrowth.
4. Root development.
5. Involved in communication in the primitive plant *Physcomitrella patens.*

Application of Synthetic Strigolactone (GR24)

1. Induce suicidal seed germination of Striga spp. in soil.
2. Regulate hypocotyl elongation.
3. Root Growth and Root-Hair Elongation.
4. Overcome thermoinhibition ex: Arabdopsis.
5. Plant Defence System ex: *Macrophomina phaseolina, Colletotrichum acutatum*.
6. Drought stress tolerance ex: Soybean.

Conclusions

Strigolactones are root exudate signals that trigger parasitic weed seed germination, and act as a branching inhibitor and plant hormone. From the early stages of plant evolution, it seems that strigolactones were involved in enabling plants to modify growth in order to gain advantage in competition with neighbouring organisms for limited resources. For example, a moss plant can alter its growth in response to strigolactones emanating from a neighbour. Within a higher plant, strigolactones appear to be involved in controlling the balance of resource distribution via strategic modification of growth and development. Most notably, higher plants that encounter phosphate deficiency increase strigolactone production, which changes root growth and promotes fungal symbiosis to enhance phosphate intake. The shoot also changes by channelling resources away from unessential leaves and branches and into the main stem and root system. This hormonal response is a key adaption that radically alters whole-plant architecture in order to optimize growth and development under diverse environmental conditions.

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Role of Melatonin in Plants

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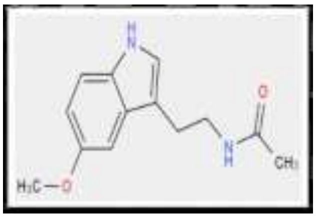
Introduction

Melatonin (N-acetyl-5-methoxytryptamine) is a naturally occurring compound in plants and has been detected in the roots, leaves, fruits, and seeds of a considerable variety of plant species. It is a ubiquitous and highly conserved molecule in plant and animal kingdoms and has been identified in insects, arthropods, planarians, mollusks, dinoflagellates, and brown algae. The known physiological functions of melatonin in animals include timing circadian rhythms, signalling environmental changes, cancer inhibition and detoxification of free radicals, and other reactive oxygen species (ROS) and related products. There are reports demonstrating the ability of melatonin to alleviate the effects of abiotic stresses such as low temperature, copper stress, and light conditions during seed germination, but little is known about its comprehensive effects in plants.

Evidence suggests the role of melatonin in seed germination, and plant survival may be related to melatonin-induced changes in membrane and protein peroxidation. In addition to its antioxidant and growth-regulating functions, melatonin may play a role in regulating photoperiod and circadian rhythms in plants. Furthermore, melatonin may play a role in protecting tissues during flower and seed development in *Datura metel*. Many investigations have examined the effects of melatonin on in vitro organogenesis, such as improving cotyledon expansion, promoting hypocotyl and coleoptile growth, and preventing apoptosis during cold-treatment in *Daucus carota* cell suspensions. It is known that the deleterious effects resulting from the cellular oxidative state may be alleviated by the enzymatic and non -enzymatic antioxidant systems. Plants respond and adapt to water stress by altering their cellular metabolism and invoking various defence mechanisms. The addition of this indoleamine treatment enables plants to survive under environmental stresses by enhancing recovery potential.

Chemical Structure of Melatonin

1. Melatonin has the molecular formula (C13H16N2O2).
2. It has many chemical names such as.
3. N-Acetyl-5- methoxytryptamine.
4. 73-31-4 Circadian.
5. 5-methoxy-nacetyltryptamine N-[2-(5-methoxy-1H-indol-3-yl)ethyl]acetamide(IUPAC name.



Role of Melatonin in Plants

Melatonin Has Proven to Be Ubiquitously Synthesized in Plant Organs. Pleiotropic Roles Ranging from Enhancing Germination to Delaying Senescence of Plants Have Been Reported. While Melatonin's Role Have Highlighted the Modulation of Circadian Rhythms in Mammals, This Function Has Not Been Thoroughly Examined in Plants.

1. Propagation: *In Vitro* Germplasm Storage Via Cryopreservation Is an Effective Tool to Ensure Conservation of Tree Species, But Plant Cells and Tissues Are Exposed to Multiple Stresses Including Osmotic Injury, Desiccation and Low Temperature Injury During the Cryopreservation Process; This Contributes to Problems During the

Regrowth of Cryopreserved Materials. Supplementing Both Preculture And Regrowth Media with Melatonin (0.1–0.5 Mm Melatonin For 24 H) Significantly Enhanced Regrowth of Frozen Shoots Compared with The Untreated Shoots. Low Concentrations of Melatonin Enhanced the Germination Rate of Cucumber Under Salinity Stress by Regulating the Biosynthesis and Catabolism of Abscisic Acid (ABA) And Gibberellic Acid (GA) (Zhang *Et Al.,* 2014). Cuttings Are Also Used as A Means of Propagation for Many Commercially Important Horticultural Crops. The Exogenous Application of Melatonin to Roots of Grape Cuttings Improved Their Growth by Enhancing Water Stress Tolerance.

2. Growth and Development: the initial report of the direct involvement of melatonin in stimulating plant growth was reported by hernández-ruiz *et al*. (2005); they observed that melatonin extended the coleoptiles. Later, it was found that 0.5–1 µm application of melatonin enhanced the initial seminal root length, growth and root biomass of transgenic rice plants. Melatonin is now known to alter many plant characteristics including germination, seedling growth, alteration of flowering time, grain yields, and senescence.

3. Stress Tolerance: Exogenous Application Of Melatonin Significantly Alleviated The Growth Inhibition Caused By Elevated Salinity; This Enabled The Plants To Maintain Their Photosynthetic Capacity. The Application of Melatonin Also Decreased The Oxidative Damage Caused By ROS By Directly Scavenging HO And Enhancing The Activities Of Antioxidant Enzymes Including Ascorbate Peroxidase, Catalase, And Peroxidase. Melatonin Application Enhanced Tolerance To Salt And Drought Stress In Soybean, And Up-Regulated The Expression Of Genes That Were Inhibited By Salt Stress (Wei *Et Al.,* 2015).

4. Cold: Melatonin Treated (10– 30 Mm) *Arabidopsis Thaliana* Plants Produced Higher Fresh Weight, Root Length And Plant Height Compared To Untreated Plants (Bajwa *Et Al*., 2014). Like Other Plants, Low Temperature Damages Wheat Plants By Reducing Leaf Area, Leaf Water Content, Photosynthetic Pigment Content, And The Accumulation Of ROS Caused Lipid Peroxidation Of Membranes. The Application Of Melatonin (1 Mm For 12 H) To Wheat Seedlings Increased The Activity Of The Antioxidant Enzymes, Superoxide Dismutase, Guaiacol Peroxidase, Ascorbate Peroxidase, And Glutathione Reductase Leading To Improved Plant Growth By Reducing Oxidative Damage (Turk *Et Al*., 2014).

5. Heat Stress: In Plants Under Stressful Conditions, The Genes Responsible For Melatonin Biosynthesis Are Typically Activated Resulting In Higher Levels Of Melatonin. As An Example, Under High Temperature Conditions The Level Of Melatonin Is Increased In Rice (Byeon And Back, 2014) Suggesting A Role Of Melatonin In defence Against Heat Stress. Melatonin Application Increased Germination Percentage Of Heat Stressed *Arabidopsis Thaliana* Seeds Up To 60% Compared To Control; This Effect Was Likely Due To Powerful Antioxidant Activity Of Melatonin (Hernández *Et Al.,* 2015).

6. Drought, Ultraviolet Radiations, Heavy Metals, And Chemicals Stress: Melatonin Has Also Proven Its Protective Role Against Drought, Ultraviolet Radiation, Heavy Metals And Chemicals Stress. Transgenic Micro-Tom Tomato Plants Overexpressing The Homologous Ovine *AANAT* And *HIOMT* Genes Exhibited Loss Of Apical Dominance And Enhanced Drought Tolerance (Wang *Et Al.,* 2014). Plant Species Sensitive To Ozone Damage Have Lower Levels Of Melatonin Compared To Ozone Resistant Species (Dubbels *Et Al.,* 1995).

7. Phytoremediation: The Water Hyacinth Grown Under Bright Produces Extremely High Concentrations Of Melatonin And N -Acetyl-N -Formyl-5-Methoxykynuramine (AMFK) As Compared To Plants Grown In Artificial Light (Tan *Et Al.,* 2007).

Conclusions

Melatonin (N-acetyl-5-methoxytryptamine) is a ubiquitous molecule with pleiotropic actions in different organisms. It performs many important functions in human, animals, and plants; these range from regulating circadian rhythms in animals to controlling senescence in plants. Melatonin application on commercially important crops can improve their growth and development and also improve the storage life and quality of fruits and vegetables. It also play major role in vascular reconnection during the grafting process and nutrient uptake from roots by modifying root architecture. Another potentially important aspect is the production of melatonin-rich food crops (cereals, fruits, and vegetables) through combination of conventional and modern breeding approaches, to increase plant resistance against biotic and abiotic stress, leading to improved crop yields, and the nutraceutical value of produce to solve food security issues.

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A Critical Analysis of Role Played by Tractors as Major Equipment's in Agricultural Sector

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The word "tractor "is derived from the Latin word "trahere" meaning "pull". It is an engine or vehicle for pulling wagons or plows . Tractors are used for drawing in towing or pulling objects that are extremely hard to move. In 1892 Johan Froelich invented and built the first gasoline/petrol powered tractor in Clayton county lowa. U.S.A. Francesco Cassini built the first diesel engine tractor in 1927. The credit of invention of modern tractor goes to Benjamin Holt an American inventor.

A tractor is an engineering vehicle specifically designed to deliver a high tractive effort at slow speeds, for the purposes of hauling a trailer or machinery such as that used in agriculture or construction. Tractors pull implements or farm machines such as plows, trailers, manure spreader and many more using a sturdy rod called a drawbar which makes a secure but very flexible link between the tractor and whatever is following it. The load pivots on drawbar so as can easily pull it around corners.

There are different types of tractors used in agricultural sectors having different applications such as utility tractors, row crop tractors, orchard type tractors, industrial tractors , garden tractors , rotary tillers tractors, implement carrier tractors , earth moving tractors. The top five leading producers or manufacturers in India are Mahindra tractors , Tafe tractors , Gujarat tractors, Sonalika tractors and Eicher tractors.

Role Played by Tractors in Agriculture of India

1. A tractor can act as a best friend to a farmer in rural areas. In country like India where farming and agriculture is the leading occupation of the people, a tractor plays a vital role in the life of a farmers and make the task of farming easier. It helps the farmers in saving time and resources through a smart strategy as is helps to cut down the expenses of the farming. The usage of tractors also causes reduction of human resources in terms of harvesting and planting.

2. It provides multiple farming uses. Various farming implements are attachable to the tractors that help in processing the soil for plantations, planting and harvesting. Tractors can also be efficiently used to provide fertilizers to lands of large areas.

3. Tractors are also used as transport carriers. Most tractors are made hardy and rough as it can withstand the challenges that the farmers face while farming. They can be used as a goods carrier. It can be used to carry seeds, fertilizers and other input to the field. Loading of the harvest can also be done easily by the tractors.

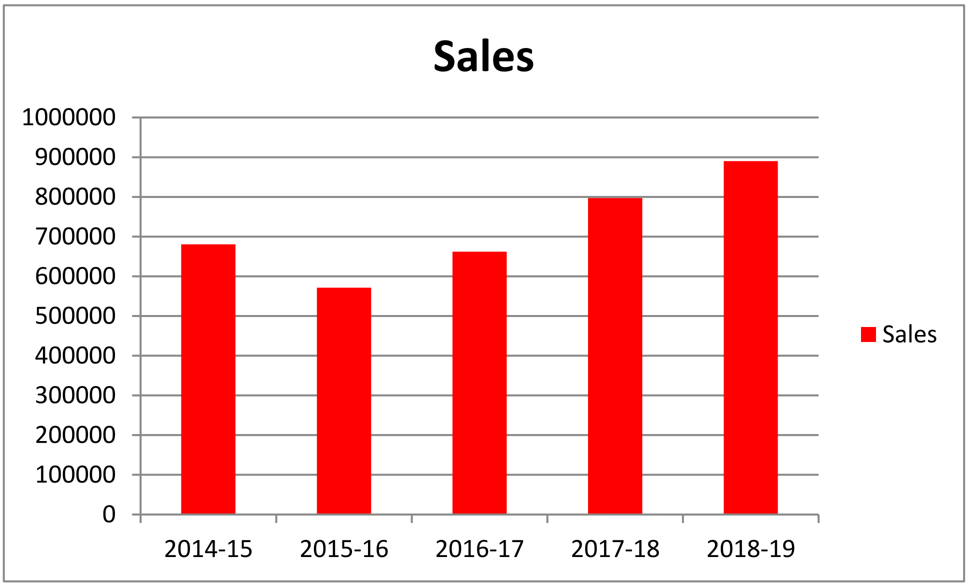
4. A tractor can also work like a family car for farmers in rural areas to travel short distance . Most tractors in India have efficient engines which can travel longer distances with low fuel consumption.

5. Tractors give opportunities for rental income to farmers because farmland size is generally very small in India and a tractor is idle most of the time .This increases the asset utilisation of the tractor and provides income to the farmers.

6. Tractors also provide social status because as a tractor owner, the farmers are considered a sophisticated and well -off member of the community. Since a tractor is a large investment, the farmer generally buys it on financing.

A tractor owner is considered creditworthy in the local business and banking circles. Ownership of tractor also connotes superior knowledge of farming and leads to farmers looking up to the tractor owner for advice and guidance.

S.N.	Year	Sales of Tractors
1	2014-15	680600
2	2015-16	571249
3	2016-17	661995
4	2017-18	796873
5	2018-19	890000
Total	-	**7948155**



The table and the graph given above shows the year wise sale of tractor in the country in last five year from 2015 to 2019. It shows the sale of tractors in 2014-15 to be as 6,80,600 while there is decrease in sale to some extent in 2015-16 to be as 5,71,249. Then it shows an increase in sale in 2016-17 to be as 6,61,995 and then it shows continuous increase in sale for next two years. Whereas the total sale for the last five years was 79,48,155. So, we can understand from above table and graph that how tractors are becoming a major part of agricultural equipment used in agricultural sector as their sale is increasing year by year.

Disadvantages of Tractors

1. Tractors require routine maintenance and clean fuel which creates a burden on small and marginal farmers in rural areas.
2. Tractors burns fossil fuels and cause pollution and waste products such as used oil filters that must be properly disposed of to avoid contamination of ground water.
3. It also leads to unemployment among the unskilled labourers working on the field of rich farmers as they a replaced due to mechanization and use of tractors.

The Indian agriculture industry is on the rise, but it has its own challenges. However, with the government facilities, advancements and increased access to modern technologies the agriculture production continues to grow at a steady pace. Undoubtedly, tractors play an important role in the success of agriculture in India as tractors are considered as the backbone of rural farmers in the country.

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Implement of Drones in Agriculture

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Introduction

Farmers will need to produce more with less, while preserving our environment for future generations. Although agriculture is, perceive as a traditional economic sector, precision agriculture technologies have already boosted crop yields significantly in the last decades. Robust investments in the commercial drone sector have made the technology cheaper, lighter, safer and more sophisticated. Drones can fly on autopilot. The unique combination of the above-mentioned factors makes the utilization of drones by smallholder farmers affordable. Early pest detection is a major application of drones in agriculture. Depending on the crop, agricultural producers survey their land several times per week. The earlier you catch the problem, the cheaper to contain it. Once you identify a small spot, you can fix it right away, as opposed to having it spread. This leads to big time and labour savings. The use of drones in almost every sector of the economy is growing fast, but drone usage in the agricultural industry is booming. In many areas drone use has become an essential part of large-scale precision farming operations already. The data collected from drones recording fields help farmers plan their planting and treatments to achieve the best possible yields. Drones equipped with special imaging equipment called Normalized Difference Vegetation Index use detailed colour information to indicate plant health. This allows farmers to monitor crops as they grow so any problems can be deal with fast enough to save the plant. Drones fly close to fields capable of producing accurate image of the location. This means that disease or pest problems can be detected and treated right away.

Currently, there are Some Common Uses of Agricultural Drones

1. Soil and Field Analysis: At the beginning, middle, and end of a crop cycle drones can be used to help obtain useful data surrounding the quality of the existing soil. By obtaining 3D maps of existing soil.

2. Seed Planting: Drone planting is a relatively newer technology and not as widely used, but some companies are experimenting with drone planting. Essentially, manufacturers are experimenting with custom systems that have the ability to shoot seed pods into prepared soil. This technology helps to minimize the need for on-the-ground planting, which can be costly, time-intensive, and strenuous work. This same drone technology can be adapted and applied to a wide range of farm types, reducing overall planting times and labour costs across the board.

3. Crop Spraying and Spot Spraying: Crops require consistent fertilization and spraying in order to maintain high yields. Traditionally this was done manually, with vehicles, or even via airplane. These methods are not only inefficient, and burdensome, but they can be very costly as well. Drones can be equipped with large reservoirs, which can be filled with fertilizers, herbicides, or pesticides. Using drones for crop spraying is much safer and cost-effective. Drones can even be operated completely autonomously and programmed to run on specific schedules and routes. With spot spraying afforded by drones, this same task can be accomplished in less time, with fewer monetary resources, and a reduced environmental cost.

4. Crop Mapping and Surveying: One of the biggest advantages of using drone technology is the ease and effectiveness of large-scale crop and acreage monitoring. In the past, satellite or plane imagery was used to help get a large-scale view of the farm, while helping to spot potential issues. However, these images were not only expensive but lacked the precision that drones can provide. Drone can not only obtain real-time footage but also time-based animation which can illuminate crop progression in real-time. With drone mapping and surveying, technology decisions can now be made based on real-time data, not outdated imagery, or best-practice guesswork. With near infrared (NIR) drone sensors you can actually determine plant health based upon light absorption, giving you a birds-eye view of the overall farm health.

With agriculture drones you'll be able to collect information like:

a. The overall crop and plant health.
b. Land distribution based on crop type.
c. Current crop life cycle.
d. Detailed GPS maps of current crop area.

Irrigation Monitoring and Management

Irrigation can be troublesome. With miles and miles of irrigation, issues are bound to arise. Drones that are equipped with thermal cameras can help to spot irrigation issues, or areas that are receiving too little or excessive moisture. With this information, crops can be better laid out to maximize drainage, adhere to natural land runoff, and avoid water pooling, which can damage sensitive crops. Water and irrigation issues are not only costly but can ruin crop yields as well. With drone surveying, these issues can be spotted before they become troublesome.

Real-Time Livestock Monitoring

Some drones are equipped with thermal imaging cameras that enable a single pilot to manage and monitor livestock. This allows farmers to keep track of livestock a much greater frequency, and with less time and staff investment. Thermal imaging will also help to keep an eye out for any livestock predators, which can be a huge advantage for some farm owners.

Spray Application

Drone use to apply spray treatments is already widespread in south-east Asia, with South Korea using drones for approximately 30 % of their agriculture spraying. Drone sprayers are able to navigate very hard to reach areas, such as steep tea fields at high elevations. Drone sprayers save workers from having to navigate fields with backpack sprayers, which can be hazardous to their health. Drones sprayers delivery very fine spray applications that can be targeted to specific areas to maximize efficiency and save on chemical costs. Currently drone sprayer regulations vary widely between countries.

Conclusion

Drones have already vastly altered the agricultural industry and will continue to grow in the coming years. While drone use is becoming more useful to small farmers, there is still a way to go before they become part of every farmer's equipment roster, particularly in developing nations. Regulations around drone use need to be made and revised in many countries and more research needs to be done on their effectiveness at certain tasks, such as pesticide application and spraying.

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Advances in Biocolor Extraction Technologies

Article ID: 31620

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Introduction

Colour affects every bit of life, strongly influencing the allure of food. It replaces the colour lost during processing, enhance colour already present in food, and minimize batch variations. Colours extracted from flowers, fruits, seeds, roots of plant and also from microorganisms are called as biocolors. Plant pigments, by virtue of their natural occurrence in edible plants, are generally considered to be harmless. Nature produces a variety of brilliant coloured pigments used for colouring foods. The search for low-cost raw materials and environment- friendly technologies has led to newer technologies for extraction and identification of natural pigments from existing and new sources of plant materials.

Major Pigments Responsible for Colour

1. Water soluble pigments - Chlorophylls and Carotenoids:
   a. Located within the plastids found in cytoplasm.
   b. Responsible for green, yellow & orange colours.
2. Lipid soluble pigments - Flavonoids and Betalains:
   a. Located within the cellular vacuole.
   b. Responsible for red through blue colours.

Sources of Biocolors

1. Plants: *Bixa orellana, Clitorea ternatea, Morus* sp., *Beta vulgaris, Tagetes* sp., Turmeric, Lilium stigma, Chilli, saffron extract etc.,
2. Animals: Cochineal
3. Micro-organisms: Monascus, Rhodotorula, Achromobacter, Phaffia.

Applications of Biocolors

1. Pharmaceutical industry: Moncascus purpureus produces pigments that are responsible for inhibiting hepatitis C virus replication by interfering with viral RNA polymerase activity.

2. Dairy: Monascus Fermented Rice (MFR) 1.2 % is used in the preparation of flavored milk.

3. Fish industry: Most promising pigment proved to be successful in enhancing skin colour is Astaxanthin. Microalgae Chlorella vulgaris imparts yellow blue hues, yielding both muscle and skin pigmentation effects.

4. Textile industry: orange color extracted from Butea monosperma, red color from lac etc.,

5. Printing industry: Decolorable ink for inkjet printing contains a Monascus pigment. The Monascus pigments are easily discoloured and finally lose their colours by the irradiation of visible and/or ultraviolet light.

Methods of Extraction

Traditional methods of extraction are maceration, infusion, digestion and solvent extraction some of the advanced methods of extraction are as follows:
1. High Hydrostatic Pressure (HHP): This method utilizes non-thermal super- high hydraulic pressure (1,000–8,000 bar). It works on the basis of mass transport phenomena. The pressure applied increases plant cell permeability and cell components diffuse under applied pressure. The increased extraction yields with HHP are

attributed to its ability to deprotonate charged groups and disrupt salt bridges and hydrophobic bonds in cell membranes, which leads to a higher permeability.

2. Pulsed Electric Field (PEF): PEF technology is the application of short pulses of high electric fields with duration of microseconds micro- to milliseconds and intensity in the order of 10-80 kV/cm. PEF is reported to enhance mass transfer rates by electroporation of plant cell membranes, improving tissue softness and thus influencing the textural properties.

3. Sonication-assisted extraction: It is one of the most commonly used methods to enhance mass transfer phenomena by cavitation forces, where bubbles in the liquid/solid extraction can explosively collapse and generate localized pressure, causing plant tissue rupture and improving the release of intracellular substances into the solvent.

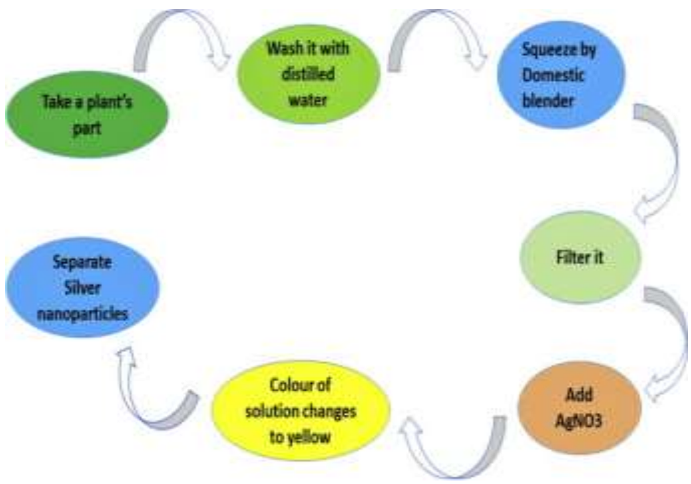
4. Gamma irradiation: Gamma-irradiation, as a pre-treatment to a plant material, increases cell wall permeabilization, resulting in enhanced extraction of cell constituents in higher yield. Textural properties such as hardness, cohesiveness, springiness, gumminess and chewiness decrease with an increase in irradiation doses up to 12.0 kGy. Pre-treatment of the plant material with calcium before irradiation reduces the damage in texture.

5. Enzymatic Extraction: Enzyme assisted extraction of value-added products from plant materials viz., pigments, antioxidants, flavors and phytochemicals is another new technology. Enzyme pretreatment cannot be a complete substitute for conventional solvent extraction, but can result in increased yield of value-added cell components and a reduction in time of extraction and reduction in amount of solvent consumption.

6. Membrane processing: It is a fast-emerging technique for the concentration and separation of macro and micro molecules based on molecular size and shape used in the field of chemical engineering, biotechnology and food processing.

7. Biotechnology: It is a boon for natural colour production. Biotechnology could be an effective technology for the efficient mass production of colorants from plant tissues. It is the genetic modification for pigment production. To date, no standardized methods are reported for the production of natural color on large scale by plant cell culture methods. this method can be worked out/ standardized for large scale preparation of colorants, it would be a major breakthrough in terms of cost effectiveness and also avoiding the usage of toxic solvents for extraction.

8. Nanotechnology: This technology has been applied to natural colorants to convert fat soluble pigments into water soluble formulations.



Conclusion

Emerging technologies such as high hydrostatic pressure, pulsed electric fields and sonication could be potential methods for the enhanced extraction of pigments and bioactive compounds from plant materials in future. Still, all the above-mentioned newer technologies cannot compete with the conventional method of extraction at an industrial level as these techniques require standardization in terms of huge quantity of raw material required to be handled, equipment at industrial scale application and also evaluation of the end product. The scale of operation is only on academic scale, which is appreciable in terms of innovations and as future technologies.

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Maximization of Crop Yield Through CO_2 Fertilization

Article ID: 31621

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Introduction

The human population of the world expected to exceed nine billion by the middle of this century. To feed such a large community of peoples, pressure rising on crop productivity due to limits of arable land, water, and nutrients, switching diet habits, and global environmental changes. In the last 50 years, a linear increase in productivity of food was due to effective agronomic and breeding practices. The environmental changes i.e. biotic and abiotic threats, newer emerging pests and rising greenhouse gases can slump the yield and quality of the crop. Among greenhouse gases, atmospheric CO_2 levels has increased from 280 to 390-µmol mol-1 since 1800 as linearly over the years and the estimation of present levels of atmospheric CO_2 may double by the end of the twenty-first century (IPCC, 2007). However, some advantages are there as green plants can get adoption to these elevated high levels of CO_2 through photosynthetic conversion into increased dry biomass. According to Kant et al. (2012), the potential of this conversion varies with different plant species to assimilate higher CO_2 concentrations and their consequences not yet fully understood.

The CO_2 fertilization effect suggests that the increase of CO_2 in the atmosphere increases the rate of photosynthesis in plants. Reports of Kimaball et al. (1983) explained that the CO_2 affects the climate of the Earth as well as the primary productivity and water use of plants. Greater CO_2 concentrations will probably boost agricultural production with less water consumption, which will be a boon to Earth's ever-expanding population. On the other hand, increased CO_2 has predicated to cause a catastrophic atmospheric warming due to CO_2's 'green house' properties, the proportions of which Earth has never before experienced. From a quarter to half of Earth's vegetated lands has shown significant greening over the last 35 years largely due to rising levels of atmospheric carbon dioxide. Researchers found as northern portions of the planet warm up even as total atmospheric CO_2 increases; there has been an increase in plant growth in these regions. They called it "Arctic greening."

Reviews of Researchers

Several theoretical models have predicted that the doubling of the atmospheric CO_2 concentration will increase the earth's temperature by 2–3°C, which could seriously disrupt agricultural production. More recent experimental data suggest that warming may only be about 0.25°C, so the primary effects on agriculture are likely to be beneficial for crop yields and water use efficiency. Hence, several researchers conducted studies to check out the impacts of CO_2 fertilization on several crops either positive or negative which discussed below.

Positive Impact of CO_2 Fertilization

Saseendran et al. (2000) evaluate the effect of climatic change as expected by the middle of the next century taking into account the projected emissions of greenhouse gases and sulphate aerosols, in a coupled atmosphere-ocean model experiment on rice production at Kerala (India). The CO_2 sensitivity on yield simulated by CERES-Rice averaged over five locations in Kerala is presented in Fig. 1. The increase in yield is exponential in the CO_2 incremental range between 180 ppm to 380 ppm, but slow increase thereafter. It appears that at around 800 ppm onwards the fertilization effect of CO_2 in increasing photosynthesis diminishes very fast. With

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a doubling of CO_2 the yield was found to increase by 10% under rainfed cultural practices for cultivation of rice crop in the state. Adams et al. (1990) also reported similar findings as increase in dry matter of 10-50 % with doubling of CO2 in most species of crops when all other factors remain constant.

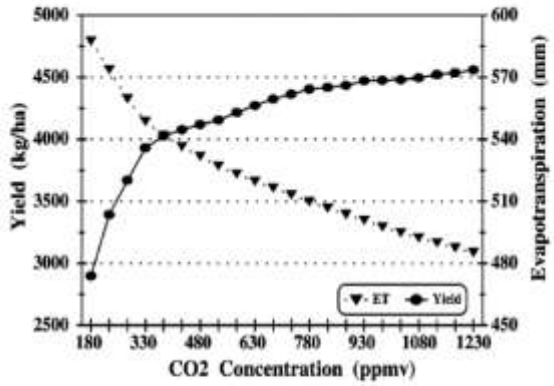

Fig. 1 Sensitivity of ET and yield to CO_2 changes in the atmosphere as simulated by the CERES-Rice model

The response of the evapotranspiration (ET) to increase levels of CO_2 is also presented in Fig. 1. The decline in ET rate is near exponential in the CO_2 incremental range from 180 ppm to 380 ppm and slower thereafter. A lowering in the ET of crop results in a reduced water requirement of the crop, which may be attributed to stomatal regulation by CO_2 concentration in the ambient atmosphere. Kimbali et al. (1983) concluded that doubling of CO_2 concentration could reduce transpiration by 34%, which combined with the yield increase, indicates that water use efficiency may double.

Median estimates of global impacts of temperature and precipitation trends (1980–2008), on average yields for four major crops (i.e. wheat, rice soya-bean and maize) at United States (David B. et al., 2011). Data shows that the concentrations of atmospheric CO_2 increased from 339 ppm in 1980 to 386 ppm in 2008.

Results revealed, C3 crops (i.e., wheat, rice, and soybean) show an average yield increase of 14% in 583 ppm CO_2 relative to 367 ppm CO_2. Hence, the 47-ppm increase CO_2 concentrations have boosted yields by roughly 3% since 1980.

At ICRISAT, Hyderabad, a field experiment taken to choose management options to increase groundnut productivity under climate change by Singh et al. (2014). Increased CO_2 concentration in the atmosphere increases crop growth through increased leaf-level photosynthesis and reduces transpiration from the crop canopy via an empirical relationship between canopy conductance and CO_2 concentration.

Hence, positive effect of higher CO_2 concentration on pod yield of peanut was noticed. Similar findings were also suggesting by Mani et al. (2009) in barley crop at CCSHAU, Hisar.

Negative Impact of CO_2 Fertilization

The net effects of higher CO_2 and climate change from 1980 to 2008 have likely been slightly positive for rice and soybean, and negative for wheat and maize (David B. *et al.* 2011). Maize crop having lesser effect of higher CO_2 because its C4 photosynthetic pathway is unresponsive to elevated CO_2.

Similarly, Geethalakshmi *et al.* (2017) revealed some negative effect of CO_2 fertilization from studies on impacts of elevated temperature and CO_2 enrichment on rice crop at Tamil Nadu Agriculture University, Coimbatore. They conducted experiment under two different environmental conditions, *viz.* ambient and modified (+4 ◦C temperature and 650 ppm CO_2).

The rice crops grown under open ambient condition registered higher grain and straw yields compared to plants grown under controlled condition. The lower yield resulted due to elevated temperature would nullify the enhanced CO_2 positive effect on growth and yield, and negatively affect the crop productivity. It might be due to increase the rate of respiration, shortened the vegetative, and grain filling stages.

Conclusion

As per the reviews by researchers, it can be concluded that CO2 fertilization is helpful for increase the crop production with lesser water use. But, increase in CO2 concentration increase the temperature that boost the yield of certain level but higher temperature above the certain level yield is decrease.

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Application of ICT in Crop Protection

Article ID: 31622

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Summary

The world population is increasing at a very fast rate and with increase in population the need for food increases sharply. In last four decades, agricultural production in India has increased significantly and country has achieved self-sufficiency in food grains. This has been achieved by use of newer technologies such as high yielding varieties, fertilizers and pesticides, as well as by the expansion of cultivable area. Today we are frequently facing some unprecedent challenges of climatic variability, declining state of natural resources, input use efficiencies, changing scenario of biotic and abiotic stresses and difficulties with access to market and all these problems can be tackled with the use of information communication technology (ICT). ICT in simple terms, can be defined as the basket of technologies, used to communicate, create, diagnose, disseminate, store and manage information with the adoption of digital approaches. In the era of globalization, innovative use of ICT can bring dramatic changes in the sector of plant protection besides other areas of agriculture.

Introduction

The world population is growing at an accelerated pace and with this burgeoning population the requirement of food supply is also increasing at an alarming rate. In the last four decades, food grain production in India has been augmented substantially and our country has achieved self-sufficiency in this regard. This growth in crop production needs to be sustained to counterbalance the emerging food demands of our ever-increasing population. Sustainability in agriculture is an aspiration that compels the farmers as well as researchers to recognize the agrarian consequences on ecosystem and communities thereby maintaining food security, minimizing crop loss and also focusing on other innumerable economic, social and environmental concerns. (Pretty 2008; Wu, 2013; Pretty et al., 2014). One of the major ways for the increment in production as well as productivity is by eliminating the losses due to some unprecedented challenges such as climate change, loss of biodiversity, drought, flood, insect and pest attack. Among these factors, pests cause significant damages to the crops cultivated in India. Conventional methods utilized by the farmers are not adequate to serve the ever-increasing demand, hence the farmers are under compulsion to use harmful chemicals in an intensified manner, thereby causing extreme deuteriation of soil fertility in the long run. Excessive and irrational utilization of chemical-based inputs for insect pest management has destructive side effects towards non-target organisms, resurgence of the pest population, development of resistance and effects on the human health due to presence of pesticide residues in/on the food (Stephenson, 2003). This imparts a huge impact on the farming practices, soil fertility and also production-related problems. Most of the above problems can be solved by the adoption of Information and Communication Technology (ICT) in agricultural fields. ICT needs inter disciplinary approaches that are engaged in linking subject matter specialists, extension agents, farmers, village level workers, scientists and other agricultural professionals.

The basic crop management decisions are often made infrequently, so farmers need tools that can help them collect and process - up-to-date, contextually appropriate information on both biophysical conditions and local socio-economic concerns. However, these applications designed for field-level management by single user are not easily dilated to broader spatial scales so it is troublesome to confront the geographical variability of agricultural landscapes distinctly. The new technology solely is inadequate for successful transformation in agriculture and allied sector but it could facilitate connecting people to information that enables user to greater capacity for decision making.

ICT in simple terms, can be defined as a basket of technologies, which assist in processing of data/information, its storage and its dissemination thus acting as a communication thread between various spheres which work towards enhancing agricultural productivity and sustainability. Approach to ICT in agricultural research and development, is enormous. Lack of scientific and systematic pest monitoring and management strategies led to the innovative use of ICT in the field of plant protection for implementation of IPM on an area-wide basis. The dissemination of information to the farmers at the time when it is required becomes very important.

Emerging Technologies

With the current multifarious challenges, agriculture is poised to shift to a modern era with the development of technologies in this digital world. This continuous exploration will assist to drive the agricultural sector from the traditional practices to data-driven high-tech management and automation. And this new paradigm will gain importance through the advent of digital agriculture by the convergence of several fundamental technologies including the mobile applications, decision support system etc.

Mobile Applications

In a world of technological advancements, android based smartphones are the rapidly growing segment of mobile market that give users a richer and faster access to services of choice. Mobile apps (=applications) can be the best option to increase countries' agricultural production by taking advantage of software designed for targeting desired needs of farmers. Today farmers are receiving diverse facts or information about faming like seeds, crop selection, fertilizer, pesticides etc. from various resources which are distributed on many locations according to its origin, its processors, producers or vendors. New opportunities are shaped by smart phone technology for farmers or the end users.

ICT Based Decision Support System

Generally, the IPM DSS provide users with the all necessary information, including pest identification/ disease diagnosis, pest/ pathogen life history, sampling and decision-making criteria, weather-based pest development models, biorational pest management methods, currently available pesticides. Farmers with internet access can explore the DSS based real- time data about weather, climate change, market data/ information and make decision to diagnose pests and diseases on target specific landscapes or farm types. Another critical area of DSS would be a major role in providing accurate forecasting and real time statistics of pests with the use of climatic-driven models on an emergency basis and making this available to farmer.

ICT Based e-Governance Projects

(http://agricoop.gov.in/divisiontype/informationtechnology/ programmes-schemes).

1. AGRISNET is a project funded by the DoA & C, Ministry of Agriculture, GoI provides information on seeds, fertilizers, pesticides, government schemes, crop management, weather and marketing of agriculture produce.

2. DACNET is an e-governance project sanctioned by the DoA & C, Ministry of Agriculture, GoI and executed by the National Informatics Centre (NIC) to facilitate services like Plant Quarantine Information System, Crop Weather Watch, Biofertilizers Informatics Online, Integrated Pest Management Information System, Computerized Registration of Pesticides.

Conclusion

Food security has become a global issue especially in recent times. Hence, the importance of agriculture cannot be overemphasized. As in every other sector, constant research in the agriculture sector is needed if it must stay in tune with advances in technology so as to meet the ever-growing demand for its produce more so with the new trend of eco-friendly green world campaign. This has put more pressure on agriculture produce which are the most eco-friendly resources available. ICT has impacted positively every sector of the economy. Agriculture being a part of the economy is yet to witness any meaningful widespread impact by ICT. The prospects that ICT holds for Agriculture can be harnessed to the maximum extent if following recommendation can be adopted.

Recommendations

1. Government should provide at least one ICT centre in every local government headquarter. This ICT centre should have computer equipped with IT such as email and the World Wide Web, for ready access to farmers.
2. Government should provide training and support staff in each of these ICT centres.
3. Government should educate farmers on the role/benefit of ICT in agriculture so as to boost user's trust on ICT.

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Yield Attribute of Tomato (*Lycopersicon esculentum* Miller, Var. Kashi Amrit) in Existing Biotic and Abiotic Factors in Varanasi

Article ID: 31623

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Vegetables are the novel and edible portion of the herbaceous plants and play an important role in the daily intake of our food. India is the second largest producer of vegetables next to China. Tomato *(Lycopersicon esculentum* Miller) is important commercial vegetable crop in India.

Tomato is rich source of various nutrients like Moisture (94%), Carbohydrate (3.6%), Protein (0.9%), Fat (0.2%), Mineral Matter (0.5%), fibre (0.8%), Carotene (351 mg), organic acids, Folic acid-free (14mg) and Folic acid (30mg). For the above reasons tomato is being one of the cash crops for many vegetable growers in India.

So, its yield potential must be of research significance which I have done for in horticultural farm BHU (Var. Kashi Amrit) during *Rabi* 2019 season. Among the biotic factor's insect pests like tomato fruit borer (*Helicoverpa armigera* Hubner) is a major pest in India (Swarup and Sharma, 1965). Abiotic factors directly affect the reproduction, growth and survival fruit borer.

In each treatment the yield data of marketable fruits at different pickings were noted separately and subjected to statistical analysis to test the significance of mean yield in various treatments. The percent increase in yield over control in each treatment was calculated by using the following formula.

$$\text{Percent increase of yield over control} = \frac{\text{Yield in treatment} - \text{Yield in control}}{\text{Yield in control}} \times 100$$

First picking was performed 80-85 days after transplanting when fruit attain their full maturity and next picking was subsequently done after 7 days intervals. The all picking was combined to calculate the average yield (qt. ha^{-1}). The minimum fruit damaged of 62.59% and the highest yield of tomato fruits (27533.22kg/ha.) was observed in a treatment sprayed with chlorantraniliprole 18.5% SC 40 gm a.i. /ha.

The succeeding best treatment was chlorantraniliprole 18.5% SC @ 30 gm a.i. / ha. Which recorded 26199.89 kg / ha yield with 54.72% increase over control and next best treatment flubendiamide 39.35% SC @ 48 gm a.i./ha in which 25574.89kg / ha yield with 51.03% increase over control was obtained.

Among the Lambda Cyhalothrin 5% SC@15 gm a.i. / ha and gave yield (24491.56 kg/ha) with 44.63 % increase over control and followed chlorantraniliprole 18.5% SC 20 gm a.i./ha gave yield (22716.57 kg/ha) with 34.15% increase over control the untreated control recorded lowest yield of 16933.26 kg/ha of tomato fruits.

The results of the present study are in conformity with the results of Safna *et al*. (2018) who found spraying of chlorantraniliprole 18.5% SC was superior in reducing the larval population with increased yield. The Chlorantraniliprole are selective insecticide, anthranilic diamides shows very specific mode of action and they cause paralysis of the muscle cells of the insects.

By both ingestion and contact, it exhibits ovicidal and larvicidal activities (Cabrera *et al.*, 2014). This insecticide is effective against chewing pest (Dinter *et al.*, 2009).Patel *et al*. who reported chlorantraniliprole 35.WG @30 gm a.i/ha is most effective and caused lowest fruit damaged and gave highest yield than other treatment.

This study was reported that chlorantraniliprole 18.5% SC @ 40 gm a.i. / ha and, chlorantraniliprole 18.5% SC @ 30 gm a.i. / ha, flubendiamide 39.35% SC @ 20 gm a.i./ha @50 gave auspicious result against *Helicoverpa armigera*.

Chlorantraniliprole 18.5% SC @ 30 gm a.i. / ha was at par with flubendiamide 39.35%SC 48 gm a.i. / ha. Chlorantraniliprole 18.5% SC is most effective than other newer insecticide against the fruit borer and also less toxic to insect predator and parasitoid such as *Chrysoperla carnea* and *Trichogramma evanescens* larvae (Al-kazafy Hassan *et al.*, 2014). Chlorantraniliprole 18.5% SC 30gm a.i /ha and lambda cyhalothrin 5%EC are also giving good result.

Safna *et al.* (2018) reported that chlorantraniliprole 18.5 SC @ 0.005 per cent was the best treatment which recorded minimum (13.82%) mean fruit infestation and was significantly superior over all other treatments. The result is conformity with to Bassi *et al.* (2009) also reported that chlorantraniliprole @ 10-60 g a.i/ha were highly effective against *H. armigera*. According to Kousika *et al.* (2015) also documented the efficacy of this insecticides which reduced the fruit damaged and conversely increased the fruit yield of tomato.

The yield was found to be high in chlorantraniliprole 18.5% SC 40gm a.i. /ha (27533.22kg /ha) and was followed by chlorantraniliprole 18.5% SC 30gm a.i. /ha (26199.89kg /ha), flubendiamide 39.35% SC 48 gm a.i/ha (23933.33 kg /ha) and among insecticides a low yield was recorded in plots treated with Nimbecidine (22266.57kg /ha) treatments but the yield was significantly higher than untreated check (16933.26 kg/ha).

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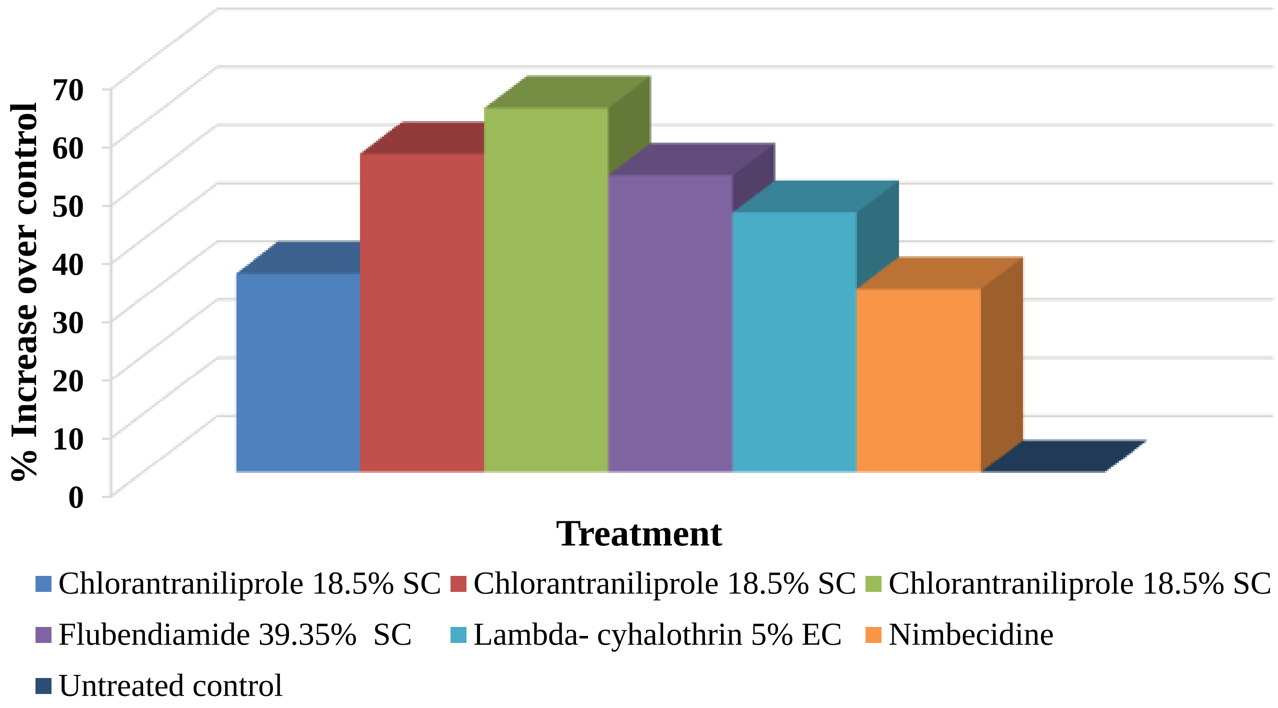
Table 1: Impact of Insecticidal Treatments on Tomato Yield

Treatment	Dose gm a.i/ ha	Yield (Kg /plot)	Yield (Kg/ha)	% increase in yield over control
Chlorantraniliprole 18.5% SC	20	27.26* (5.31)**	22716.57	34.15
Chlorantraniliprole 18.5% SC	30	31.44 (5.69)	26199.89	54.72
Chlorantraniliprole 18.5% SC	40	33.04 (5.83)	27533.22	62.59
Flubendiamide 39.35% SC	48	30.69 (5.61)	26199.89	51.03
Lambda- cyhalothrin 5% EC	15	29.39 (5.51)	24491.56	44.63
Nimbecidine		26.72 (5.26)	22266.57	31.49
Untreated control	-	20.32	16933.26	-
SE(±m)	-	0.143	-	-
C.D at 5%	-	0.444	-	-

*mean of three replications.

**value in parentheses are squire root transformed value.

Fig. 1: Impact of Insecticidal Treatments on Tomato Yield


% Increase over control
70
60
50
40
30
20
10
0
Treatment
Chlorantraniliprole 18.5% SC
Chlorantraniliprole 18.5% SC
Chlorantraniliprole 18.5% SC
Flubendiamide 39.35% SC
Lambda- cyhalothrin 5% EC
Nimbecidine
Untreated control

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Crop Residue Burning: Multiple Management Approaches

Article ID: 31624

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Summary

CRB is conventional, speedy and labour-saving practice to prepare the field for next cropping and to get rid of the residues. It has several impacts on ecology and environment. Despite knowing the consequences, it is still followed in many parts of the county specially the Northern states of Indian Territory. The Agricultural residues have several other competitive uses like it can be used in energy generation, fodder production, composting, mulching, etc. The farmers must be motivated about the alternative uses and available technologies & schemes to manage crop residue. Mere motivation is not enough; there is need of tremendous Research & Development in this sector. This article provides brief information about CRB and its management approaches.

Keywords: Crop Residue Burning (CRB), Green House Gases (GHG's).

Introduction

With the increase in global population count, there is need of simultaneous increase in the production of food grains to feed the population. Increasing production comes along a humongous task of managing the uneconomical part of the crop. Agriculture being the backbone of the Indian economy generates enormous amount of crop residues. Around 500 million tonnes of agricultural waste are generated in India (Ministry of New and Renewable Energy). According to an estimate by The Energy and Resource Institute (TERI 2019), 87 metric tons of surplus crop residues are burnt in diverse croplands. Burning residues on field significantly affects the environment and the quality of air which in turn affects the human health as suggested by various studies. Suitable management practices must be adopted by the farmers to escape the ill effects of crop residue burning. The approach should be sustainable and economically feasible to the resource deprived farmers.

Possible Reasons Behind Crop Residue Burning

With the introduction of photo-insensitive short duration varieties during 1960's, made farmers to take multiple cropping per year with the help of high level of mechanisation, irrigation facilities and other inputs. The time window to manage the crop residue between the subsequent crops is very less. The farmers have only 10-20 days for harvesting paddy and planting the succeeding crop. For planting the next crop, farmers need to prepare the field removing the paddy stalks left behind after harvesting through combine harvester which is labour intensive. So, to get rid of this, just one stroke of matchstick is enough for them.

There are other reasons behind purposeful burning of crop residue. It offers faster way of controlling weeds, pests and diseases by eliminating the host or by altering the ecosystem of pests. It provides farmers a faster way of clearing the fields and short-term soil fertility enhancement. Due to less livestock rearing, farmers have very little use of residue as fodder.

Impacts of Crop Residue Burning

1. Impact on air pollution: CRB considerably increases the amount of air pollutants in the atmosphere such as particulate matters, oxides of carbon (CO2, CO), oxides of nitrogen, Sulphur dioxide and other volatile organic compounds (Awasthy et al., 2010). Burning one tonne of straw discharges approximately 3 kg of particulate matter (PM), 60 kg CO, 1,460 kg CO_2, 2 kg of SO_2 and 199 kg ash, (Jenkins et *al*., 2003).

2. Impact on GHG's emissions from agricultural fields: According to Venkataraman et al. (2006), the GHG emissions from CRB ranges from 175-539 Tg/yr for CO_2 whereas 313-1164 Tg/yr.

3. Impact on human health: The emissions from CRB possess a grave threat to human health. According to the report of Agarwal et al. (2010), even short-term exposure to CRB can cause respiratory disorders.

4. Impact on soil nutrient status of the soil: After burning the crop residue, entire amount of C, along with almost 80% N, 25% of P, 20% of K and 50% of S present in straw are lost (Ponnamperuma et al., 1984).

5. Impact on soil properties: The heat generated from burning residues, elevates the soil temperature which kills the beneficial bacterial and fungal populations. CRB also degrades the soil structure (Valzano et al., 1997).

Management Approaches

1. Technological options:

a. Biomass energy generation from residues is viable option of fulfilling emerging need of cleaner energy.
b. Biochar production and application to soil which in return provides nutrients, improves water holding capacity and habitat for microorganisms (Lehmann et al.).
c. Enhanced composting of agricultural wastes using earthworms. (Rajkhowa et al.).

2. Mechanical options: In-situ management of crop residue can be done by incorporating the residues using the available tools like Happy Seeder, Zero till seed drill, Rotavator, etc.

3. Government Interventions: With vigilant Government agencies like National Green Tribunal, it is possible to curb the menace. Ministry of agriculture launched NPMCR with the objective of formulating and implementing suitable regulations and policy measures to curb CRB. Farmers using alternative cropping pattern should be provided stress free financial aid from government.

4. Capacity building and awareness generation:

a. Awareness can be created about several technologies to prevent CRB through demonstration and using various Medias in parallel way. Local self-government can be given authority to impose fine on the wilful defaulters.
b. Promoting and supporting financially the entrepreneurs who are engaged in various residue management activities like establishment of custom hiring centres.

5. Other viable options

a. Preparation of bedding materials for animals.
b. Using the residues for mulching purposes to protect the soil from erosion and conserving water.
c. Mushroom cultivation on paddy/wheat straws.
d. Residues can be utilised in producing papers and packaging materials.

Conclusion

With the increase in mechanisation and improved methods of farming, India reached self-sufficiency in food grains. This also increased the share of agricultural residue. On farm burning of crop residue is sporadic but possesses a great threat to human and environment. Implementing all available options at ground level with the cooperation of people and government agency is necessary. The huge volume of crop residue hinders the process of its collection and management. Cost effective mechanisation and availability of machineries can be provided through custom hiring centres at local level. Robust monitoring and implementation mechanism through the use of remote sensing technology, real-time satellite imagery, along with village-level enforcement teams with the ambition of zero incidence rate of crop residue burning is the need of the hour. Roles and responsibility should be distinct for better harmony and promotion of crop residue management practices.

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Agro–Tourisman Emerging Opportunity for Farmers

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Abstract

Agro-tourism is the latest concept in the Indian tourism industry, which normally occurs on farms. Agro-tourism is a form of agricultural multi-functionality it gives you the opportunity to experience the real alluring and authentic contact with the village life, taste the local veritable food and get familiar with the many farming tasks during the visit. It provides you the welcome break free from the daily busy and hectic life in the peaceful village environment. It gives you the chance to relax and reinvigorate in the pure natural environment, surrounded by splendid setting. It gives you the chance to see the real India and have the experience on the farm stay holidays. Many Indian farmers especially from Pune and Maharashtra currently involved in or are considering the use of agro-tourism as a mode of diversifying their farm operations.

Keywords: Agro-tourism, Employment, Rural development.

Introduction

Indian population has increased five times than that existed at the time of independence, but the land area is not change even the agricultural land got decease, currently only one fourth of the land is available for per person as compared to the time of independence. Agriculture business is becoming more and more costly and many farmers cannot afford it. In addition to this the gradual decrease in fertility of land that giving marginally diminishing yields. So, to overcome this continuously increasing gap farmers must think of an alternative business of any type to support their overall income from land, or else they shall be forced to live out a life of below poverty line with lots of scarcity of resources. In order to work in this direction some farmers must be encouraged to start small and viable business like Agro-Tourism units on the farm in their villages. Around 70 to 80 % of Indian Population lives in rural area. By realizing their problems and needs we felt that, there is still many things that can be done for these people. ATDC has been contributing its efforts for the overall upliftment of the farmers in rural areas. The youth population in rural specially the school dropouts, educational backward and rural women constitute more than 50% of our rural population. Until and unless we do some welfare activities for this section of the community overall social upliftment of the nation remains uncompleted.

What Is Agro-Tourism and Why Agro-Tourism?

Agro-tourism is a business conducted by a farmer for the enjoyment and knowledge of the people, to promote the products of the land and generate additional income from farms. It provides rural experiences to urban population and economic alternatives to farmers. Agro-tourism includes activities such as roadside stands, farm tours, bed-breakfast, and cattle drives. It can provide economically feasible ways to care for natural resources, natural habitats, natural scenic areas and special places.

Development of Agro-Tourism is Desirable?

It is a sustainable form of tourism. Where there is limited scope of extra earnings for family depending on agriculture, agro-tourism could serve as additional source of income for the farmers. It gives prestige to rural life, creates jobs at local levels. It gives opportunity to urban tourist to escape from his busy and hectic routine and allows him to go back to his roots. It can enhance the quality of life for local residence. It gives the tourists glimpse of village ambience, local cuisine, culture and art. It expects the active involvement from the tourist, rather than a passive spectator, so a bond between guest-host is strengthened.

Benefits of Agro-Tourism

1. An inexpensive gateway.
2. Interest in natural environment.
3. Curiosity about the farming industry and lifestyle.
4. Disillusionment with overcrowded resorts and cities.
5. Strong demand for wholesome family oriented recreational activities.
6. Health consciousness of urban population.
7. Rural recreation, Desire for peace.

Challenges to the Agro-Tourism Industry

Agro-tourism is although a boom for the development of our rural society but if it can positively handle. The following challenges in its path as stated below:

1. Quality of the service.
2. Complexity in the delivery of the service.
3. Infrastructural deficiency.
4. Multilevel channel involved this tourism development at local and regional level.
5. Literacy rate of the farmers and farm owners.
6. Government Support and Identification.

Conclusion

Agro-tourism is a supportive system to the agricultural activities in India. It is an Innovative practice which can be utilized by the famer and farm owners to harvest this opportunity, through a diversified approach. It will be beneficial model for both farmer and the tourist, as farmers have and extra edge for earning and employments whereas the tourist gets a privilege to relive a smooth, clam &rejuvenating atmosphere and culture of our agricultural heritage. Although is a long way on go as the development and acknowledgement of the Agro-tourisms is potential seen and cultivated by only Maharashtra government and its supporting agencies. Rest on the nation is yet to understand its worth and move ahead on it. Is it the best platform for the socio-economic development of the rural areas, thus the government has to provide a full fledge policy support system for the rooting and strengthen of the Agro-tourism in India?

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New Technologies of Drones for Smart Farmers

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Introduction

Drones can collect high-resolution images and videos, telephone conversations, intercept electronic communications and any other wave or signal depending on the payload installed on board. They can also recognise faces, or even detect "abnormal behaviours" and identify human targets. Future solar-power drones will be able to stay in the air forever, becoming a continuous surveillance tool in the hand of public authorities.

There is no doubt that drones may represent a real threat to the privacy right. Drones are remote controlled aircraft with no human pilot on-board. These have a huge potential in agriculture in supporting evidence-based planning and in spatial data collection. Despite some inherent limitations, these tools and technologies can provide valuable data that can then be used to influence policies and decisions.

The advantages that "an eye in the sky" provides when combined with analytic tools that can interpret the data and images to actionable information have ushered in a new revolution. However, priority in addressing issues related to privacy, safety and security is the key to the sustainable implementation of these technologies.

The use of drones in agriculture is extending at a brisk pace in crop production, early warning systems, disaster risk reduction, forestry, fisheries, as well as in wildlife conservation.

For example, drone technology will give the agriculture industry a high-technology makeover, with planning and strategy based on real-time data gathering and processing following: soil and field analysis, planting, crop spraying, crop monitoring, irrigation, and health assessment.

These systems shoot pods with seeds and plant nutrients into the soil, providing the plant all the nutrients necessary to sustain life. First, a drone scans the topography to create a 3D map. Then, the most efficient planting pattern for that area is calculated using algorithms.

A drone loaded with germinated seeds fires pods into the ground at a rate of one per second, or about 100,000 a day. Scale this up and 60 drone teams could plant 1 billion trees a year.

Current Uses

1. Precision fertilizer programme planning: Nitrogen deficient areas in a crop can be clearly identified from above using drones fitted with cameras that have enhanced sensors. The sensors are calibrated to limit the effect of changing sunlight levels and allow a more accurate calculation of the green area to be made.

2. Weed and disease control programmes: Drone operators can accurately assess weed and disease levels in arable crops. The drone gathers data that identifies the differing reflective properties of various plant species and areas of the crop which have succumbed to disease. When this information is allied to software and analysed, weed species and disease can be pinpointed and targeted with high precision crop control measures.

3. Tree and land mapping: The ability to cover large ground areas is a major benefit for mapping generally. Hundreds of hectares can be mapped in a day with the most sophisticated systems accurately pinpointing changes in terrain and boundary features to within 10cm. The data captured then creates a 3D computer model to highlight ground features and any changes that may have occurred. The drone has a significant advantage over a more time-consuming ground-based system which would involve travelling to, and moving around, the sites and logging GPS co-ordinates.

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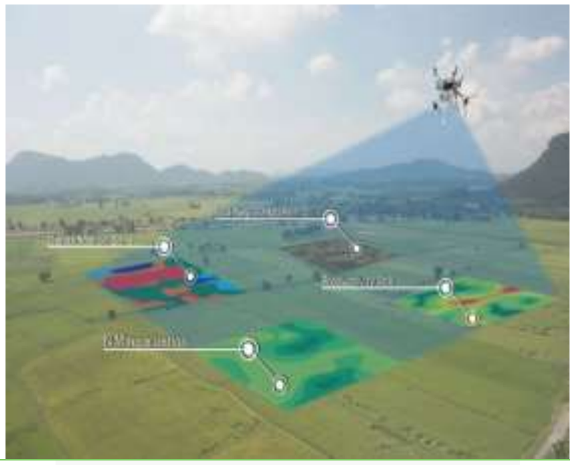
4. Crop Spraying: Larger drones are already capable of applying small quantities of pesticide or fertilizer to crops, orchards and forested areas. However, only a handful of regions and countries permit the use of drones for this type of task. Since September 2016 farmers in Queensland, Australia, were granted permission to apply pesticides from drones, joining farmers in the USA, Switzerland, New Zealand and China.

The Future Scope

1. Drone swarms: While most spraying is carried out using single drone units to either patch, strip or spot spray, rapidly developing technology within the drone may allow much larger areas to be sprayed in the future. Drones are already capable of communicating with each other to avoid collisions and to fly in formation. This could allow a string or swarm of drones to apply pesticide across whole fields in the future.

2. Plant Pollination: A decline in bee numbers has prompted worldwide concern over the future of plant pollination which underpins horticultural and agricultural production. In Japan, researchers have investigated the use of drones to carry out the task. Measuring just four centimetres across and weighing only 15 grams, the drone has proved it is capable of pollinating flowers without damaging the plant.

3. Beyond Visual Line of Sight (BVLOS) flying: A common component of drone legislation is a safety restriction, limiting maximum operating distances to 500m. Within that distance the pilot must also have Visual Line of Sight at all times. However, pilots claim that these rules are severely limiting the technology's potential.

	
A drone, claw to soil analysis	**Crop spraying**
	
Health assessment drone	**Real-Time Monitoring and Analysis**

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Entomology
Entomotherapy: Use of Insects in Medicine

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Introduction

Insects and the substances extracted from the insects have been used as a medicinal resource by human cultures all over the world from ancient times. Besides medicines, insects have also played an important role in treatment of several illnesses. The rise of antibiotic resistant infections has forced pharmaceutical research into looking for new resources. Many insects, used in alternative medicine, are now being tested for mainstream medical products. Science has already proven the existence of immunological, antibacterial, diuretic, analgesic, anesthetic, and antirheumatic properties in the bodies of insects. Due to therapeutic potential of insects, an insect seems to constitute an almost inexhaustible source for pharmacological research.

What is Entomotherapy?

Entomotherapy is a branch of science that uses insects for medicine. The rise of antibiotic resistant infections has forced pharmaceutical research into looking for new resources.

Modern Scientific Uses of Insects in Medicine

1. Maggot therapy: It is used in military medicine very effectively. Maggot therapy is the intentional introduction of disinfected blowfly larvae into soft tissue wounds. It selectively cleans out the necrotic tissues. Hence, it helps to prevent infection, it also speeds healing of infected wounds and ulcers. This is because of the chemicals secreted by maggots.

2. Apitherapy: It is widely used for anti-microbial factors. Apitherapy is the medical use of honeybee products such as honey, pollen, bee bread, propolis, royal jelly and bee venom. Melittin present in bee venom has the potential to treat inflammation in sufferers of rheumatoid arthritis and multiple sclerosis by blocking the expression of inflammatory genes, thus reducing swelling and pain. Bee products demonstrate a wide array of antimicrobial factors.

3. Blood-feeding insects: To prevent clot formation. Many blood-feeding insects like ticks, horseflies, and mosquitoes inject multiple bioactive compounds into their prey. The compounds present in the saliva these insects are capable of increasing the ease of blood-feeding by preventing coagulation of platelets around the wound. Over 1280 different protein families have been associated with saliva of blood-feeding insects. This may include: anticoagulants, vasodilators, vasoconstrictors, inhibitors of platelet aggregation etc. However, modern medical research has recently investigated the drug development potential of blood-feeding insect saliva.

4. Blister beetle and spanish fly: Cantharidin against cancer cells. Cantharidin, the blister-causing oil found in several families of beetle used for the treatment of warts and several skin problems. It is also used as an aphrodisiac in some societies. Several studies in cell culture and animal models have demonstrated powerful tumour-fighting properties of cantharidin.

Examples of Some Lesser Known Insects which are Used in Human Medicine

1. South American jungle ants: The venom of this ant is used to treat rheumatoid arthritis. Researchers have tested the efficiency of this ant venom by injecting this extract to half of the patients and the other half patients with placebos. Those who received the venom derivative showed dramatic reduction in the number and intensity of inflamed joints, and marked increases in their freedom of motion. Patients who received placebos showed no improvement.

2. Grasshoppers: The poultices are made from ground grasshoppers as pain relievers for migraines. Neurologists hypothesize that grasshopper toxins stimulate the human central nervous system, and dilate blood vessels, increasing circulation. Powdered, sun-dried, grasshopper is turned into tea for the treatment of asthma and hepatitis.

3. Silkworm: Silkworm extracts may have benefits, as dietary supplements, for patients with heart disease and circulatory disorders. Preliminary studies indicate they reduce serum cholesterol, and dissolve vascular plaque. A bacterium that lives in the digestive system of silkworms contains a substance known as serrapeptase. This substance gives pain relief for people with back injuries.

4. Termites: Ayurveda uses termites, and their mounds, for ulcers, rheumatic diseases, anemia and pain. In Africa termites are used in asthma, bronchitis, whooping cough.

5. Centipedes: Traditional Asian practitioners use centipedes to treat tetanus, seizures, and convulsions. Herbal detoxification preparations that include powdered centipede do dissipate toxins and wash away free radicals. Centipedes are dried, ground into a paste, and applied topically to sores and carbuncles.

6. Mealy bugs: A mass of boiled mealy bugs was ingested to alleviate the effects of poisonous mushrooms and other fungi, and to clean the teeth and in the treatment of dental caries.

Conclusion

Human beings have used insects as medicine in different human cultures throughout the world, but very little research was done to convert local use into proven, standardized medicine. Heavy reliance on antibiotics, coupled with discomfort with insects in western culture limited the field of insect pharmacology. Recently, the rise of antibiotic resistant infections sparked pharmaceutical research to explore new resources.

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Sustainability in Agriculture Through Conservation Agriculture

Article ID: 31628

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Introduction

Conservation agriculture (CA) refers to a range of soil management practices that minimise effects on composition, structure and natural biodiversity and reduce erosion and degradation. Such practices include direct sowing/no-tillage, reduced tillage/minimum tillage or surface-incorporation of crop residues and establishment of cover crops in both annual and perennial crops. As such the soil is protected from rainfall erosion and water runoff; the soil aggregates, organic matter and fertility level naturally increase and soil compaction is reduced. Furthermore, less contamination of surface water occurs, water retention and storage are enhanced, which allows recharging of aquifers. Conservation agriculture aims to achieve sustainable and profitable agriculture through the application of the three CA principles: minimal soil disturbance, permanent soil cover and crop rotations. CA holds tremendous potential for all sizes of farms and agro-ecological systems, but its adoption is perhaps most urgently required by smallholder farmers, especially those facing acute labour shortages. It is a way to combine profitable agricultural production with environmental concerns and sustainability and it has been proven to work in a variety of agro ecological zones and farming systems.

Conservation agriculture has wide range of benefits including improvement in soil fertility, reduction in soil erosion, carbon accumulation, savings in time and energy (fuel), and increase in biodiversity 98%. Conservation agriculture has gained significance in view of adverse effects of intensive agriculture on natural resource base, including soil and water. Conservation agriculture has to wide applications in irrigated and rainfed condition. Conservation Agriculture is the best option for a sustainable and productive agriculture.

Need of Conservation Agriculture

1. To stabilize soil productivity without soil degradation.
2. To enhance water use efficiency for both irrigated and rainfed agriculture.
3. To increase crop productivity.
4. To reduce production costs.

Conservation agriculture is vital for sustaining high-growth agriculture without clashing with the environment. Of late, modern agriculture has come in for considerable flak for causing possibly irretrievable damage to the earth's natural resources, notably soil and water, and for vitiating the environment through harmful greenhouse gas (GHG) emissions. Conservation agriculture, involving some novel farm practices, is said to be an antidote for most of the ill-effects of intensive farming. For, it aims to not only reduce the damage to natural resources and the environment but actually reverse it. burning one tonne of crop residue produces about 3 kg of particulate matter, 199 kg of ash, 60 kg of carbon monoxide, 1,460 kg of carbon dioxide, 2 kg of sulphur dioxide and varying amounts of other obnoxious greenhouse gases like methane, nitrogen dioxide and nitrous oxide. Progressive farmers, especially in the irrigated belts, are taking it up because it facilitates higher incomes by cutting costs and raising production. Conservation agriculture is based on soil life. Therefore, soils have to be brought up to a condition where life can develop. This refers to nutrients, pH, organic matter and moisture. Soils under CA are usually improving, which means the rate of degradation and erosion is lower than the rate of soil build-up. For that reason, even degraded soils will improve and become productive under this system.

Elements of Conservation Agriculture

1. Residue management: Crop and weed residue management is an essential element of CA. For example, slashing a cover crop or weed cover before flowering or seed set, or rolling to flatten crop residues, reduces weed infestations, increases infiltration of rainwater and protects the soil water against evaporation. The residue cover also protects and feeds the soil fauna that produces and maintains an open pore system in the soil. Only in very few soil and climatic conditions, soil able to maintain its structure on its own. No-till systems such as CA rely on soil life to build and maintain an open pore structure in the soil. This biological tillage replaces mechanical tillage in CA. The soil life consists of macro and micro fauna and flora such as earthworms, insects, bacteria, fungi and plant roots. These have to be fed and protected. Soil cover provides protection for the living environment of soil life and the substrate to feed it. In addition, the soil cover plays an important role for weed control. No-till agriculture without soil cover is only successful in a few cases and invariably runs into weed problems requiring large amounts of herbicides.

2. Crop rotations: Crop rotation is necessary in CA in order to avoid the built-up of pest, weed or disease and to ensure that root systems explore the soil to different depths. It also entails a more balanced extraction of plan nutrients from the soil. Conservation agriculture without crop rotations may be possible, but it is very difficult, especially if the use of pesticides is to be reduced to a minimum. Any crop which is grown repeatedly on the same field accumulates pests and diseases over time. Under CA the crop residues remain on the soil surface are neither burnt nor ploughed in and the infection chain to the subsequent crop can only be broken by leaving sufficient time between similar crops. In addition, the different crops in a rotation have other rooting systems and exploit or develop different parts of the soil profile or have different nutrient requirements. Crop rotations not only allow diversified production but also make use of synergy effects between different crops in pest control, nutrient availability and rooting environment.

3. Zero tillage: One of the most important principles of CA is minimal soil disturbance. In no-till or zero till system, the seed is placed into the soil by a seed drill without prior land preparation. It is estimated that for each liter of diesel fuel consumed, 2.6 kg of CO_2 is released to the atmosphere. Assuming that 150 liters of fuel is used per hectare per annum for tractor uses and irrigation purposes in conventional system, would amount to nearly 400 kg CO_2 being emitted per annum per hectare. Hence, in the direction of CA, no-till system has been proved to be the important step in the conservation agriculture and economic growth. Zero tillage is a technical component used in CA but not everyone carrying out zero tillage is practising CA. Conservation agriculture not only avoids tillage by placing the seed into the soil with direct drills, it also improves the structure of the soil by maintaining a soil cover. This facilitates direct planting. Conservation agriculture uses biological tillage. Zero tillage can also be applied as a stand-alone technique in conventional agriculture under certain circumstances.

4. Conservation tillage: Tillage produces an aeration and thus rapid mineralization of organic matter in virgin soils. This mining of soil organic matter makes available plant nutrients for the next crop, albeit only for a limited number of years. This is the origin of the misconception that tillage increases soil fertility. Conservation tillage practices leave some crop residues on the surface, which increases water infiltration and reduces erosion. They are used in conventional agriculture to reduce soil erosion on bare soils. However, some conservation tillage practices such as zero tillage can be elements of CA.

5. Direct planting / seeding: This is a technique of seeding or planting without prior cultivation to prepare a seedbed. Equipment or tools that place the seed in the soil through a mulch or residue cover are used in CA. However, the term direct seeding can also refer to implements used in conventional agriculture that combines primary and secondary tillage and seeding in one machine / tractor operation.

6. Organic farming: Organic farming practices can be elements of CA, but organic farming still relies on tillage in many cases. Conversely, CA is not necessarily organic farming, although it is based on natural processes. Conservation agriculture does not prohibit the use of farm chemical inputs. For example, herbicides are an important component in CA, particularly in the transition phase, until the new balance of weed populations is managed. However, in view of the importance of the soil life for the system, farm chemicals, including fertilizer, are carefully applied and, over the years, quantities applied tend to decline.

Constraints in Adoption of Conservation Agriculture

The adoption of conservation agriculture does not happen spontaneously despite of the obvious productivity, economic, environmental and social advantages and benefits of CA. There are a number of reasons for relatively slow spread of conservation agriculture. Conservation agriculture has great potential due to its ability to control erosion, give more stable yields and reduce labour. There are a number of ongoing initiatives promoting different practices, from conservation tillage up to CA. However, there are still some significant problems.

Converting to CA needs higher management skills. The first years might be very difficult for the farmers; therefore, they might need moral support – from other farmers or from extension services – and perhaps even financial support to invest in new machinery such as zero-tillage planters. Necessary technologies are often unavailable in order to try CA, the minimum a farmer needs are a zero-tillage planter, which might not be locally available. In some cases, individual farmers not to adopt CA in her / his specific farm situations, since the farmer is not in the position to know the merits and disadvantages of CA against conventional tillage farming. In all cases CA is the new unknown concept, while the default condition for more than 90% of the world's farmers is the conventional tillage-based practice which has worked for them so far. In some areas, the climatic conditions allow conventional farming without producing disasters in terms of erosion and other ill effects. The constraints in adoption of conservation agriculture come in different categories viz., intellectual (knowledge), social, financial, technical, infrastructural and political / policy issues.

Conclusion

Conservation agriculture, which is mainly based on the three principles of minimum soil disturbance, permanent soil cover and crop rotation, has shown to improve, conserve and use natural resources in a more efficient way through integrated management of available soil, water and biological resources. It is now widely recognized as a viable concept for sustainable agriculture due to its comprehensive benefits in economic, environmental and social terms. Its ability to increase grain yields to provide better economic performance and reduce production risks and to improve energy use efficiency has been well-documented. What is required is better understanding of its performance and requirements across wider geographic regions and environmental conditions to enable the diffusion of the technology. For its successful implementation in developing regions where it is needed most the design and dissemination of cost-effective farming tools, access to herbicides and economic incentives will be require in addition to creating awareness.

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Study of Important Insecticide Samples

Article ID: 31629

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Introduction

Insecticides are chemical substances which are used to kill insects. They include avicides and larvicides used against insect eggs and larvae respectively. Nearly all insecticides have the potential to significantly alter ecosystems; many are toxic to humans and/or animals; some become concentrated as they spread along the food chain. Insecticides can be classified into two major groups i.e. systemic insecticides, which have residual or long-term activity and contact insecticides, which have no residual activity. The mode of action describes how the pesticide kills or inactivates a pest. It provides another way of classifying insecticides. Mode of action can be important in understanding whether an insecticide will be toxic to unrelated species, such as fish, birds and mammals. The study is conducted on various important insecticides samples which are as mentioned below.

Acephate

1. Chemical Name: O, S-dimethyl acetylphos-phoramidothioate
2. Trade Name: Asataf, Orethene, Starthene
3. Formulation: 75%SP
4. Level of Toxicity: very low toxicity
5. Range of LD50: 1.4 g/kg in male rats, and 1.0 g/kg in female rats.
6. Solubility: very soluble in acetone, soluble in ethanol
7. Mode of action Acephate can kill target insects when they touch it or eat it. When insects eat acephate, their bodies turn it into a chemical called methamidophos, which is another, stronger insecticide. Acephate is less toxic in mammals because mammal bodies do not turn it into methamidophos very well. Acephate and methamidophos affect the nervous system, causing over-activity in the nerves, muscles, or brain. Acephate is absorbed into plants, so insects that feed on treated plants may eat acephate.
8. Doses: lowest lethal dose observed in a study of Beagle dogs was 680 mg/kg, highest doses tested, 1.2 mg/kg in men and 1.0 mg/kg in women.
9. Mode of entry: Inhalation, dermal.

Cartap Hydrochloride

1. Chemical Name: 1,3-di (carbamoylthio)-2-dimethylaminopropane
2. Trade Name: Padan, Caldan
3. Formulation: 25% and 50% water-soluble powder, 2% dust, 4% and 10% granules and 2% fine granules are available. A bait formulation has recently been introduced.
4. Level of Toxicity: Very toxic to aquatic life with long lasting effects
5. Range of LD50: Oral (rat) LD50: 325 mg/kg (female), Oral (rat) LD50: 345 mg/kg (male), Eye (rabbit): non-irritating,

6. Solubility: Soluble in water(13.2/10°C,17.8/20°C, 25.3/30°C slightly soluble in methanol (2.08/5°C), almost insoluble in acetone, benzene, chloroform, diethyl ether, ethyl acetate, and n-hexane.

7. Mode of action: Systemic insecticide with stomach and contact action. Causes paralysis by ganglionic blocking action on the CNS. Insects discontinue feeding upon contact, and die of starvation.

8. Doses: 225 mg/kg (225 mg/kg) for rat, 92 mg/kg (92 mg/kg) for mouse.

9. Mode of entry: Inhalation, eye, skin, swallowing.

Chlorantraniliprole

1. Chemical Name: 3-bromo-N-(4-chloro-2-methyl-6-((methylamino)carbonyl)phenyl)-1-(3-chloro-2-pyridinyl)-1H-pyrazole-5-carboxamide

2. Trade Name: Ferterra, Coragen.

3. Formulation: 0.4%GR, 18.5%SC.

4. Level of Toxicity: Highly toxic.

5. Range of LD50: Rat LD50 oral > 5000 mg/kg bw, Rat LD50 dermal > 5000 mg/kg bw, Rat LC50 inhalation > 5.1 mg/L.

6. Solubility: Solubility in acetone 3.4, acetonitrile 0.71, dichloromethane 2.48, ethyl acetate 1.14, methanol 1.71 (all in g/L). In water, 0.9-1.0 mg/L at 20 °C, pH 7.

7. Mode of action: Chlorantraniliprole opens muscular calcium channels (in particular the ryanodine receptor), rapidly causing paralysis and ultimately death of sensitive species.

8. Doses: 0–2 mg/kg bw.

9. Mode of entry: Ingestion, contact.

Chlorpyriphos

1. Chemical Name: O, O-diethyl O-3, 5, 6-trichloropyridin-2-yl phosphorothioate

2. Trade Name: Dursban

3. Formulation: 20EC

4. Level of Toxicity: Moderately toxic

5. Range of LD50: 32 to 1000 mg/kg

6. Solubility: It is not soluble in water. Solubility (g/100 g): acetone 650, benzene 790, carbondisulfide 590, carbontetrachloride 310, chloroform 630, diethylether 510, ethanol 63, ethylacetate >200, isooctane 79,kerosene60, methanol 45, methylene chloride 400, propylene glycol 4, toluene 150, 1,1,1-trichloroethane 400, triethylene glycol 5, xylene 400. Readily soluble in other organic solvents.

7. Mode of action: Chlorpyrifos leads to a build-up of acetylcholine between neurons and a stronger, longer-lasting signal to the next neuron. Only when new molecules of acetylcholinesterase have been synthesized can normally function return. Acute symptoms of chlorpyrifos poisoning only occur when more than 70% of acetylcholinesterase molecules are inhibited. This mechanism is well established for acute chlorpyrifos poisoning and also some lower-dose health impacts. It is also the primary insecticidal mechanism.

8. Doses: 0.3 micrograms/kg

9. Mode of entry: Inhalation.

Dicofol

1. Chemical Name: 2,2,2-Trichloro-1,1-bis(4-chlorophenyl)ethanol.

2. Trade Name: Kelthane.

3. Formulation: 18.5EC.

4. Level of Toxicity: Moderately toxic.

5. Range of LD50: 587 mg/kg for rats.

6. Solubility: It is stable under cool and dry conditions, is practically insoluble in water but soluble in organic solvents. Solubility: 0.8 mg/l (25 °C) in water.

7. Mode of action: Dicofol is a nerve poison. The exact mode of action is not known, although in mammals it causes hyperstimulation of nerve transmission along nerve axons (cells). This effect is thought to be related to the inhibition of certain enzymes in the central nervous system.

8. Doses: 50 mg/kg.

9. Mode of entry: Ingestion, inhalation.

Fipronil

1. Chemical Name: 5-amino-1-[2,6-dichloro-4-(trifluoromethyl)phenyl]-4-[(trifluoromethyl)sulfinyl]-1H-pyrazole-3-carbonitrile.

2. Trade Name: Regent

3. Formulation: 5SC

4. Level of Toxicity: Moderately toxic

5. Range of LD50: oral LD50 of 97 mg/kg in rats and an LD50 of 95 mg/ kg in mice.

6. Solubility: In water 0.0019 g/L (1.9 mg/L) (pH 5); 0.0024 g/L (2.4 mg/L) (pH 9) at 20 °C

7. Mode of action: Fipronil blocks GABAA-gated chloride channels in the central nervous system. Disruption of the GABAA receptors by fipronil prevents the uptake of chloride ions resulting in excess neuronal stimulation and death of the target insect. Fipronil exhibits differential binding affinity for GABAA receptor subunits, with a higher binding affinity for insect receptor complexes compared to mammalian complexes. The lower binding affinity for mammalian receptors enhances selectivity for insects and increases the margin of safety for people and animals.

8. Doses: 1.5 ppm (0.059 mg/kg/day males, 0.078 mg/kg/day females).

9. Mode of entry: Contact or ingestion.

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Cultural Methods of Pest Control

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Introduction

Manipulation of cultural practices for reducing or avoiding pest damage to crops is called cultural control. It is also defined as control of insect pests through adoption of ordinary farm practices in appropriate time in such a way that insects are eliminated or reduced in population.

Cultural practices do not allow the favourable conditions for life cycle, growth and breeding of pests. In this practice such as ploughing, sowing, irrigation and harvesting are so managed that the pest's population does not cross the economic injury level.

These methods are aimed either at reducing the sources of inoculum or at reducing the exposure of plants to infection. Its primary objective is the prevention of pest damage and not the destruction of an existing and damaging pest population. Some of the cultural methods of pests control are as follows:

1. Selection of site and good soil preparation: This is the first important element in pest control strategy. For successful production of crop and trees, it is essential to select proper field and climatic region. The selected variety should be tolerant to the pests of that particular climatic region. A healthy soil means healthy plants which are relatively more resistant to pests. A soil rich in humus hosts a wide variety of beneficial microflora that trap nematodes and destroy or keep in dormancy disease organisms, thereby encouraging beneficial insects.

2. Use of indigenous or resistant varieties: Traditional varieties are hardier and relatively more resistant to pests. They can withstand harsh environmental conditions better than modem hybrids. Some crops are less attacked by pests because they have more natural resistance than others. They have some special characteristics like acidity or tasteless of cell sap, early maturity, hard bark etc. which help in building their resistance.

3. Ploughing: Deep ploughing of soil exposes the hidden eggs and pupa of insects, nematodes, rhizomes and bulbs of the persistent weeds and organisms which become food for their natural enemies. Some birds follow the plough or tractor at the time of ploughing is the good example. Insects in the pupal stages are helpless and are easily removed and killed.

4. Rouging / Pruning and destruction of crop residue: Removal of diseased plants or plant parts prevents the spread of microorganisms to uninfected areas. Unhealthy and infested portion of the fruit trees and horticultural plants are removed through pruning and are collected and burnt.

5. Planting material: Many insect pests and diseases are transmitted from one crop to next the next crop through infested/infected seeds or any other planting material. Therefore, to grow such crop such certified seeds should be used which are free from all the insect pests and diseases.

6. Time of planting and crop duration: Adjustment in the time of sowing or transplanting helps in pests' control. Crops of the short duration give less chance to pest infestation because these crops mature before the emergence of pests.

7. Intercropping: Intercropping is the cultivation of two or more crops simultaneously on the same field. Several types of odorous plants can be grown together with the main crop to repel insects.

8. Multiple cropping: Multiple cropping is the practice of growing two or more crops in the same piece of land during two or more crop season instead of just one crop. This provides genetic diversity to minimize pest increase. Variation in susceptibility among species or varieties to a particular disease is great. Given abundant hosts of a single species or variety, a pest could easily be spread from host to host. When the number of hosts declines, the pest incidence will also decrease for lack of necessary food for the organism.

9. Crop rotation: Crop rotation is the growing of different crops in succession on a piece of land to avoid exhausting the soil and to control weeds, pests and diseases. This is a practice of following a crop susceptible to a pest by a resistant crop. There is no build-up of the organism to a high level since the growth cycle of the organism has been broken. The pest's problem of monoculture can be controlled by adopting crop rotation.

10. Trap crops: Trap crops is a plant that attracts agricultural pests, usually insects, away from nearby crops. Certain pests may be controlled by using trap crops in the cropping scheme. Certain pests are more attracted towards certain crops. Such crops are sown in narrow strip around the major crops at a specified row distance are served as a trap for the pests that might be common in both.

The preferred host plants can be grown around the valuable main crop when the pest has appeared, they can be cut and destroyed. This form of companion planting can save the main crop from decimation by pests without the use of pesticides.

11. Encouraging insect predators: Pests can be controlled by their natural enemies. By growing a variety of flowering plants, specifically those belonging to Umbelliferae family, such as, fennel (*Foeniculurn vulgare*) and celery (*Apium graveolens*), insect predators will be attracted to stay in the garden. These beneficial insects feed on pests, keeping the pest population below economic injury level.

12. Destruction of alternate hosts and off type plants: Many plants especially weeds work as alternate hosts in off season for insect pests and diseases. Off type plants is impure of new variety grown during the crop production. Such off-type plant is more susceptible to pests which is grown along with the standard variety.

13. Fertilizer management: The crop growth depends on the soil fertility which indirectly affects the pests. Excess use of nitrogen fertilizer invites pests attack. Normal and excess supply of potassium protects from pest's attack where as low dose of potassium promotes pest's infestation.

14. Water management: Soil inhabiting pests like white grub and cutworms are reduced after the irrigation. In flooded areas the pests inhabiting in the soil are submerged, some are flown away and some are exposed to their natural enemies.

Impact of Cultural Control

The cultural practices may lead to the control of insect pests either by directly affecting their growth and multiplication or by minimizing the chance of their attack on plants. The main purpose of cultural control is to make the environment less favourable for the pest and more favourable for its natural enemies.

Advantages of Cultural Control

1. No extra cost.
2. No costly inputs.
3. No special equipment.
4. Minimum cost of labour, if required.
5. Minimum chances for biotype selection.
6. Ecologically sound as no health hazards.
7. No harmful effects on non-target organisms.
8. Good component in IPM.

Disadvantages of Cultural Control

1. No complete control.
2. Prophylactic in nature.
3. Timing decides success.
4. Large scale adoption is required.
5. Requires long term planning.
6. Sound knowledge on pest ecology is essential.

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Rain Water Harvesting: Need of the Days

Article ID: 31631

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Introduction

Rain water harvesting (RWH) systems can, to some extent, help improve water provision where required and encourage water conservation, thereby reducing the demand on existing water sources. Another benefit of RWH systems is that the surface runoff during storms, which causes floods and erosion, is reduced, since the rainwater is retained in the storage tanks. Additionally, the delayed release leads to accumulation of ground water.

The technology of RWH can be as complex or as simple as required. Many groups and individuals throughout the world have taken the initiative and developed a wide variety of different solutions. Due to the flexibility and adaptability to a very wide range of conditions, these systems are now being used in the wettest and driest regions and in the richest and poorest societies of the world.

The industrialized world has developed sophisticated RWH systems with the aim of reducing water bills or to meet the needs of remote communities or individual households in arid regions. These countries have recognized RWH as a solution to the problems of overexploitation of water resources and are working on user friendly, reliable and high-quality systems in a cost-effective manner. RWH is also able to address the developing world's need for an inexpensive and suitable water supply technology, but the adapting and spreading happens more slowly than in the industrialized world.

What is Rain Water Harvesting?

RWH is simply collecting, storing and purifying the naturally soft and pure rainfall that falls upon your roof. Rainwater may be utilized for both potable and non-potable requirements such as:

1. Drinking, cooking, bathing (potable quality).
2. Swimming pool replenishment.
3. Toilet flushing.
4. Laundry (reduces detergent & bleach).
5. Landscape irrigation.
6. Livestock & animals.

Water Supply options may include:

1. Municipal service.
2. Groundwater well.
3. Rain water harvesting.

RWH is the sustainable supply option. Rainwater can be utilized alone or together with other supply sources in residential, commercial and industrial projects where pure water is desired.

Why Harvest the Rain?

RWH is most suitable where:

1. Groundwater is scarce.
2. Groundwater is contaminated.
3. Terrain is rugged or mountainous.

4. Seismic & flooding events are common.
5. The aquifer is at risk of saltwater intrusion.
6. Population density is low.
7. Electricity & water prices are rising.
8. Water is too hard or mineral laden.
9. Consumers must restrict salt/chlorine intake.
10. Where utility service is unreliable and where.
11. Conservation is an objective.

Practical Advantages of RWH:

1. Availability not subject to outside utility control.
2. Not subject to pipelines interruption (seismic).
3. Quality is controlled by the consumer.
4. Available even when power is interrupted.
5. Reduces run-off and erosion.
6. Available even when storms & disaster strike.
7. Available immediately for fire suppression.
8. Reduces mosquito breeding grounds (Dengue Fever).
9. Thermal mass can naturally cool buildings.
10. Ideal for people on low sodium diets or with health concerns (weakened immunity systems).

Qualitative Advantage of RWH:

1. Naturally pure.
2. Naturally soft (no dissolved minerals).
3. Free for those who collect it.
4. Sustainable.
5. Free of chlorine and its by-products.
6. Free of pesticides and other man-made contaminants.
7. Abundantly available in Costa Rica.

How to Harvest the Rain?

The six basic components of a Rain Water Harvesting system include:

1. Catchment: roof surface to collect the rain.
2. Conveyance: channels or pipes from roof or catchment area to storage.
3. Roof washing: ‘first flush’ diverter system to filter and remove contaminants.
4. Storage: cisterns or tanks where collected rainwater is securely stored – i.e. insect proof.
5. Purification: includes filtration, ozone or UV light to purify the collected rainwater for potable use.
6. Distribution: system that delivers the rainwater, usually including a small pump and pressure tank.

Components of a Rainwater Harvesting System

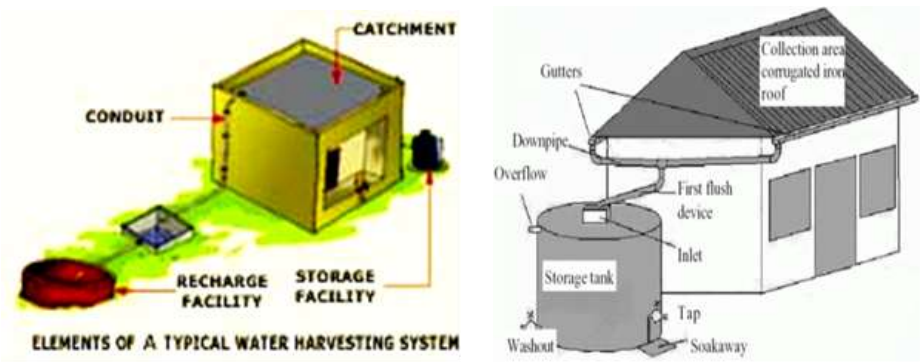

Fig. 1 Typical Domestic Roof Water Harvesting System

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A rainwater harvesting system comprises components of various stages: transporting rainwater through pipes or drains, filtration, and storage in tanks for reuse or recharge. The common components of a rainwater harvesting system involved in these stages are illustrated here

Do You Know the Attributes of Groundwater?

1. There is more ground water than surface water
2. Ground water is less expensive and economic resource.
3. Ground water is sustainable and reliable source of water supply.
4. Ground water is relatively less vulnerable to pollution
5. Ground water is usually of high bacteriological purity.
6. Ground water is free of pathogenic organisms.
7. Ground water needs little treatment before use.
8. Ground water has no turbidity and colour.
9. Ground water has distinct health advantage as art alternative for lower sanitary quality surface water.
10. Ground water is usually universally available.
11. Ground water resource can be instantly developed and used.
12. There are no conveyance losses in ground water-based supplies.
13. Ground water has low vulnerability to drought.
14. Ground water is key to life in arid and semi-arid regions.
15. Ground water is source of dry weather flow in rivers and streams.

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Drought Management for Sustainable Crop Production in Dry Farming Area

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Introduction

There is ample scientific evidence to suggest that productivity of rainfed regions can be enhanced significantly on sustainable basis, provided the two basic natural resources, soil and rainwater, are managed in a judicious manner. Over the last several decades, researchers have concentrated on methods of increasing crop production under dry land conditions in order to mitigate drought effects at farm level. Simple easily implementable practices were developed for doubling the yields even in dry years over farmer's practices. To meet the weather aberrations, alternate crop strategies to the mid-season correction and crop life saving techniques forms important components. Drought management is the certain management techniques or skill used to maximize the production and quality of agricultural commodities in arid and semi-arid areas where irrigation water is not available. These techniques involve moisture conservation practices, cropping system efficient use of water, water harvesting, proper tillage operation, intercultural operation and weed management etc.

Drought

Drought occurs in high rainfall as well as low rainfall areas. Drought is defined as deficient rainfall; lack of moisture or a dry spell resulting in low crop yields including crop failure. The seasonal variations in precipitation and temperature are much more important in farming than annual averages. Regardless of variability in prospective, it is clear that drought is a normal feature of climate and its recurrence is inevitable.

Based on extent of rainfall deficit, the terms like dry spell, drought and famines are used. Dry spell is a rainless period more than 10 days in light soil area and 15 days in heavy soil areas. Drought is prolonged dry spell resulting wilting or drying of crops. Severe form drought is called famine.

Classification of Drought

1. On the basis of source of water availability:

a. Agricultural Drought: A period when insufficient water is available to support the normal activities of a crop over a fairly normal long period of a fortnight or more.

b. Meteorological Drought: The intensity of drought is a ratio of actual evapotranspiration (AET) to potential evapotranspiration (PET) during the growing season. Meteorological Drought = AET/PET.

c. Hydrological Drought: Means low flows in the streams, inadequate storage in reservoirs and lowering of water level in the reservoirs, lakes and aquifers.

2. On the basis of time of occurrence:

a. Permanent drought: This is the area generally of permanent dry, arid and desert regions. Crop production is not possible without irrigation due to inadequate rainfall. In these areas' vegetation like cactus, thorny shrubs, xerophytes etc. are generally observed.

b. Seasonal drought: It occurs in the regions with clearly defined as rainy (wet) and dry climates. Seasonal drought may occur due to large scale seasonal circulation.

c. Contingent drought: This result due to irregular and variability in rainfall, especially in humid and sub humid regions.

3. On the basis of medium: On the basis of medium in which drought has divided the drought into two types.

a. Soil drought: It is the condition when soil moisture depletes and falls short to meet potential evapotranspiration of the crop.

b. Atmospheric drought: This results from low humidity, dry and hot winds and causes desiccation of plants.

Causes for Drought

As point of Climate they are as follows:

1. Highly variable rainfall
2. Late onset of monsoon
3. Unequal distribution of rainfall
4. Early withdrawal of monsoon
5. Prolonged intermittent dry spell in crop growing period.
6. High temperature.

Points to be Consider at the Time of Drought Management

1. Soil moisture conservation:

a. Improve Infiltration rate:

i. Conserve every drop of rainfall.
ii. Tillage practice- reduces runoff and increases soil moisture storage.
iii. INM improves structure of soil and improves infiltration.
iv. In situ-moisture conservation.

b. Reduce of percolation losses:

i. Water conservation in soil root zone by water retention.
ii. Mitigate the problem of drought.
iii. Soil Compaction decreases percolation losses and drainage pores, whereas increasing water retention.

c. Land configuration:

i. Sowing across the slope.
ii. Dead furrow at optimum distance.
iii. Compartment bunding helps in reducing runoff and soil loss.
iv. Broad bed and furrow preparation to conserve soil and water.

d. Mulching: It is the practice of covering the soil surface around the plant with a material that creates a congenial condition for the crop growth and development. Some commonly used mulchare straw, leaves and crops residues etc.

2. Cropping Systems: Cropping system is most important for mitigate the drought. There are various cropping systems in arid and semi-arid region for escaping the drought:

a. Inter Cropping.
b. Mixed Cropping.
c. Alley Cropping.
d. Relay Cropping.

3. Antitranspirant: Hardly 1 % water is utilized in physiological activities of plant and remaining water lost through transpiration, it may help maintenance of favourable water balance in plant system. Any material applied for reducing water loss from the plant is known as Antitranspirant. There are four types of Antitranspirant:

a. Stomatal Closing type - e.g. PMA, Atrazine

b. Film Forming type - e.g. Mobileaf, Silicone.
c. Reflectant type - e.g. Kaolin, Calcium bicarbonate.
d. Growth Retardants - e.g. Cycocel.

4. Rain water harvesting: Collection and Storage of rain water, either runoff or stream flow for securing and improving water availability for crop growth under unirrigated condition. Water harvesting can be done either through in situ water harvesting where water is stored in the soil profile itself or by collection and storage of runoff in a reservoir or pond for recycling, when needed.

a. On-farm reservoirs or farm ponds.
b. Well recharging through surplus rain water.
c. In situ moisture conservation.
d. Lifesaving irrigation at most critical stages.

5. Alternate Land Use System: Diversification of land according to land capability classes increases the land use efficiency:

a. Agro forestry.
b. Agri-horticultural system.
c. Silvi-pastoral system.

Conclusion

Tillage, land configuration, mulching etc. play vital role in conserving soil moisture, reducing runoff as well as improving physical properties of soil and ultimately enhances the crop productivity. Due to rain water management with water harvesting and farm pond helps to use that water in most critical growth stages of crops and more benefit is experienced. Alternate land use system is an important option for dry land agriculture.

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Significance of Farm Pond in Rainfed Agriculture

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Water harvesting is one of the key components of successful rainfed farming in semi-arid regions. Harvesting surplus runoff in dug out ponds and recycling the same for providing supplemental irrigation to kharif crops or pre-sowing irrigation to rabi crops has proved to be the most successful technologies for adoption. Water harvesting becomes all the more relevant now in view of the recent increase in the extreme events wherein heavy rainfall is occurring in few days followed by long dry spells. Under such circumstances, the only answer is harvesting the surplus runoff during high rainfall events and using the same during dry spells for critical irrigation.

Rainfed agriculture constitutes 55% of net sown area in the country. The annual average rainfall of the country varies from 400 to more than 2000mm varying in both space and time. In low to medium rainfall rainfed regions, the occurrence of high intense rainfall events with the short duration is very common causing the soil erosion. Rainfall is a basic resource for all the forms of water in semi-arid tropics of India. Though the annual average rainfall of the country is 1200 mm, it varies in both space and time affecting the availability of water for different sectors. Farm ponds would help the farmers for on farm water management by using stored water for tackling the drought or dry spells during the season.

Farm ponds are square or rectangular holes made on the earth which harvest rainwater and store it for future use. The farm pond has an inlet that regulates the flow of water inside the pond while the outlet discharges excess water. The pond is surrounded by a small bund, which prevents erosion from the banks of the pond. Water from the farm pond can be used for the fields either manually or by pumping or both. The water is usually harvested from a small catchment area and then used for irrigation during prolonged periods.

Farm ponds are used as one of the strategies to support water conservation. Much of the rainfall runs off the ground. The run off not only causes loss of water but also washes away precious top soil. Farm ponds help the farmers to store water and to use it for irrigation.

Although the farm pond technology is well known in the country, its adoption has been quite low due to number of constraints like high initial cost, short life of the lining materials, lack of suitable lifting systems and above all low awareness among farmers about its utility and cost benefit analysis. There is also lack of authentic literature on the design and performance of farm ponds in different agro ecological zones and soil types.

Benefits of Farm Ponds

1. It collects excess runoff during rainy period and stored water can be used for supplemental irrigation to crops.
2. Ponds are commonly used on ranches for stock watering.
3. Ponds help recharge groundwater.
4. They provide water to growing crops, without waiting for rainfall.
5. They reduce soil erosion.
6. It contributes to agriculture intensification and boost farm incomes.
7. It collects excess runoff during rainy period.
8. They are cost-effective.
9. It is useful as drinking water for cattle's during drought situation.
10. It conserves soil and moisture.

Types of Farm Pond

As per the method of construction and their suitability to different topographic conditions and depending on the source of water and their location, farm ponds are grouped into four types:

1. Excavated or Dug out ponds.
2. Surface ponds.
3. Spring or creek fed ponds.
4. Off stream storage ponds.

Farm Pond Shape

Excavated farm ponds are of two types viz. Square and Rectangular. However square pond is most commonly adopted having less evaporation and seepage area compared to a rectangular pond and easy to construct.

Layout of a Farm Pond

Farm pond is a dugout structure with definite shape and size. They have proper inlet and outlet structures for collecting the surface runoff flowing from the farm area. The size and depth of the pond depend upon the amount of land available, the type of soil, water requirement of farmers and the cost of excavation. The stored water is used for irrigation.

Survey of Water Resources

The most important factor for designing farm pond is water catchment area. There should be enough water available either by perennial or seasonal and runoffs through watershed area for fulfil the farm pond water requirement. The natural tendency of soil and elevation should be taken into consideration.

Selection of Site

Selection of the site for farm pond depends on local soil condition, topography of area, drainage capacity, infiltration, rainfall pattern and distribution. Selecting the suitable site is considered as one of the most important steps in planning for farm ponds. The following points may be considered for site selection within farm area:

1. Site selection must be at appropriate place of water sources and nearby the command area.
2. Avoid hard rock area due to high labour cost and angular projection in drought pond may damage the laid pond films.
3. Observe the average slope direction in the farm area in which farm pond is to be planned for construction.
4. Optimum catchment size for considerable storage and ensuring long period.
5. Well-protected (treated) catchment for arresting rapid siltation.
6. While deciding the capacity, the conservation measures such as agronomical and mechanical measures are considered.
7. The command area near the pond should be free from salinity /alkalinity and the site should require little or no land shaping around the pond.

Size of Pond

The capacity of the dugout pond depends on purpose for which water is needed and by the amount of inflow that can be expected in a given period. The selection of size of pond is very important depends on catchment area, sources of water availabilities, type of soil, selection of crops, frequency of irrigation and volume of water required etc. The slope and shape of pond mainly depends on the soil type and its topography. Deep soils have the capacity to store harvested water for longer duration. Depth of the pond should variable range from 3 to 5 m generally constructed. Most of the farmers are constructed more than 2 m for minimum evaporation loss and maintenance hazard as well as adequate space is not available at the farm.

Dimensions

The topographic features of the farm catchment area may vary from place to place and proposed land for pond construction must have minimum earth excavation so that cost can be reduced with increased storage. The drainage/catchments area which produces surface runoff for storage in farm pond is very important from hydrology point of view. The structure must get filled at least once in the season so that the farmers can use the water for critical irrigation during dry spells. A well-designed pond is a valuable asset for integrated farming system with minimum maintenance cost. Proper construction of a pond must be preceded by proper planning and design. To design a pond, careful study is required with respect to the hydrology of the catchment, rainfall–runoff relationship, requirement of water, expected seepage and evaporation losses.

Side Slopes

The side slopes are decided by the angle repose for the sub-soil. Where the soils are very deep (more than 90 cm) the angle of repose for the deep black soils may also have to be considered. The constant action of standing water may require relatively flatter side slopes to avoid slippage due to saturation. Generally side slopes of 1.5:1 would be sufficient for the murrum obtained under the deep black soils in this tract.

Catchment Area

Rainfall is one of the most important and critical hydrological input parameters for the design of farm ponds. Its distribution varies both spatially and temporally in semi-arid regions of the country. The quantity of surface runoff depends mainly on the rainfall characteristics like intensity, frequency and duration of its occurrence. The high intense rainfall exceeding infiltration capacity of soil can produce more runoff than the event with low intensity for longer duration. Apart from the physical characteristics of the catchment area contributing to produce surface runoff, the rainfall analysis is very critical for optimal economic design of farm pond. But long-term data on rainfall intensity is seldom available in the country.

Maintenance of Farm Ponds

Proper maintenance of the pond can ensure good life and service as it prevents expensive repair costs. A pond must be adequately maintained if its intended purpose is to be realized throughout its expected life. The pond should be inspected periodically. Care should be taken when heavy rains occur for the damages if any in farm pond. Initially damage may be small, but if neglected it may increase until repair becomes impractical. Any rills on the side slopes of the pond may be filled and any washes in the inlet spillway must be immediately filled with suitable material with thorough compaction. Care should be taken to keep the water in the pond as clean and unpolluted as possible. Trampling by livestock, particularly dogs and wild life must be prevented. The drainage from barn lots, feeding yards, bedding ground, or any other sources of contamination will have to be kept away from the pond. Storage of clean water is especially important in ponds which are used for irrigating crops, fish culture, and livestock drinking. Annually, the deposited silt at the bottom of the farm pond must be removed and applied to the nearby fields. In general care should be taken for following aspects:

1. Desiltation from farm pond
2. Maintenance of inlet and outlet
3. Maintenance of shoulder bunds and main bunds
4. Clearing silt trap regularly
5. Fencing of the farm pond to keep away animals
6. Maintenance of depth gauges
7. Control of water pollution of farm pond water
8. Control of aquatic weed growth in the farm pond etc.

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Fig. 1 Farm Pond

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Role of Expert System in Agriculture

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Introduction

An expert system is a computer system that emulates the decision-making ability of a human expert. The expert systems are the computer applications developed to solve complex problems in a particular domain, at the level of extra-ordinary human intelligence and expertise. In order to raise successful crops and remain competitive, the modern farmers often rely on crop production specialists to assist them in arriving at the timely decision. Unfortunately, crop specialists are not always available for consultation at the nick of the time. To solve this problem, an Expert System (ES) may become a powerful tool which is a dire need of the day for farmers, extension workers and Government officials. ES can provide on-line information on different crop management issues like diagnosing and controlling noxious and commonly found insect-pests and diseases, crop economics and designing schedule for irrigation and fertilization application etc. This article explores the possibilities of designing, developing and implementation of an Expert System for different activities of agriculture in integrated approach.

Expert System in Agriculture

An expert system is a software application attempts to reduce the performance of one or more human experts. Expert system is mostly based on a specific problem domain, and are a traditional application if artificial intelligence the expert system is used to behave like a human expert to solve the problem with the help of pre-set conditions in the software application .

Expert system aims to achieve better performance of specialized problems with an involvement of computer program. The computer program behaves like an expert person. Decision support system helps to take decision with the help of available data (or information) and domain knowledge for unstructured and semi structured problem (Ford F.N. 1985). Although there is no specific depiction for IDSS and Web based DSS, one can interpret them as a hybrid system of DSS and ES. Role of These systems are diagnostic, advisory, informative and operational. Application areas of these systems encompass wide-ranging activities of agricultural such as irrigation scheduling, farm management, disease identification, disease forecasting and nutrition advisory. Better accessibility of internet among the farmer communities made it an obvious choice to focus on web based agricultural DSS. In recent times, several research publications demonstrate growing interest in this type of decision support system.

Methodologies and Applications

The two main methodologies categories are first generation and second-generation expert system. The first-generation expert system methodology is based on using commercial expert system shells after acquiring the knowledge through traditional knowledge acquisition techniques and using rapid prototyping method. The second-generation expert system methodology is mainly based on the principle of knowledge level which means developing a knowledge model at the human level problem solving approach, not at the computational level approach. The domain application aspects will be analysed taking the agriculture area and the task type to classify the given application.

Future Trends

Developing domain specific task in agriculture is a very important future trend that will help in knowledge sharing and reuse and in automating the knowledge acquisition process. Successful results in these two directions will expedite the development procedure of expert system. Machine learning will help also in automating the knowledge acquisition process and more attention will be given to it in the near future.

Sophisticated user interfaces for different media types are expected to be an important issue. Different user interface models will also be investigated as agricultural expert systems have different types of users: researchers, extensionists and growers. Their requirements and needs are different.

More sophisticated explanation facility will be provided once domain specific models are well established. The explanation facility should not be as expert systems are providing know, the why and how primitives, but it should be intelligent enough to generate the explanation based on the user level. Intelligent agent-based approach may also be used in developing such explanation facility.

Another issue that will play an important role is the usage of internet to access expert systems developed in different locations. There is a trend now to develop tools to facilitate the dissemination of expert systems through the World Wide Web. It is expected in the near future that shells and tools will enable developers to put their expert systems on the web.

Summary

This article has discussed the role of expert systems in agriculture and revealed their importance as tools for information transfer through information generation from knowledge and expertise. The advantages that an expert system can offer better than traditional methods, are: providing the growers with dynamic information related to their actual situation, taking into consideration different specialties and different sources of information, shortening the update time of information specially if the expert system is centralized and accessible from different locations, and transferring real experience that is not documented in any form of media by acquiring it from its sources: extensionists, highly experienced growers, and/or researchers.

The future trends in research and development of agricultural expert systems are expected to be: using agent-based approaches to solve the integration problem of different software components, developing domain specific task that will contribute to knowledge sharing and reuse and automatic knowledge acquisition. Sophisticated user interfaces and explanation facilities that depend on the user level are expected to be seriously considered. The dissemination of expert systems through the internet is also anticipated. Hence, development of expert systems (ES) is identified as powerful tool for farmers, extension workers and government officials.

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Bitter Melon: A Natural Medicinal Vegetable

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Introduction

Bitter melon (*Momordica charantia* L.) belongs to the family cucurbitaceae and sub-familycucurbitoideae having somatic chromosome no 2n=2x=22.Its Domestication is from south China and east India and introduced from Brazil and distributed among India, China, Malaysia, Thailand, and Tropical Africa. It is also called African Cucumber, Ampalaya, Balsam pear, Balsam Apple, Karela. The important growing areas are Uttar Pradesh, Bihar, West Bengal, North East Region, Haryana, Tamilnadu and Madhya Pradesh.

Bitter melon is a good source of nutrients like fiber, vitamin A&C and foliate. It is also helpful in contolling long term blood sugar and also useful in increasing the levels of fructosamine and hemaglobin A1c. It also contains cancer fighting properties and also fight against breast cancer cells, nasopharynx colon and lung.

Bitter gourd/ Bitter melon is helpful in curing many health issues .It is helpful in improving the quality conditions of the life. It contains bio active compounds like alkaloids , polypeptide, vitamins and minerals .Due to the presence of steroidal saponin called charantin in bitter melon it helps in reducing the blood sugar. It is very in vitamins like A & C and minerals. It also has potassium, magnesium and iron .It also contains anti-oxidants and anti- inflammatory compounds. Bitter melon has the calcium twice of spinach and beta-carotene twice of broccoli.

Classification of Bitter melon	Nutrient facts
Kingdom – Plantae	For 100 gms of bitter gourd
Subkingdom – Tracheobionta	Calories – 34
Super division – Spermatophyte	Fat - 0.2 gms
Division – Magnoliophyte	Sodium – 13 mg
Class – Magnoliopsida	Potassium – 602 g
Subclass – Dilleniidae	Carbohydrate – 7
Order – Violales	Protein – 3.6 g
Family – Cucurbitaceae	Vitamin A- 48%
Genus – *Momordica L*	Vitamin C – 92%
Family – Cucurbitaceae	Vitamin B-6 -40 %
Genus – *Momordica L*	Calcium – 4%
Species – *Momordic acharantia L*	Iron – 5%
	Magnesium – 23%

Medicinal Uses of Bitter Melon

1. There are several important nutrients in bitter melon micronutrient present in vitamin C which helps in prevention of disease, formation of bone and wondhealing, vitamin A present in bitter melon helps in soluble of fats and good vision. It also contains potassium , zinc and iron in lesser amount.

2. It also help full in decreasing the blood cholesterol. It decreases the bad LDL cholesterol and tryglycerides. Most of the animal suites shows that there is decrease in cholesterol levels.

3. Antioxidant present in bitter melon helps against cell damage, it contains catechin, gallic acid, epicatechin and chlorogenic acid and juice helps in prevention of wrinkles on the skin and also for premature skin ageing, it

also helpful in reducing the acne, it also treats eczema and psoriasis and also helpful in protecting from UV rays which are harmful to the skin.

Sugar intake of 2000 mg of bitter melon reduces blood sugar in 3 months. Due the secretion of insulin (harmone responsible of regulation of blood) it reduces the sugar levels.

Cancer cells present in stomach, colon and nasopharynx were killed by the bitter melon extract. It also helpful in blocking the growth of the breast cancer cells.

Bitter melon is low in calories and high in fibre content hence it is good in weight loss diet. Due to presence of fibre content it reduces the hunger for longer time and helpful in weight loss

Bitter melon juice also helps for hair care problems, reduction of hair fall, split end, and dandruff. Applying of bitter melon juice to hair reduces the hair fall problem due to the presence of vitamin A, vitamin C and biotin. Direct application bitter gourd juice is very useful or else we can apply bitter melon juice along with the curd also effective. Bitter gourd juice is also helpful in making hair mask along with cumin seeds is beneficial and more effective.

Bitter melon is also showing good result in cleaning the liver and heals the liver problems. It is useful in strengthening the anti-oxidant activity in the liver . the compound *Momordica charantia* which is present in bitter melon helps to protest against the failure of the liver. It is also good at functioning of the bladder

Bitter melon strengthens the immune system and fights against viruses and bacteria. It solves the indigestion problems and allergies in the stomach.

It fights against the illness because the antioxidants present in the bitter melon works as defence mechanism. It also fights free radical damage to protest against various types of cancers. Also reduces the risk of cervical cancer and breast cancer due the presence of the anti- carcinogenic and anti- tumour properties.

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Quality Improvement of Jute Fibre

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Introduction

Jute is one of the important commercial crops in India next to cotton in terms of cultivation and usage and the most important cash crops of eastern India. Jute was initially regarded as 'Golden Fibre' considering its national importance. Almost 85% of the world's jute cultivation is concentrated in the Ganges Delta. In West Bengal Jute area is 519.0 thousand hectares and production 8075 thousand bales (2015-16). West Bengal is the major jute growing state sharing about three- fourth of the country's production. Jute is used for manufacturing a wide variety of articles like gunny bags, ropes, hessian, carpets, rugs and clothes, tarpaulins, upholstery, strings, carpets and decoration pieces. However, this fibre is chiefly used for manufacturing hessian, sacking and carpet backing. The jute sticks are widely used as fuel and also for making gunpowder, charcoal, as a raw material for coarser paper. Interestingly, resin-bonded pressed jute sticks make durable hardboard.

Quality jute fibres, golden and lustrous, producing various diversified products including fine dress materials and fetching high prices to the farmers, now-a-days. The quality of jute fibres is governed by genetic makeup and retting conditions of jute, which is mainly being cultivated by poor farmers in West Bengal. The traditional method of retting and extraction of fibre from jute plants is triple-disadvantaged in terms of time (2-3 weeks), cost of labourers and production of poor quality of fibre due to lack of fresh water (Borkar and Das, 2006). It may not be suitable for value-added goods besides, low price fetched by the farmers. Such realization has let to develop mechanical extractor of fibre directly from the green plants followed by improved retting method.

Traditional Retting Method

Generally, the jute plants are harvested at 100-120 days after sowing. The plants are stacked in bundles and kept lying in the field for 4-5 days for shedding the leaves. The defoliated jute bundles are then transported to the nearby retting facilities, immersed in clean or stagnant water according to the availability in natural retting tank, road-side ditches, sometimes in river with locally available jak materials. Most of the farmers use mud/soil and banana pseudostem as jak materials for immersion of jute bundles in water. The retting of jute is completed in 18-21 days in this method. The fibre is then extracted manually by "beat-break-jerk" or single plant extraction method which varies from place to place. The farmers using or selling jute stick as fencing or roof materials prefer single plant extraction method, whereas, farmers using jute sticks for fuel purpose prefer beat-break-jerk method of extraction. After extraction, fibre is sun dried, tied and transported to market for sale. Use of mud or soil and banana pseudostem for retting purpose helped in the production of ferrous tanin which imparts black colour to the fibre, known as 'Shyamla'.

Need for Improved Method of Retting

The traditional method of retting requires a large volume of water (1:20 :: Plant : water) for proper retting. There is a sharp decline in the permanent water bodies in jute growing areas during last 3 to 4 decades because of urbanization, siltation and creation of modern facilities and industrialization. The reduction in permanent water bodies reduced the scope of retting in good quality water with efficient retting microbes. Besides the decline in permanent water bodies, the irregular rainfall pattern during retting period aggravated the situation. The less rainfall during retting period for last few years in various jute growing areas of the country and West Bengal in particular has affected the jute farming. Under such a water scarce situation, retting following traditional method becomes a risky and non-profitable business. Sometimes farmers are compelled to ret their harvest in very low volume of muddy water resulting in very poor-quality fibre and low net income.

Improved Fibre Extraction Method

In this process jute fibres are extracted in green condition after harvesting and retting the same in a very small volume of water under the farmers own control. Now, with the aim to production quality jute fibres through practically feasible technology, CRIJAF has developed simple mechanical device.

1. Bast fibre extractor: The function of Machine is to remove ribbons containing fibre from the harvested jute plants in green condition. Machine is simple and being portable easy to carry to field site. The machine bast fibre extractor is operated with a 1HP electrical motor or a 1.5 H.P. kerosene oil engine. In an hour, it is possible to handle about 400-500 kg raw jute plants and this will extract about 25 kg of dry jute fibres. This extractor may be used for other bast fibre crops like, ramie, mesta and sunnhemp without change of spares. The broken sticks can be used to prepare compost or domestic fuel by mixing with cow dung. However, the farmers desired intact jute sticks from jute cultivation for various domestic purposes especially as fuel, fencing which is more important to them than jute fibres. Keeping this felt need of the farmers in view, jute extractor was developed.

2. Jute extractor: Manually operated device, called jute extractor was developed considering the different circumstances where availability of electric or kerosene oil was a constraint and or often more importantly, the farmers desire to get unbroken sticks for their domestic use. It extracts green ribbons without breaking stick and capacity is 25 kg dry fibre per hour. Sticks separating mechanism has been operated by pressing a foot operated pedal. The canes are fed into the machine by the tip end, about half meter length, and then the pedal is pressed to active the stick separating mechanism. The canes are subjected to impact load through nylon roller against the protruded sharp knife edge. This help in opening the bark longitudinally and breaking away from the stick at its edge. The operator holds the tip end of the canes that are projected upward under the impact of nylon roller and pulls in opposite direction from the top. Thus, the ribbons are separated and remains in the hand of the operator, whereas the sticks are ejected forward on the other side.

Fibre Quality Improvement Process

1. Improved retting method: Then the green ribbons containing fibre extracted from the above extractors, were retted by dipping it vertically arranging on bamboo-gratings into a small pool of water. It may be said that a pit of 2m×1m×1m size is enough to hold ribbons yielding about 50 kg of dry fibres for retting. It takes about seven days to complete the process of retting. This process saves a lot of time, space, water, labour and ultimate cost of the farmers. Significantly, the process results in improved quality of fibres, which the variety is capable of as per its genetic makeup. Moreover, the slim jute plants, which are thrown away by the farmers, can also been extracted in this machine and in that way an increase of production by 15% is found. Farmers, as a result, should fetch much better price.

2. Use of bacterial cultures: Use of mixed bacterial cultures which are efficient retting agents and which have a measure of symbiosis within the culture may be used for jute retting. The IBFC China succeeded in retting kenaf in three days using a special microbial culture multiplied in an incubator and then released into ground water. The JTRL India screened large numbers of water bodies used for retting, identified a mixed bacterial culture capable of retting in 2-3 days and kept samples of the culture for experimentation.

3. Use of fungal cultures: The BJRI screened fungi of different origins and found that the saprophytic fungus (Sporotricchum) was capable of retting dry ribbons of jute satisfactorily, under laboratory conditions. BJRI workers also developed a technique for dipping the dry ribbons into the fungal solution prior to separation. Post-retting treatments with the use of fungal cultures were also examined to minimize the effect of cuttings on the fibres by removing the hard and barky bottom portion without adversely affecting other fibre qualities. Aspergillus sp. was found to be beneficial in improving the quality of fibres produced by one or two grades.

4. Bleaching treatments: The dark colouring of fibres resulting from soil contamination and/or poor retting practices lowers the quality of the fibres produced. Extracts of tamarind leaves and roselle leaves, vinegar and the commercial bleach Clorox may be used as bleaching materials. The BJRI Bangladesh found that a 2.5% solution of tamarind leaves was useful.

5. Retting of green ribbon with microbial formulation: The green ribbons extracted are then kept in polyethylene lined or concrete retting tank for retting. The green ribbon: water is kept as 1: 5. The green ribbons: water ratio should be maintained strictly for application of formulation and proper retting. Microbial formulation @ 1 kg/2q of ribbons with a cfu of 1010 to 1012/g of formulation is added in the retting water of the tank. After completion of the retting, ribbons are washed in clean water for obtaining good quality fibre. The same retting water can be used for retting again, by removing half of the water and filling it with fresh water. No fresh application of formulation is needed for further retting in the same retting tank.

6. Modified conventional method of retting with microbial formulation: The scarcity of rainfall during retting period in recent years in jute growing areas of eastern India in general and West Bengal in particular hindered the retting process culminated to the production of inferior quality fibre resulting in reduced net income. Repeated retting of jute in the same stagnant water of natural retting tank led to the production of inferior quality fibre if addition of fresh water either from rainfall or ground water resources are not met after each retting. Moreover, in case of less rainfall retting of jute utilizing uplifted ground water lengths retting period and requires repeated watering for retting. Under such situation, use of talc based microbial formulation developed by CRIJAF was found suitable not only for reduction of retting period but also for improvement in fibre quality by at least two or three grades. Here, in this method, instead of using mud and banana plants as 'jak' materials for immersion of jute bundles, old cement bags filled with soil/mud/ sand/bricks etc. are used for immersion purpose. At the time of making the 'jak' of jute bundles, the talc-based formulation is applied on the jute bundles in each layer and when the 'jak' is ready, the filled cement bags are kept on the jute bundles for proper immersion in the water. As no banana plants and mud is used directly for immersion purpose, the retting water in the retting tank does not become dirty and in the same stagnant water 2 to 3 cycles of retting can be carried out using the same filled old cement bags. Three to four kg microbial formulation is needed for quick retting of jute plants harvested from 1 bigha (0.13 ha) land. For the second or third retting in the same stagnant water, the need of microbial formulation will be half of the amount required at first retting. By following this method, farmers can get quality fibre with good golden colour, lustre and strength.

Some Important Things of Retting

1. Harvesting of jute plants should be done at proper stage of maturity between 110 to 120 days for quick retting and quality fibre production. Over-aged plants take longer period for retting with deterioration in fibre quality.
2. If possible, jute plants should be sorted in thick and thin diameter of stems before retting, it will prevent the over retting of thin plants.
3. Defoliation prior to retting will reduce transport and handling charges and return organic materials to the soil and reduce the amount of organic load discharged to the retting waters.
4. Keeping dhaincha *(Sesbania aculeate)*, sunnhemp *(Crotalaria juncea)* plants and Gliricidia leaves as covering materials or in between the jak reduced the retting period by 3-5 days.
5. Retting should be done in free-flowing water. If free flowing water is not available retting should be done in stagnant water and water should be non-saline and clean.
6. The volume of water should be enough to allow the jute bundles to float.
7. The minimal volume of water used for retting should be such that the jak is submerged completely in water and there is 4 inches of water above the upper layer of jak.
8. Jute bundles when immersed in water should not touch the bottom or ground.
9. Concrete block, wooden log, old cement bags filled with sand, mud or stone can be used as covering materials for proper immersion of jute bundles in water
10. Periodic checking of jute bundles kept in retting tank should be checked for extraction of fibre in proper time and to avoid over retting.
11. Extracted fibres should be washed in clean water.
12. Fibres should be dried properly under the sun in a bamboo-frame.

Conclusion

A good crop of jute not necessarily always produces quality fibre. The quality jute fibre production entirely depends upon the process of retting. Slow moving clean water used for rating produces best quality fibre, but such conditions are rarely prevailed in the jute growing areas of India. Scarcity of water or low rainfall retting period compels farmers to ret their jute crop in stagnant water resulting in low quality jute fibre. Under such situation, adoption of modified conventional method of retting and use of microbial formulation developed by CRIJAF will produce quality fibre and get more net income than conventional method of retting.

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Effect of Biofertilizer on Oat Production: An Overview

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Summary
Oat, a crop scientifically known as *Avena sativa* is a nutritious crop. Important crop used as a cattle feed, use of biofertilizer in oat is incredibly beneficial. Beneficiary effect of biofertilizer on oat is that chlorophyll content can be improved. On application of biofertilizer, Azotobacter green forage and dry forage content increased.

Introduction
Oat a good cattle feed and the human food in the form of good quality grain. Oat is a whole grain food known scientifically as *Avena sativa*. Area and production of oat in the world are about 27 million hectare and 40 MT respectively. Oats are widely cultivated in countries like Russia federation, USA, Canada, Poland, China, France and Austria and Oats growing state in India are Punjab, Haryana, UP, limited area in M.P, Orissa, Bihar, West Bengal.

Nutrient Value

Nutrient	Amount
1. Magnesium	34% of the RDI
2. Phosphorus	41% of the RDI
3. Manganese	191% of the RDI
4. Copper	24% of the RDI
5. Iron	20% of the RDI
6. Zinc	20% of the RDI
7. Folate	11% of the RDI
8.. Vitamin B1 (thiamine)	39% of the RDI
9. Vitamin B5 (pantothenic acid)	10% of the RDI

*RDI= Recommended Dietary Intake

Use of Oat
1. Incredibly nutritious.
2. Whole oats are rich in antioxidant including avenanthramides.
3. Contain powerful soluble fiber called beta-glucon.
4. High vitamin B1 content.
5. Oat oil is of good quality and improves the energy value of oat.
6. High protein content well balanced amino acid composition.

Biofertilizer and Utilization in Oat
The term biofertilizer is used to all such microorganism which either adds or conserve or mobilize the plant nutrient in the soil. Biofertilizer also known as microbial inoculants or microbial fertilizer. These are the product containing one or more carrier based (solid, liquid) living species of microorganism which have the ability to mobilize nutritionally important element from non-usable to usable form.

On applying biofertilizer, chlorophyll content can be improved at jointing, heading, and filling stage and could also improve the accumulation of total N including stem, leaves, and ear of oat. It had a great influence on physiological indexes as net photosynthetic rate, stomata conductance, transpiration rate, WUE, LUE. Treatment with biofertilizer at seed dressing and spraying on trefoil stage was better than that simply with seed dressing.

Effect of Biofertilizer on Production

On application of Azotobacter green and dry forage yield increased by 10 to 15%. It can also increase crude protein, digestive crude protein percentage, digestive crude protein percentage and cp and dcp yield up to 40 kg fertilizer N/ha but did not affect the crude fiber content. The beneficiary effect of biofertilizer on growth and dry matter of oat were more visible at intermediate level of inorganic nitrogen which was slowly decreased at higher N- level.

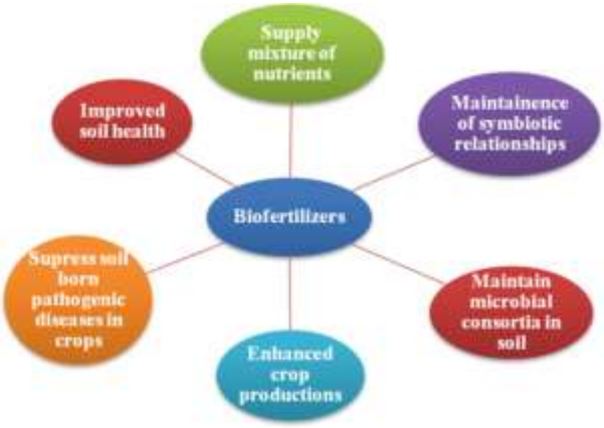

Figure 1: Diagrammatic representation of use of biofertilizers

Conclusion

Oat incredibly nutritious crop having dual purpose. Although use of chemical fertilizer can increase its production up to great extent. Oat has traditionally been considered a low input crop and has generally been grown on paddocks with lower soil fertility. Use of biofertilizer is good for soil and environment and it can also increase the good quality grain and hay in oats. Biofertilizer Azotobacter or it can be used as integrated form as with combination of other biofertilizer is effective and increased dry matter content.

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Plant-Pathogen Interaction: A Phytopathological Key to Modern Disease Forecasting

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Introduction

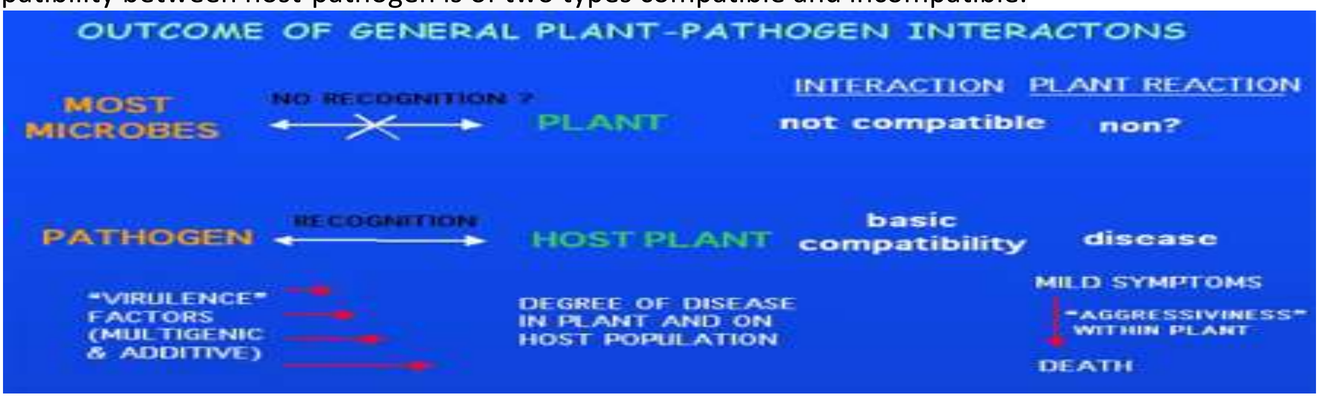
The most common response of plants to pathogens is resistance, and the rare event is susceptibility. Plants have evolved to establish efficient defensive mechanisms and to avoid attacks by microbes that are in close contact with their potential host. Pathogens need to face and neutralize various obstacles on their way into the plant tissue to establish disease. Plants exist in a world filled with nematodes, bacteria , fungi and possibly parasites (stariga, cascuta, orobaincy, etc.). They may be inoculated with viruses during insect feeding or other vectors (pest/insects, water ,humans, air etc.). In order to invade plants, overcome plant defence mechanisms, and colonize plant tissues for growth , survival, and reproduction, plant pathogens have made many adaptations. Pathogens do these activities mostly through secretions of chemical substances that affect certain components or their hosts' metabolic mechanisms. However, penetration and invasion appear to be helped by the mechanical force exerted by certain pathogens on the plant's cell walls, or in some cases to be entirely the result of it.

Gene for Gene Hypothesis

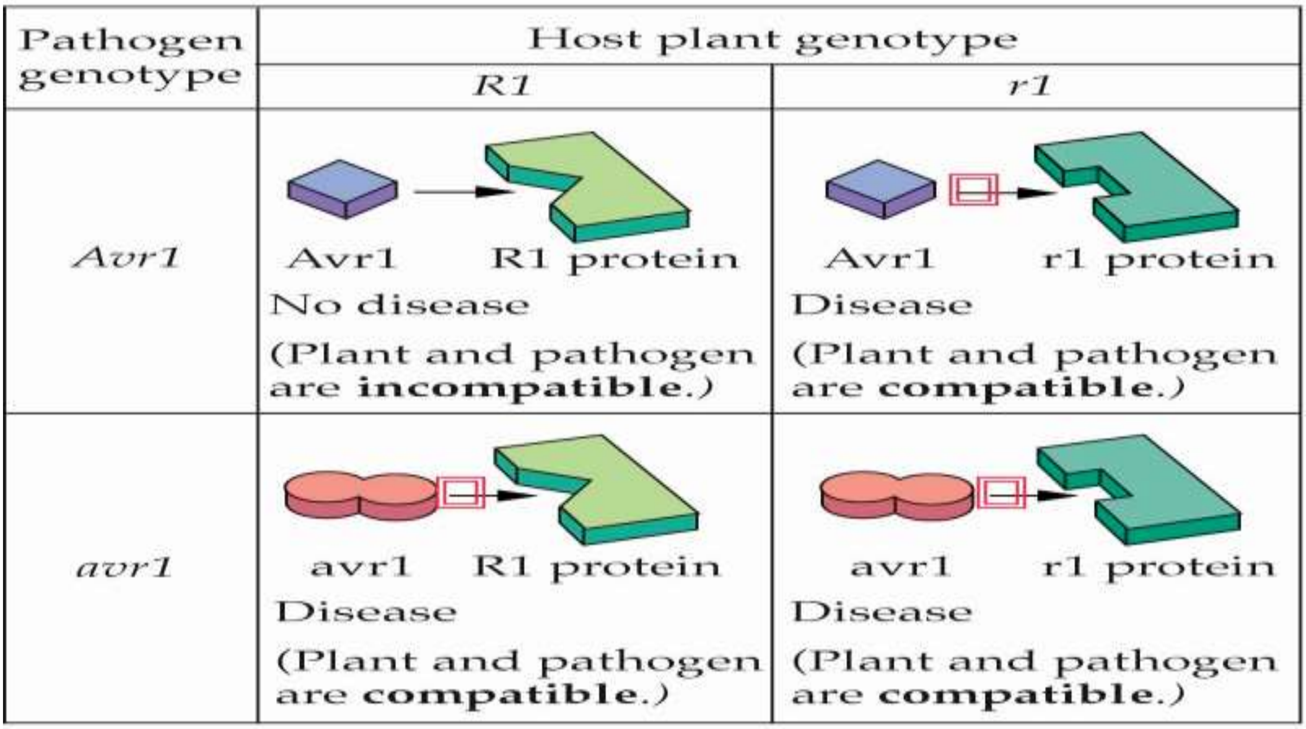
The concept of gene-for-gene was developed by Flor in the 1940s to explain the genetic interactions between *Melampsora lini* and flax. The gene for gene hypothesis states that there is a corresponding gene controlling pathogenicity in the pathogen for each gene controlling resistance in the host. Host resistance is governed by dominant genes, and pathogen virulence by recessive genes. The gene for gene hypothesis is also known as "Flor Hypothesis." At the molecular level it is assumed the drug for gene resistance typically includes the development of antibiotic protein toxins through a resistance process. Gene dosage is related to the production of toxins. Toxin production is related to gene dosage. Most desirable is the resistance controlled by domain gene. Gene for gene relationships are rare or unknown for virus , bacteria, and fusarium diseases.

Compatibility

Compatibility between host-pathogen is of two types compatible and incompatible.



Flor's Hypothesis



Steps in Plant-Pathogen Interaction

1. Perception.
2. Signalling.
3. Response.

Perception means how pathogen and host mutually recognize. It can take place directly or indirectly. After evaluating numerous experiments in physiology, biochemistry and genetics, different models have gained importance as the basis for all models is the gene-for - gene relationship between host and pathogen to trigger race-specific resistance. Indirect interaction models.

The recognition process during the host-pathogen interaction represents a signal-sensor reaction, i.e. a signal or elicitor is released from the pathogen and received by the located sensor or receptor, most likely on the host cell surface.

The elicitor is the avirulence product (A) whereas receptor (sensor) is the resistance factor ®.

The ensuing recognition event between them generates a signal transduction pathway that ultimately affects the plant cell sites (s) responsible for activating the defence reaction.

Gene for gene hypothesis does not address the actual nature of the signal transduction process, structure, and substances involved. Four models were proposed after no. of physiological, biochemical and genetic experiments to demonstrate the nature of the recognition reaction and the expression of the defence reaction:

Elicitor-Receptor Model (Albersheim et al., 1981)

The model for the Elicitor-Receptor is based on experiments in physiology and biochemistry. This theory includes the two gene group class of plant gene where one gene act as a sensor within the signal-sensor reaction that helps in pathogen recognition. Second group of many genes that express the plant defence reactions. This model does not however explain how plant recognition turns on plant dense gene expression.

According to E-R model, the release of race specific resistance proceeds as follows:
1. The Avr pathogen either directly generates a signal or the Avr gene encodes an enzyme that produces a pathogenic elicitor.

2. Genetically determined by race-specific genes is the plant recognition of the exogenous race-specific resistance elicitor i.e. sensor, receptor and resistance factor.
3. Since each resistance factor recognizes only one corresponding avirulence factor and specific elicitor, one speaks of a pair of corresponding race-specific resistance R and Avr genes.
4. The plant receptor is believed to be a membrane protein found in the plasma membrane, so that this receptor position near the cell wall may provide the earliest meeting point between the elicitor and the receptor.
In short, the race-specific resistance triggered in this way manifests itself in metabolically active cells by expressing the active defence reactions induced by the particular Effector. The defence is displayed in two ways: HR (PCD), gene activation that develops / creates new plant defence barrier.

Dimer Model (Ellingboe 1982)

The Dimer model applies a stringent and formal genetic interpretation which refers to genetic regulation in bacteria for the expts of the elicitor-receptor model. It is based on the hypothesis that the product Avr and the product R-gene form a dimer, that is, a single gene in the host and a single gene in pathogen form a product consisting of two gene products. Dimer acts as a regulator acting negatively directly blocking gene expression leading to basic compatibility, thus parasitism, being created. At the transcription point, Dimer serves as a genetic regulator.

In other words, the pathogen protection or incompatibility according to the dimer model is thought to arise from a block of reaction chains involved in basic compatibility or pathogenicity, while the E-R model considers incompatibility as the creation of a new defence mechanism in the presence of already existing basic compatibility.

Ion Channel Model (Gabriel, 1988)

The Ion Channel protection model departs from physiological studies involving electro and membrane by bringing into the topic membrane bound ion channels together with elicitor receptors, enzyme complexes, and second messengers that together form a signal transduction chain that can alter the plant cell's metabolic activity.

It gives importance to the elicitor-resistance gene product interaction from more or less immediate impact on gene expression to epigenetic level. This level represents a network of signal transduction process that regulates metabolic activities by either activating or blocking, permanently or transiently, the expression of genes. It assumes that trans-proteins located on the cell surface, some of which act as ion channels, provide all the steps required to cause race-specific resistance. Therefore, the same mechanism does not provide solely pathogenic identification but also for the transmission of signals involved in pathogen defence.

Supressor Receptor Model (Bushnell and Rowell ,1981 and Heath, 1982)

The suppressor- receptor model applies to the same elector-receptor model experimental findings but interprets them using various assumptions. This is based on the fact that all plants are vulnerable to attack by any pathogen and must have essential compatibility with the plants. However, a general elicitor released by all pathogen which releases unspecific basic resistance is counteracting basic compatibility. To colonize a particular plant, the homologous pathogen must create a different suppressor to block the general elicitor action, i.e. pathogen blocks its own basic resistance elicitor secondarily. This assumes that the active basic resistance of general acting elicitors provided by all pathogens is also recognized by receptors present in all plants.

Nonetheless, part pathogen is compatible with certain plant species because of mutation, the pathogen produces a species-specific suppressor that prevents its general elicitor from otherwise acting on plant receptor or block receptor interaction, disrupting subsequent signal transduction, or hindering effector formation or action. In short, basic resistance should be prevented by specific suppressors created by pathogens, thereby allowing basic compatibility. Bailey defined this as elicitor / specific suppression to counteract the release of active basic resistance by a specifically acting elicitor.

Conclusion

The plant-pathogen interactions are unique, complex and dynamic. In response to the recognition, signals for activation of various defenses initiate. The outcome of interaction depends on the other organism 's initial sensing through the exchange of molecular signal through signaling cascade and changed gene expression. Recognition is the first step in generating response that involves the transduction of the defense signal. In agriculture today one of the most distruptive factors is the persistent threat of loss of yield and quality from diseases. Currently it is mostly being overcome through agrochemicals. The isolation and preliminary characterization of R genes offers opportunities to produce disease resistant plant varieties. Future research goals in the field of phytopathology will be to establish the molecular basis of disease resistance to a wide variety of phytopathogens and to identify mechanisms by which R-gene products recognize pathogenic elicitors and the plant defense blocks pathogen growth The knowledge gained from future research will undoubtedly contribute to sustainable disease resistance and help reduce the use of agrochemicals that are harmful to the environment as well as will help in complex plant disease forecasting. In nutshell, decorating the world of plants with the best molecular arsenals that can defend themselves from pathogen attack is only possible by dissecting the molecular basis of interaction between plant pathogen.

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Forgotten Vegetables - A Boon to Present Horticulture

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Introduction

Now-a-days Agriculture is under tremendous pressure to produce appreciable amount of food, feed and biofuel on a limited natural resource. At present scenario we over-reliance on a few major staple crops which inherent to agronomic, environmental, nutritional and economic risks and is most likely unseasonable in the long run with the changing climate. Malnutrition, poor health, hunger and even starvation are still the greatest challenges in India. According to FAO estimates within the state of food security and nutrition within the world, 2020 report, 189.2 million people are undernourished in India. By this measure 14% of population is undernourished in India, also 51.4% of women in reproductive age (15-49 years) are anaemic. Vegetables are the key component of balanced human diet by providing nutrients, vitamins and minerals and also the main drivers in achieving global nutritional security. While foods of animal origin are often unaffordable to low-income families, various underexploited vegetables offer an alternate source of micronutrients, vitamins, also as health-promoting secondary plant metabolites.

Underexploited vegetables are "those species with underexploited potential for contributing to food security, health (nutritional/medicinal), income generation and environmental services". Also known as neglected and underused, orphan, abandoned, lost, underutilized, local, minor, traditional, alternative, niche, or underdeveloped crops and more lately often referred to as forgotten or smart food. The vegetable crops which are neither grown commercially on large scale nor traded widely may be termed as underexploited vegetable crops.

The possible reasons for the low utilization of underexploited vegetables, in spite of their recognized importance are due to lack of availability of planting material, lack of awareness on nutritional and medicinal importance and lack of documentation on production technique of those crops. In this context, there is an urgent call to take up programme on genetic resources exploration, management, utilization and improvement of underexploited vegetable crops to make sure food and nutritional security for future. The climate and soil of India are favourable for the production of different underexploited vegetables. Thus, the government of India has been taking some steps towards highlighting the underexploited vegetables.

Treasure for Future

1. Improve Nutrition and Food Security: Many underexploited vegetables can cultivate with low agricultural input and rich nutritionally. They supplementing required vitamin and minerals to a daily diet based on staple crops. The further neglect and genetic erosion of these species can have immediate consequences on the nutritional status and food security around the world.

Table 1: Mineral and trace element content in some underexploited Vegetables:

Neglected Vegetables	Minerals and trace elements (mg per 100g of edible portion)							
	Fe	Ca	P	Mg	Na	K	Cu	S
Amaranthus spp.	3.49	397	83	122	230	341	0.08	61
Moringa leaves	0.85	440	70	42	-	259	0.07	137
Moringa fruit	0.18	30	110	28	-	259	0.01	137
Broad bean	1.4	50	64	33	43.5	39	0.17	53
Sword bean	2.0	60	40	-	29.0	1800	-	-
Snake gourd	1.53	26	20	28	25.4	34	0.14	35
Spinach	1.14	73	21	64	58.5	206	0.10	30

Broccoli	1.7	56	87	22	8.0	370	0.02	130
Curry leaf	0.93	830	57	44	-	-	0.10	81
Round melon	0.9	25	24	14	35.0	24	0.12	-

2. Therapeutic Use: A number of underexploited vegetables possess several desired medicinal properties. Drumstick (Moringa oleifera) is known for its medicinal properties since time immemorial and its leaves are used by physicians of traditional medicine for the treatment of hypertension.

Table 2: Some Underexploited Vegetables as Ethno-botanicals:

Scientific Name	Odia Name	Medicinal Uses
Alternthera sessilis	Madaranga	Apetizer, blood tonic, cures infertility, cures piles, great for nightblindness etc.
Amorphophallus paeoniifolius	Olua	Treats acute rheumatism, tumors, lung swelling, asthma, abdominal disorders etc.
Colocasia esculenta	Saru	Anti-depresant, antifungal, helps to protect from lungs and oral cavity cancer, Hypoglycemic etc.
Dioscorea alata	Khamba allu	Moderate laxative, Wormicide for stomach worms, Reduce weekness etc.
Commelina benghalensis	kaniseera	Analgesic, fertility inducing property, sedative and anxiolytic property etc.
Moringa oleifera	Sajana	Anti-microbial, Antispasmodic, Treats skin infections, anemia, bronchitis etc.
Ipomoea aquatica	Kalama saga	Laxative, blood purifier, antioxidant
Glinus oppositifolius	Pita saga	Anti-diabetic, treats jaundice and dizziness

3. Increased livelihood opportunity in tribal areas: Underexploited species hold an excellent genetic diversity and a huge heritage of indigenous knowledge. The new emphasis given to indigenous knowledge is creating new favourable conditions for the enhancement of these species largely maintained today by local communities.

4. Stability and Sustainability of Biosphere: Neglected species maintain environmental stability and sustainability through two key principle i.e., Resilience and Resistance. Climate emergency, degradation of natural resources catalyses greater recognition for those species, as better adapted to stressed and difficult environmental conditions where it can play a strategic role for maintaining high diversity and hence provide a stable habitat for plant as well as animal kingdom. The cultivation of many of those species are restricted to their natural/local corner, where they alleged to get substandard farming techniques in a vulnerable biosphere, also includes areas which are prone to salinization and desertification. These species have also recognised for their potential to yield up to a mark even in marginal lands. Selection criteria should thus take into consideration their comparative advantages in halting soil erosion, contribute to land rehabilitation, ability to hold out against difficult soils (excess of salt, lack of water, etc.), contribute to sustain balanced ecosystems and ability to tolerate heat, cold and other abiotic stresses.

5. Strengthen biodiversity and genetic germplasm: Accessibility of newly developed tools (GIS and molecular markers) to get the measure of genetic diversity in plant species, its distribution and uses. Along with innovative ways to improve productivity constraints (gene transfer techniques) is opening-up new opportunities for the influential classification of agrobiodiversity.

6. Used as rootstock in grafting:

a. Provide resistance against disease and pest.
b. Avoid fusarium wilt (soil borne diseases) in cucumber and melon.
c. Bacterial wilt in tomato and pepper.

d. Boon for organic farming.
e. Keep away from nematode infestation.
f. Lowers down the auto-toxic effect up to certain level.
g. Part with cold hardiness.
h. When Cucumber grafted on Cucurbita ficifolia rootstock can survive at 10°C temperature.
i. Survival of graftage under excessive moisture.
j. Influence the harvesting time of the crop.

7. Global market opportunity:

a. Availability of latest biotechnological tools to transfigure useful plant species into diverse products from plastics to surgical tissues or to increase storage time period of perishable vegetables represent important factors that enhance commercialisation and strengthen marketing systems of those neglected vegetables.
b. The movement of individuals or groups across countries and regions provides opportunities for strengthening markets of underexploited vegetables in during which immigrants identify their own culture and traditions.
c. Tourism represents increasingly a crucial source for supporting local marketplace for underexploited species. Example: Broccoli.
d. High standard of living in industrialised/developed countries is generating demands for more natural food and environmentally friendly products, and this demand are often met by underexploited vegetables.

Potentiality of Traditional Vegetables

1. They have potential to contribute to poverty elimination through employment opportunities and income generation and also through improved efficiency and profitability of farm household labour use in both rural and urban areas.

2. With the utilization of these local vegetables, lay the ground work to reduce the threat of over-reliance on very limited number of major vegetables.

3. They can contribute to sustainable livelihoods through household food security as they widen the food edibility options.

4. They add nutrients to the diet and are sometimes convenience food for low income urban people. They are adapted to fragile environments and may contribute to the perseverance of agroecosystems.

5. They provide a broad spectrum of vegetables to improve productivity and global food security and to satisfy new market desire.

6. They assist development of rural community through small-scale investment.

7. They have a robust cultural and sacred identity and are interconnected with traditional customs and beliefs. Which is a best way to preserve and acknowledge forgotten vegetables through cultural and dietary diversity.

Conclusion

Underexploited vegetables embedded with rich nutrient potentials in company with ability to stand against adverse climate may prove boon to all or any concerns - growers, consumers and environmentalists, on condition that they are tamed properly.

The possible reasons for the low utilization of underexploited vegetables in spite of their recognized importance are the lack of seeds, lack of information about their performance and input requirements, lack of information on how they can fit into production systems and non-viability of indigenous vegetable production just like the major cultivated species of vegetables like tomato, pepper, eggplant, cauliflowers, cabbage, etc., whose improvement and seed production are taken care of by the private sector as well as government institutions, whereas the underexploited vegetables are a neglected lot.

Most research on production covers only a couple of economically important vegetable crop species. Underexploited vegetable crops also provide many fold employment opportunities in agro-based industries, packaging, storage, preservation, canning and transportation. Furthermore, the potential role of underexploited vegetables in sustainable agriculture through diversification of the agricultural environment has not been fully exploited. Finally, it may be concluded that, underexploited vegetables production will meet the shortage of per capita consumption availability there by solve the nutritional problems and simultaneously it generates the employment and also increase the income of rural people and eventually it could contribute to the national economy.

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Morphology, Biology and Predatory Habit of One Common Species of Carabid Beetle

Article ID: 31640

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Ground beetles are large , cosmopolitan family of beetles. Carabidae, with more than 40,000 species worldwide, around 2,000 of which are found in North America and 2,700 in Europe. It is one of the ten largest animal families, as of 2015.

Description and Etiology

1. Although their body shapes and colouring vary somewhat, most are shiny black or metallic and have ridged wing covers (elytra).
2. The elytra are fused in some species particularly large Carabinae, rendering the beetles unable to fly.
3. The genus *Mormolyce* is known as violin beetles due to their peculiarly shaped elytra.
4. All carabids except the quite primitive flanged bombardier beetles (Paussinae) have a groove on their foreleg tibiae bearing a comb of hairs used for cleaning their antennae.
5. Threadlike antennae emerge from between the eyes and the jaws of the ground beetle. The pronotum is always wider than the area of the head where the eyes are present.

Scientific classification	
Kingdom:	Animalia
Clade:	Euarthropoda
Class:	Insecta
Order:	Coleoptera
Suborder:	Adephaga
(unranked):	Geadephaga
Superfamily:	Caraboidea
Family:	Carabidae

Defensive Secretions

1. Typical for the ancient beetle suborder Adephaga to which they belong, they have paired pygidial glands in the lower back of the abdomen.
2. These are well developed in ground beetles, and produce noxious or even caustic secretions used to deter would-be predators.
3. In some, commonly known as bombardier beetles, these secretions are mixed with volatile compounds and ejected by a small combustion, producing a loud popping sound and a cloud of hot and acrid gas which can injure small mammals, such as shrews, and is liable to kill invertebrate predators outright.

Ecology

1. Common habitats are under the bark of trees, under logs, or among rocks or sand by the edge of ponds and rivers.
2. Most species are carnivorous and actively hunt for any invertebrate prey they can overpower.

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3. Some run swiftly to catch their prey; tiger beetles (Cicindelinae) can sustain speeds of 9 km/h in relation to their body length they are among the fastest land animals on Earth.
4. Unlike most Carabidae which are nocturnal, the tiger beetles are active diurnal hunters and often brightly coloured; they have large eyes and hunt by sight.
5. Ground beetles of the species *Promecognathus laevissimus* are specialised predators of the cyanide millipede *Harpaphe haydeniana*, countering the hydrogen cyanide which makes these millipedes poisonous to most carnivores.

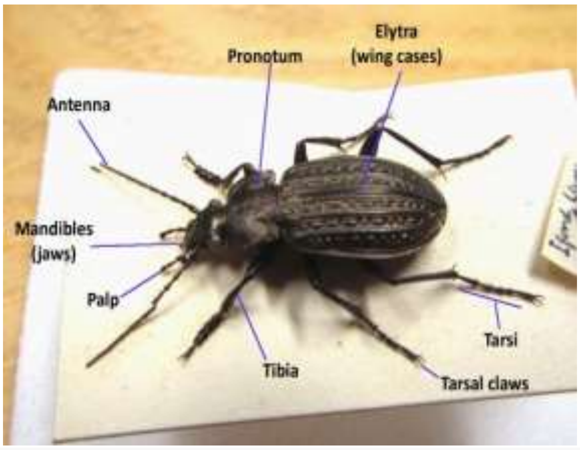
	
Carabus lateralis	***Notiophilus substriatus***

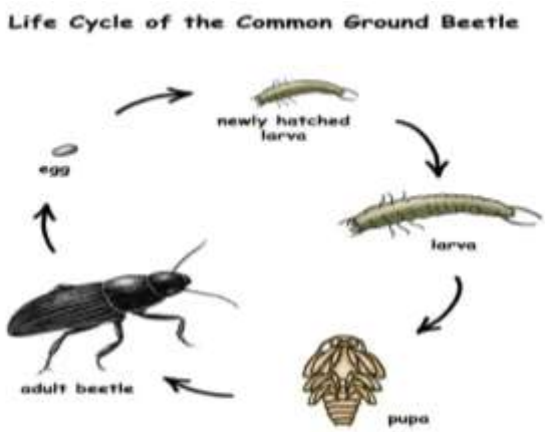
Carabidae vs Staphylinidae (Larvae)

You can tell carabids from staphs because the former has 6-segmented legs and often 2 claws, while staphs have only 5-segmented legs and always only 1 claw. Also, nearly all carabids have the urgomphi solidly attached to segment 9 (no joint at the base), and at least some of the ones that do have them articulated basally have more than 2 segments, which staphs never have. Staphs almost always have the urogomphi articulated and they have only one or two segments; the ones with solid urogomphi are all little guys (including pselaphines) and quite different in form from carabid larvae.

Relationship with Humans

1. As predators of invertebrates, including many pests, most ground beetles are considered beneficial organisms. The caterpillar hunters *(Calosoma)* are famous for their habit of devouring prey in quantity, eagerly feeding on tussock moth (Lymantriidae) caterpillars, processionary caterpillars (Thaumetopoeidae) and woolly worms(Arctiidae), which due to their urticating hairs are avoided by most insectivores.
2. Large numbers of the forest caterpillar hunter *(C. sycophanta),* native to Europe, were shipped to New England for biological control of the gypsy moth (*Lymantria dispar)* as early as 1905.
3. A few species are nuisance pests. *Zabrus* is one of the few herbivorous ground beetle genera, and on rare occasions *Zabrus tenebrioides*, for example, occurs abundantly enough to cause some damage to grain crops.





4. Large species, usually Carabinae, can become a nuisance if present in numbers, particularly during outdoor activities such as camping; they void their defensive secretions when threatened, and in hiding among provisions their presence may spoil food.

5. Since ground beetles are generally reluctant or even unable to fly, mechanically blocking their potential routes of entry is usually easy.
6. The use of insecticides specifically for Carabid intrusion may lead to unfortunate side effects, such as the release of their repugnatorial secretions, so it generally is not a good idea unless the same applications are intended to exclude ants, parasites or other crawling pests.

Life Cycle

1. Like all beetles, Carabids undergo complete metamorphosis with four stages of development: egg, larva, pupa, and adult.
2. The entire cycle, from egg to reaching reproductivity, takes a full year in most species.
3. Ground beetles usually lay their eggs on the surface of the soil or cover their eggs with soil. In general, eggs take up to a week to hatch.
4. Larvae go through 2-4 instars before reaching the pupal stage. Ground beetles which breed in the spring typically overwinter as adults.
5. Carabids that breed during the summer months tend to overwinter as larvae, then finish their development to adults in the spring.

Evolution and Systematics

1. The Adephaga are documented since the end of the Permian, about 250 million years ago. Ground beetles evolved in the latter Triassic, having separated from their closest relatives by 200 million years ago.
2. The family diversified throughout the Jurassic, and the more advanced lineages, such as the Harpalinae, underwent a vigorous radiation starting in the Cretaceous.
3. The closest living relatives of the ground beetles are the false ground beetles (Trachypachidae) and the wrinkled bark beetles (Rhysodidae).
4. They are sometimes even included in the Carabidae as subfamilies or as tribes *Incertae sedis*, but more preferably they are united with the ground beetles in the superfamily Caraboidea.
5. Much research has been done on elucidating the phylogeny of the ground beetles and adjusting systematics and taxonomy accordingly.

Dixus sphaerocephalus

Mormolyce phyllodes

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CRISPR/CAS9 Genome Editing in Crop Improvement

Article ID: 31641

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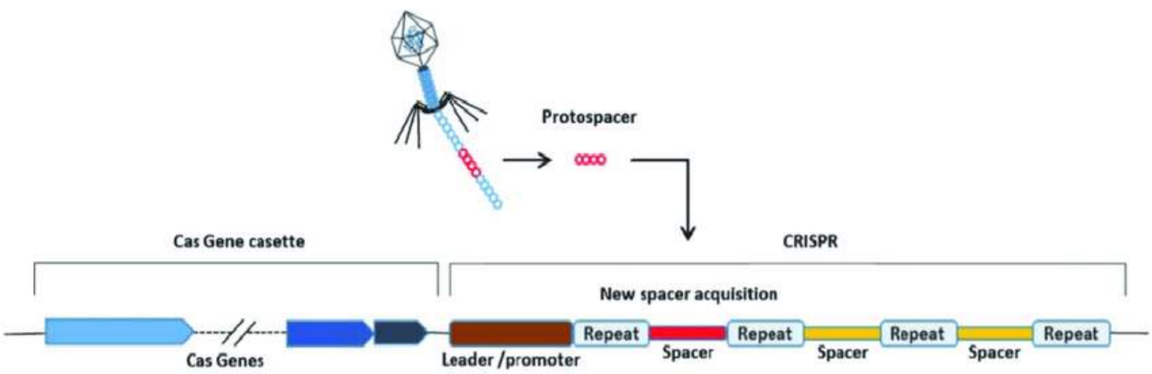
Introduction

CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) sequence was first observed in bacterial *(Escherichia coli)* immune system by Yoshizumi Ishino in 1987 at osaka university, Japan. CRISPRs acronym indicates tandem repeats flanked by non-repetitive DNA stretches homologous with foreign DNA derived from plasmids and phages. This mechanism of homology-dependent cleavage was utilised in genome editing to produce improved varieties.



A CRISPR locus

Seahyoung et al., 2015

CRISPRs method involves a short synthetic guide RNA sequence of 20 nucleotides that bind to the target DNA and Cas9 nuclease enzyme that cleaves 3–4 bases after the protospacer adjacent motif (Jinek et al., 2012). The Cas9 nuclease is composed of two domains, RuvC-like domains and an HNH domain. It has been widely applied in plant genome editing. Steps involving incorporation of CRISPR into plants:

Identifying the PAM (Proto spacer Adjacent Motif) sequence in the target gene

↓

Synthesizing a single gRNA (single guide RNA)

↓

Cloning the sgRNA into a suitable binary vector

↓

Introduction into host cell lines transformation

↓

Followed by screening

↓

Validation of edited lines

CRISPR techniques have been used more extensively to edit plant genomes in the last years compared to other genome editing methods like zinc finger nucleases (ZFNs), transcription activator-like effectors nucleases (TALENs). In plants, most editing techniques has been practiced in model plants such as Arabidopsis, rice and tobacco and only a few crop species have been explored using CRISPR technology (Jiang et al., 2013). CRISPR/Cas9 method of gene editing adopted in approximately 20 crop species so far (Ricroch et al., 2017).

CRISPR/Cas9 Applications in Rice

In rice CRISPR/Cas9 targeted mutation in the ethylene responsive factor, *OsERF922* successfully utilized to increase resistance to blast disease caused by *Magnaporthe oryzae* . The expression of the disease susceptibility gene, *OsSWEET13* in rice is essential for infection by *Xanthomonas oryzae* to cause bacterial blight. Through CRISPR/Cas9 technology leads develop two knockout mutants of *OsSWEET13* that target its promoter, leading to improved resistance to bacterial blight disease in *indica* rice, IR24. Plant annexins play a significant role in plant development and protection of plants from environmental stresses. The important role played by rice annexin gene (*OsAnn3*) under cold stress was examined in *OsAnn3* CRISPR knockouts. CRISPR/Cas9 system is a potent tool to introduce rare mutations in crop plants. The function of grain size (*GS3*) and grain number QTLs (*Gn1a*) in rice varieties were examined using a CRISPR based-QTL editing approach (Shen *et al*., 2018).

Wheat

In wheat protoplasts for *TaMLO* gene which is responsible for Mildew resistance locus O. The CRISPR *TaMLO* knockout was also confers resistance to powdery mildew disease caused by *Blumeria graminis*. Protoplasts for two abiotic stress-related genes namely, wheat dehydration responsive element binding protein 2 (*TaDREB2*) and wheat ethylene. Three wheat genes, *TaGW2* which is negative regulator of grain traits, *TaLpx-1* lipoxygenase, which provides resistance to *Fusarium graminearum* and TaMLO confers resistance to powdery mildew resistance were targeted (Wang *et al.*, 2018).

Maize

Phytic acid constitutes more than 70% of the maize seed and anti-nutritional as it is not digested by monogastric animals and environmental pollutant. Gene editing of phytoene synthase gene (PSY1) using maize U6 snRNA promoter. The production of hybrid maize requires sterilization to avoid self-fertilization. Maize *thermosensitive genic male-sterile* 5 (ZmTMS5), known to cause male sterility was targeted for genome editing by CRISPR/Cas9 approach.

Barley

CRISPR/Cas9 based knock out for the endo-N-acetyl-b-D-glucosaminidase (ENGase) gene and genotyping of T0 and T1 mutant barley lines showed 78% of mutational efficiency. Such knockout plants will be useful for studying the function of genes in functional genetics.

Cotton

CRISPR/Cas9-induced specific truncation events in the cotton fibre development controlling GhMYB25 homoeologous genes in transgenic cotton possible through CRISPR genome editing. Resistance to *Verticillium* infestation was reported through gene editing of Gh14-3-3d gene. The resulting transgene-free plants showed a high resistance and can be used as a germplasm to breed disease-resistant cotton cultivars (Zhang et al., 2018).

Soyabean

CRISPR was used to disrupt the pathogen virulence gene in *Phytophthora sojae*. Homologous gene replacement of Avr4/6 by a marker gene mediated by the CRISPR/Cas9 system made by the virulence gene in recognition of the pathogen by plants containing the soybean R gene loci, Rps4 and Rps6. CRISPR knockout of the soybean flowering time gene, GmFT2, was stably heritable in the subsequent T2 generation, with homozygous GmFT2a mutants exhibiting late flowering under both long-day and short-day conditions.

Tomato

Regulation of ripening is one of the most critical concerns in the study of fleshy fruit species. Ripening inhibitor (RIN) is a MADS Box transcription factor that is a master regulator controlling tomato fruit ripening. lncRNA1459 mutants showed repression of fruit ripening a well as inhibition of ethylene and carotenoid biosynthesis (Li et al., 2018a). Mitogen-activated protein kinases (MAPKs) are important signaling molecules that respond to drought stress in tomato by safeguarding the cell membrane from oxidative damage and regulating the transcription of genes involved in drought stress.

Potato

Characterization of starch in genome-edited lines revealed only the presence of amylopectin, with a complete lack of amylose, Similarly, multi-allelic muagenesis has been achieved in potato by mutating acetolactate synthase1gene.

Citrus

Improvement of citrus canker resistance has been made possible through targeted modification of the 5' regulatory region of the lateral organ boundaries (CsLOB1) gene. CsLOB1 is the susceptibility gene for citrus canker and plays a critical role in promoting pathogen growth. Enhanced resistance to citrus canker is observed in promoter disrupted CsLOB1 and deletion of the entire EBEPthA4 sequence from both CsLOB1 alleles provided a high degree of resistance.

Grape

Editing using CRISPR/Cas9 ribo nucleo proteins (RNPs) as delivery particles in grape protoplasts effective against the powdery mildew susceptibility gene, MLO-7. Targeted mutagenesis of VvWRKY52, a transcription factor gene has elucidated its role in biotic stress responses. In addition, knockout of VvWRKY52 in grape increased disease resistance to fungal infection *Botrytis cinerea.*

Conclusion

CRISPR/Cas9 genome editing is a new revolutionary breakthrough in crop improvement. Application of CRISPR/Cas9 genome editing tools in crop improvement for improving the yield, various nutritional traits, eliminating the anti-nutrional factors, biotic and abiotic resistance aspects are need to be taken consideration for future prosperity . In the last half decade, it is being applied enormously in many plant systems to overcome biotic and abiotic stresses and to improve other agronomical important traits. Thus, CRISPR/Cas9 an essential genome editing technique to obtain desired edited plants that will help in food security.

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Various Methods to Preserved Food from Contamination as Well as Spoilage

Article ID: 31642

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Summary

There are numerous conservation strategies utilized for making nourishment steady and safe, e.g., warming, chilling, freezing, freeze drying, drying, restoring, salting, sugar expansion, fermentation, aging, smoking, and oxygen expulsion. Notwithstanding, these cycles depend on moderately not many boundaries, or obstacles, i.e., high temperature (F-value), low temperature (t-value), water activity (aw), acidification (pH), redox potential (Eh), additives, and competitive flora. The basic estimations of these boundaries for the demise, endurance, or development of microorganisms happening in nourishment have been resolved in late decades and are currently the premise of food preservation.

Introduction

Food conservation includes the activity taken to keep up a nourishment with the ideal properties or nature for as far as might be feasible. The cycle is presently moving from workmanship to profoundly interdisciplinary science.

In many nations, development, manageability, and security have become the primary foci of the current industry and economy. The Assembled Countries World Commission on Condition and Improvement characterized supportable advancement as "addressing the necessities of the current age without bargaining the capacity of people in the future to address their own issues." A maintainable method of planning and creating food items stands to speak to purchasers and gives a state of separation from contenders and an ideal stage for a scope of positive advertising exercises. Development is fundamental to keep up the progress in innovation and building. Sanitation is currently the primary goal of the food creation and conservation industry, fusing development, and manageability. The business can bargain with certain amounts, for example, shading somewhat, however not with security.

The protection and preparing of food aren't as basic or direct as it was before. Various new safeguarding methods are being created to fulfill current requests of financial protection and customer fulfillment in nourishing and tactile viewpoints, accommodation, and security, nonappearance of compound additives, cost, and ecological well-being. Understanding the impacts of every safeguarding strategy on food has hence gotten basic in all angles. This section gives reviews of the new innovation, distinguishing the changing requests for food quality, comfort, and security.

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Types of Food Preservation

Safeguarding guarantees that the quality, edibility, and the nutritive estimation of the food remain intact. Preservation involves forestalling the development of microbes, growths, and different microorganisms just as impeding oxidation of fats to diminish rancidity. The cycle additionally guarantees that there is no staining or maturing.

1. Drying is the most established technique for food conservation. This strategy diminishes water movement which forestalls bacterial development. Drying lessens weight so nourishment can be conveyed without any problem.

2. Freezing is keeping arranged food kinds of stuff in chilly stockpiles. Potatoes can be put away in dim rooms however potato arrangements should be solidified.

3. Smoking is the cycle that cooks, flavours, and jelly food presenting it to the smoke from consuming wood. Smoke is antimicrobial and cell reinforcement and frequently meats and fish are smoked.

4. Pasteurization is a warm treatment that executes a section yet not all microorganisms introduce and for the most part include the readiness of temp. Under 100 degree centigrade.

5. Bubbling (at 100-degree centigrade) at home we favoured this cycle. Cooking of rice, vegetables, meat, fish, and so on.

6. Canning is the measure in which the nourishment is warmed in airtight fixed (impenetrable) containers or jars to a temp that crushing microorganisms and inactivates compounds that could be a well-being peril or reasons for food to ruin.

7. Pickling food protected in vinegar. Jelly meat, vegetables because of the activity of acidic corrosive which forestalls microbial development.

8. Concoction added substances food added substances will be substances added to food to safeguard flavour or improve its taste and appearance or forestall deterioration. A substance added substances to hinder microbial development.

9. Radiation UV beams, beta beams, gamma beams generally utilized in food conservation. Control and forestalls microbial development. Additionally, called as chilly disinfection.

Applications

1. Prevention of foodborne disease.
2. Food protection and time span of usability augmentation.
3. Control of bugs.
4. Delay of growing and maturing.
5. Sterilization and bug disinfestations.
6. Quarantine control.
7. Fermentation ventures.
8. Biotechnological fields.

Conclusion

Food protection is a cycle of hindering food from getting terrible. Other than making the food keeps going longer, protection likewise forestalls food wastage. Conservation by low-temperature strategies is predominant to different techniques for long haul safeguarding because it is more compelling in holding flavor, shading, and nutritive estimation of food, and respectably powerful for protection of the surface. It is a relatively less tedious protection strategy.

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Gramin Krishi Mausam Sewa: A Weather Based Agromet Advisory Service Scheme

Article ID: 31643

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Introduction

Agricultural sectors contribute a huge percent to the Indian economy and Indian farmer largely depends on the Monsoon rains for their agricultural operation. Weather is one of the most important factors determining success or failure of agricultural production. It effects on every phase of growth and development of plant. Any variability in the weather during the crop season, such as delay in the monsoon, excessive rains, flood, droughts, and spells of too high or too-low temperatures would affect the crop growth and finally the quality and quantity of the yield. The losses in crop can be reduced by doing proper crop management in time by timely and accurate weather forecasts. It is now clear that, we need to take situation specific action to mitigate the impact of adverse weather and adapt the farming system to the change weather conditions.

Gramin Krishi Mausam Sewa (GKMS)

India Meteorological Department (IMD) under the Ministry of Earth Sciences (MoES) implements an operational Agromet Advisory Service (AAS) scheme, viz., Gramin Krishi Mausam Sewa (GKMS) for the benefit of farming community in the country. GKMS is multi-disciplinary and multi-institutional project.

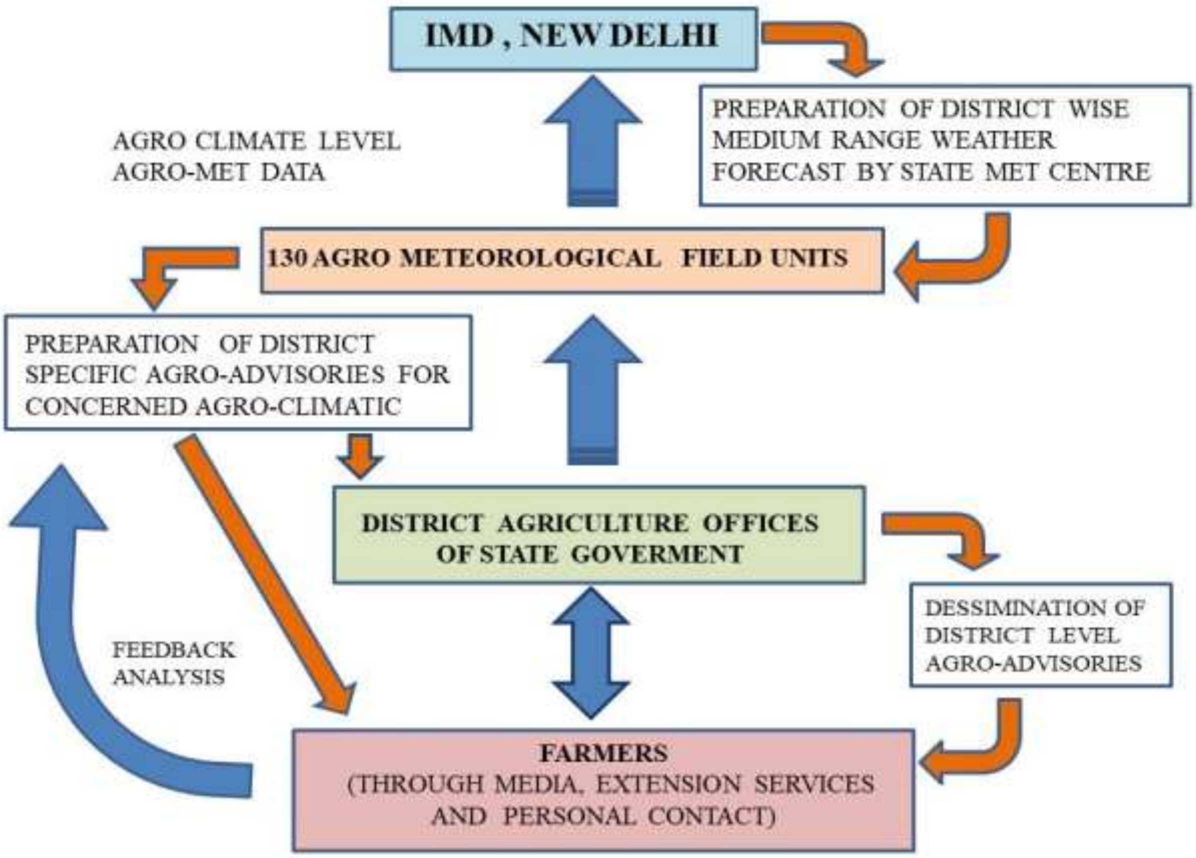

Figure 1: The Flow Chart for District Level Agro-Met Advisory Service System (Source: Rathore, 2013).

Under Gramin Krishi Mausam Sewa project (GKMS), India Meteorological Department, Ministry of Earth Science in collaboration with State Agricultural Universities /Indian Council of Agricultural Research, Krishi Vigyan Kendra etc. is issuing crop and location specific weather based agro advisories for the benefit of farming community. AAS is rendered by IMD is a step to weather-based crop and livestock management strategies and operation dedicated to enhancing crop production besides reducing crop damage and loss due to extreme weather events. The major objective of this programme is to guide timely and requirement (weather condition) based crop management practices.

Under GKMS scheme weather-based crop and locale-specific agro-advisories for rural districts are prepared and disseminated to farmers deploying various modes of information dissemination e.g. radio, television, print media, internet, Kisan Call Centres and mobile phones. It can facilitate farmers to take help of favourable weather parameters and minimise the undesirable impact of weather irregularities on crops.

Agromet Advisory Bulletin

Agromet advisory bulletins are issued at three levels district, state and at national. The district level bulletins are issued by Agro-Met Field Units (AMFUs). The weather forecast based agro-met bulletin issued every Tuesday and Friday.

Bulletin are published in English and regional languages. It contains:
1. Summary of previous weeks' weather
2. Weather forecast information for the next five days (Rainfall, Maximum and minimum temperature, Maximum and minimum relative humidity, wind speed , wind direction and cloud cover).
3. Weather Summery /Alert.
4. SMS Advisory.
5. Crop Specific Advisory.
6. Horticulture Specific Advisory.
7. Livestock Specific Advisory.

State level bulletins are issued by Regional Meteorological Centre collaboration with State Agricultural University and State Agricultural Department, using inputs from various districts. National level bulletin are prepared by National Agromet Advisory Service Centre, Division of Agriculture Meteorology, IMD, using inputs from various states.

Usefulness of Weather Based Agro Advisory Bulletins

1. Agro-met Advisory on set of monsoon rain is very much useful in deciding sowing time of kharif crops.
2. Forewarning of cyclone, hailstorm, and heat/cold waves, drought and flood should be given in advance and suggestions to protect the crop from them.
3. This will help the farmers and planners in tactical and strategical decisions regarding irrigation scheduling and efficient water management in both irrigated and rainfed agriculture system.
4. Advisories on sowing/planting dates and suitability of intercultural operations covering the entire crop spectrum from pre-sowing to post harvest to guide farmer in their day-to-day cultural operations.
5. Advisory on plant protection measures is very much helpful for protecting crops from insect pest and diseases of crops.
6. Advisory is useful for planning of irrigation and fertilizer management in crops.
7. Advisory on kept harvested crops in a safe place during rainfall forecasted days restrict post-harvest losses.
8. Advisory for livestock on health, shelter, and nutrition.
9. Advisory helps in reducing contribution of agricultural production system to global warming and environment degradation through judicious management of land, water and farm inputs, particularly pesticides, herbicides and fertilizers.
10. Advisory helps in reducing cost of production also reduce economic loss due to timely farm operations.

Conclusion

Farmers need both weather and climate services for better crop production. Agromet Advisory services are the provision of accurate and locally-appropriate climate and weather information play a vital on risk mitigation in agriculture. These weathers based agromet advisory may also help the farming community to increase the yield as well as for the reducing the cost of cultivation of crops. These Services meet the real-time needs of farmers and contribute to weather-based crop/livestock management strategies and operations dedicated to enhancing crop production and food security.

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Gaillardia: A Potential Seasonal Flower for Landscaping

Article ID: 31644

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Introduction

Blanket Flower (Gaillardia) belongs to the family Asteraceae and is native to North and South America. It is also known as Fire Wheel and Indian Blanket. The genus Gaillardia was named in the honour of Gaillard de Marentoneau, an 18th century French botanist. Gaillardia is an annual or seasonal flower or short-lived perennial. Plants are hardy, bushy with spreading branches and can grow in wide range of climatic conditions. Leaves are alternate, more or less toothed and rough. The plants bear luminous daisy like flowers with single, double and semi double forms. The centres of the flowers are large and in rose-purple colour and petals are densely filled and are of different shades of yellow, orange, crimson or copper scarlet. Flowers of gaillardia are borne in solitary, usually showy heads bracts in 2 or 3 series, hairy, ligules 3-toothed, providing fringed appearance. This is popular garden plant due to attractive and bright coloured flowers, longer flowering period and tolerance to drought.

Uses

1. These are excellent plants for herbaceous border, mixed borders, edging and growing in informal areas.
2. Gaillardias are used as cut flowers due to longer vase life.
3. It is an excellent nectar plant for butterflies and pollinators.
4. *Gaillardia pulchella* is also useful in reducing erosion in coastal dune areas.
5. *Gaillardia aristata* is appropriate for dry lands and requires low maintenance.
6. It is grown as catch crop due to its nematicidal properties.

Species

This genus is having approximately 30 species of hardy annual and perennial herbaceous plants. Out of which, three species namely *Gaillardia grandiflora, Gaillardia aristata* and *Gaillardia pulchella* have played a vital role in the evolution of many varieties of horticultural importance. Anuual forms of gaillardia were derived from species, *Gaillardia pulchella* and perennial forms from species, *Gaillardia aristata. Gaillardia pulchella* is diploid (2n=36) and *Gaillardia aristata* is both diploid and tetraploid (2n=78).

Cultivars

The cultivars of *Gaillardia aristata* have varying heights from 35 to 37 cm and different colours such as yellow, crimson banded yellow, orange, orange brown, coppery scarlet, etc. Whereas, cultivars of *Gaillardia pulchella* have various coloured flowers with single and double forms. The colour their flowers are Yellow tipped red, bronze scarlet, orange yellow, red, Red tipped yellow, etc. *Gaillardia grandifloras* is hybrid of *Gaillardia aristata* and *Gaillardia pulchella.* It is a short-lived perennial plant and having bushy growth habit. It bears large attractive flowers with different colours viz., Yellow tipped red ray floret, yellow tipped orange red, wine red, orange red, etc. The common cultivars of gaillardia are Red Plume, Dazzler, Goblin, Golden, Kobold, Monarch Strain, The Sun, Arizona series (Arizona Apricot, Arizona Sun, Arizona Red Shades), Sunrita Series (Sunrita Golden Yellow, Sunrita Red, Sunrita Yellow Red Ring, Sunrita Burgundy Imp., Sunrita Peach, Yellow Tip Imp.), etc.

Soil and Climate

Gaillardia requires an abundance of sun in an open position. The perennial forms are reasonably hardy and can tolerate temperatures as low as -1°C. Sometimes, their plants do not survive under long cold wet winter with heavy frost alternating with mild spells. Hence, to protect plants from cold stress, mulching with a layer of straw, salt, hay or dead leaves is necessary.

Gaillardia prefers well-drained sandy loam soil. However, the garden varieties can also be grown in heavier soil, but for better results, addition of 20 per cent coarse sand is recommended. The soil should be fertile and moderately well enriched with completely, composed (or dried) manure. Damp soil causes root rot in winter.

Propagation

Perennial gaillardia is propagated by division or cuttings in spring or autumn or seeds. The cuttings are planted individually in a potting mixture of sand: peat (2:1). These are also propagated from root cuttings. However, annual gaillardia is propagated through seeds. Gaillardia seed have no dormancy. Seeds are sown in the month of March depending on the climatic conditions. The seedlings should prick out into flats or frames, or individually into small fibre pots of 4 - 5 cm diameter and then planted out in the field during April-May. Seeds can also be sown as late as April, in cold frames or in unheated greenhouses but then the seedlings should be pricked out directly into their flowering beds. Gaillardia seeds need a 4-month after-ripening period before germination. The seeds remain viable for 30 months.

Planting and Fertilization

The planting should be done at a spacing of 30-40 cm apart. Optimum rate of fertilizers for higher flower yield was standardized by researchers. Apply 30g N/m^2, where 1/3 N should be applied at transplanting and rest in 2 equal split doses at monthly interval and 5 Kg FYM, 15g P_2O_5 and 10g K_2O/m^2. Various vegetative and floral traits such as plant growth, days to flowering, total flowering duration and number of flowers per plant increases significantly with NPK application.

Weed Control

Pre-emergence herbicides such as Prodiamine, Pendimethalin and Dithiopyr may control spotted spurge *(Euphorbia maculata)* and yellow wood sorrel *(Oxalis stricta)* in Blanket Flowers with minimum crop loss.

Flowering

Flowering begins about 3-4 months after seed sowing. It has a longer flowering duration. Removal of wilted flowers extends the flowering duration. In places where the autumn is warm, dry and sunny, the flowering period is protracted until the advent of winter. Growth regulators have a significant effect on morphological characters, flower production and seed yield of *Gailardia pulchella* cv. *Picta*. TIBA at 200 pprn and kinetin at 50 ppm will produce significantly higher flower yield in Gaillardia. *In Gaillardia pulchella* var. *picta,* flowering may be induced during the winter if the day length is extended by means of additional illumination. The yield of flowers depends on the cultivars and the environment. Removal of summer flower results in higher yield in autumn. The seed yield, which is a factor of flower yield, increased with the application of TIBA (200 ppm) and kinetin (50 ppm).

Harvest and Post-Harvest Technology

Fully opened flowers with long stems should be harvested for cut flowers. Flower stems remain fresh for 5-6 days in vase. Flowers are made up into bunches of 12 stems for proper packaging and transporting.

Diseases

Gaillardia plants are less susceptible to diseases and insect pests than other seasonal flowers.

Seed Borne Mycoflora

Seed-borne fungi like *Allernaria allernata, Botrytis cinerea, Curvularia pallescens* and species of *Drechslera, fusarium* and *Aspergillus* induce varying degrees of seed and seedling mortality, *Alternaria alternata* and *Botrytis cinerea* are also foliar pathogens.

Control

Seed treatment with Dithane M-45 (0.3 per cent) and Aureofungin (0.01 per cent) controls the fungi.

Flower Phyllody

It is caused by mycoplasma like organism in sieve cells of phloem.

Damping Off

It is caused by Pythium sp. And disease is enhanced by over-crowding or over-watering. It can be controlled by sterilization of nursery beds before sowing.

Leaf Spot

lt is caused by *Septoria gaillardiae*. Symptoms include brown flecks with reddish purple borders which appear on the leaves. These grow larger upon aging and the centres turn ash grey in colour. Frequently, the affected tissue falls away; leaving a ragged hole in the leaf, and diseased foliage may eventually wither and die. It can be controlled by removing infected leaves. Dust the plants with a copper fungicide or spray with Bordeaux mix. Disinfect seeds before sowing with 0.1 per cent $HgCl_2$.

Powdery Mildew

It is caused by *Erysiphe cichoracearum*. Symptoms include white, powdery coating appearance on both sides of the leaves and formation of a thick belt on the stems. The infested parts are dwarfed and stunted. Infected leaves often dry out and die prematurely. Numerous reddish-brown fruiting bodies develop on the older spots. Spray with a copper fungicide.

Insect Pests

Occasionally, plants are attacked by leaf hoppers, thrips, spider mites and aphids. These can be controlled by spraying Malathion. Spraying of Kelthane at 2 per cent is effective to control spider mites.

Conclusion

Blanket Flower (Gaillardia) is summer and rainy season annual flower and is used for various purposes such as cut flower, garden plant, suitable for herbaceous border. It has huge potential for use in Landscaping of any area during summer season.

Suggested Readings

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Antisense RNA Technology for Crop Improvement

Article ID: 31645

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Introduction

Antisense technology is a tool that is used for the Inhibition of gene expression. The principle behind it is that an antisense nucleic acid sequence base pairs with its complementary sense RNA strand and prevents it from being translated into a protein. The complimentary nucleic acid sequence can be either a synthetic oligonucleotide, often oligodeoxy ribonucleotides (ODN) of less than 30 nucleotides, or longer antisense RNA (aRNA) sequences. An example of sense and antisense RNA is: - 5'ACGU3' mRNA, and 3'UGCA5'.

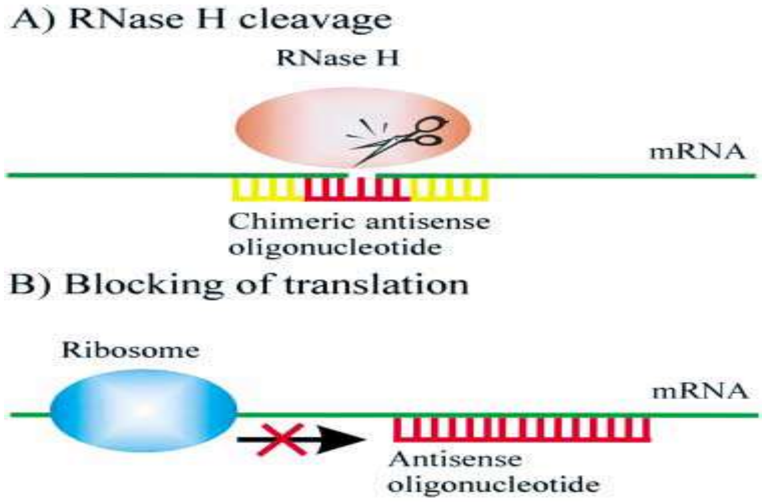
Antisense technology is the process in which the antisense strand hydrogen bonds with the targeted sense strand. When an antisense strand binds to a mRNA sense strand, a cell will recognize the double helix as foreign to the cell and proceed to degrade the faculty mRNA molecule thus preventing the production of undesired protein. Although DNA is already a double stranded molecule, antisense technology can be applied to it building a triplex formation.

The therapeutic objective of antisense technology is to block the production of disease technology is to block the production of disease-causing proteins. This is achieved by creating a synthetic "antisense" or complementary nucleotide sequence of DNA or RNA that interacts with, and binds to the "sense" or original mRNA sequence. This "mRNA"- antisense complex" can no longer be translated and the disease-causing protein cannot be produced.

Types of Antisense Technology

1.Antisense-oligonucleotides.
2.Ribozymes.
3.RNA interference.

Antisense-Oligonucleotides

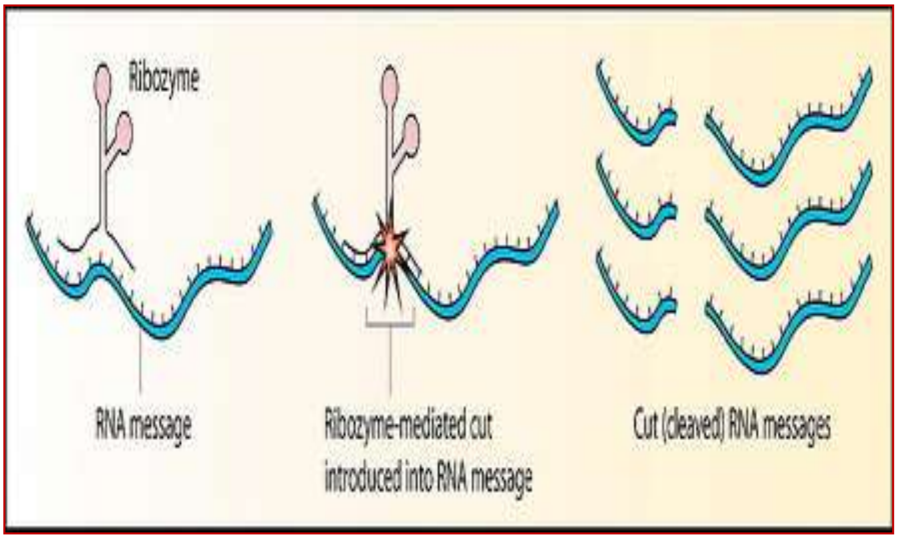


1. In this technique, Short segments of single stranded RNA are introduced.
2. These oligonucleotides are complementary to the mRNA, which physically bind to the mRNA.

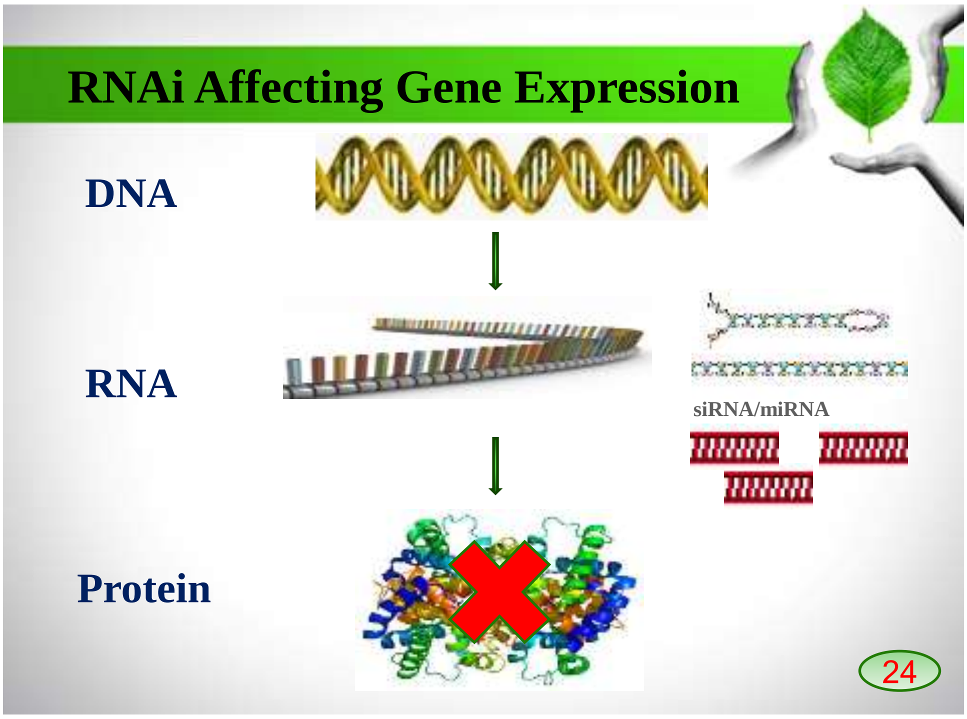
3. So , they block the expression of particular gene.
4. In case of viruses, antisense oligonucleotides inhibit viral replication with blocking expression of integrated proviral genes.
5. Usually consist of 15–20 nucleotides.

Ribozymes

1. Thomas and coworkers coined the term 'Ribozymes'.
2. These are RNA molecules which have catalytic activity which degrade nucleotides .
3. Ribozyme Bind to the target RNA moiety and inactivate it by cleaving the phosphodiester backbone at a specific cutting site.
4. Ribozyme destroy RNA that carries the massage of disease.
5. These are effectively used against HIV virus.



RNA Interference

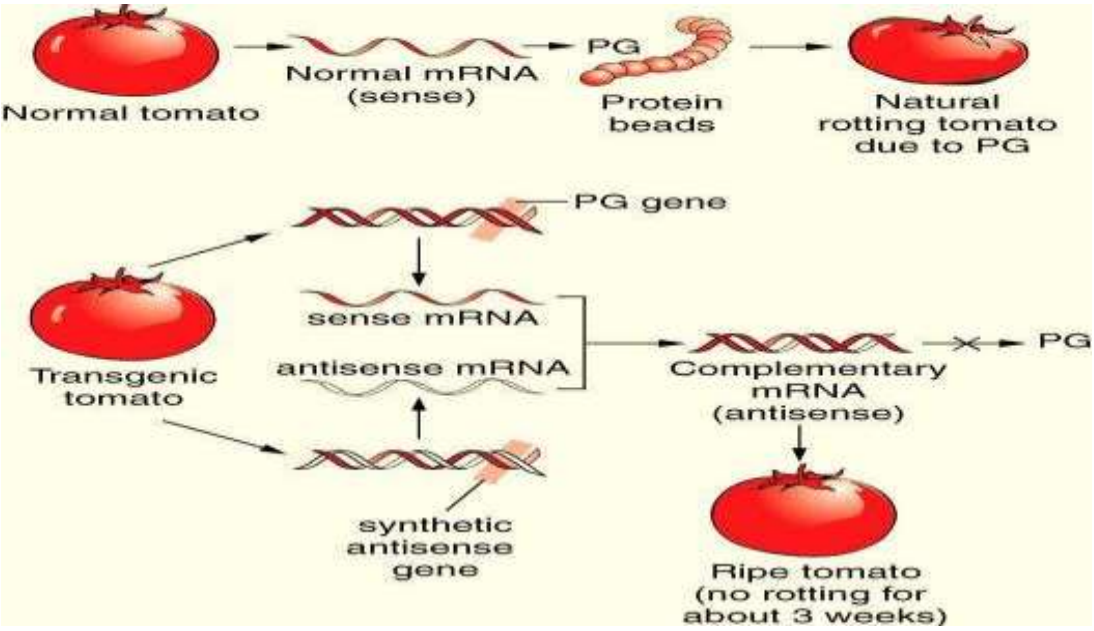


1. RNA interference (RNAi) is a sequence specific gene silencing phenomenon caused by the presence of double stranded RNA.

2. The common feature in all RNAi experiments is the presence of dsRNA carrying portion of the nucleotide sequence of the gene that is to be silenced in the organism.
3. It has been widely used as a knockdown technology and to analyse gene function in various organisms.

Applications

The FLAVR SAVR™ tomato was developed through the use of antisense RNA to regulate the expression of the enzyme polygalacturonase (PG) in ripening tomato fruit. This enzyme is one of the most abundant proteins in ripe tomato fruit and has long been thought to be responsible for softening in ripe tomatoes.



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Soil Borne Diseases of Tomato and its Management

Article ID: 31646

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Summary

This article is based on collective information resulting from available literature and expertise knowledge concerning their symptomatology, epidemiology, and management practices of soil borne diseases of tomato.

Introduction

Tomato (*Lycopersicon esculentum*) is economically the most significant and popular fresh market vegetables through the world. It is chiefly rich in Vitamin C and minerals specifically Phosphorus, Potassium, and Calcium, and high in palatability it is esteemed in various dishes (Taylor, 1987). Tomato is also called as poor man's orange. It is a warm-season crop, requires a warm and cool climate. The prevalence of high humidity and warm temperature during crop season makes the crop susceptible to biotic (fungi, bacteria, viruses, and nematodes) and abiotic (temperature, sunlight, malnutrition, etc.) stresses (Balanchard 1992) and causing significant yield losses. The major soil borne (fungal) diseases in tomato are seedling Damping off, *Fusarium* wilt and *Verticillium* wilt. These diseases are transmissible and can spread from one plant to another plant in a field, often very speedily when environmental conditions are favourable.

Damping Off

It is caused by a number of fungi including, *Pythium* species (spp), *Rhizoctonia* spp, *Fusarium* spp and *Phytophthora* spp. High temperature, high humidity, high soil moisture, soil drying, or conversely water logging and closely sown seeds favour the disease development (Agrios, 2005). It arises in two stages, i.e. the pre-emergence and the post-emergence stage. In the first stage, before they extent the soil surfaces the seedlings are killed. The fresh radical and the plumule are damaged and lead to the complete rotting of the seedlings. The later stage is categorised at the ground level by the infection of the young and juvenile tissues of the collar. The infected tissues develop soft and water soaked. The infected seedlings topple over immediately after infection and the infected stem which gets constricted at the point of infection.

Fusarium Wilt

It is caused by the fungus *Fusarium oxysporum* f.p. *lycopersici*. The pathogen is seed and soil borne continues for several years in the soil deprived of a host. Warm temperatures (27-28°C), dry weather, and acidic soil (pH 5-5.6) are favourable for disease development. The fungus has the ability to endure in the soil as chlamydospores or in the infected plant debris as mycelium for more than 10 years. It can be dispersed by infected seed or by transplants grown in infested soil and soil adhering to agricultural implements also helps in the dissemination of the pathogen from one field to another field. The initial symptom of the disease is the clearing of the veinlets and chlorosis of the leaves. The newer leaves may die in sequence and then, the entire plant may wilt and die in a few days. Shortly, the petiole and the leaves droop and wilt. In young plants, symptom involves of clearing of veinlet and dropping of petioles. In field, symptoms developed as yellowing of the lower leaves and affected leaflets wilt and die and continue in succeeding leaves. At a later stage, browning of vascular tissue occurs which shows a strong indication of Fusarium wilt and thereby causing stunted and die.

Verticillium Wilt of Tomato

Verticillium wilt associated with two species of *Verticillium* i.e *V. albo-atrum* and *V. dahlia*. When the fungus enters root, wounds affected by intercultural operations, secondary root development and nematode feeding lead to the occurrence of wilt infection. The disease incidence is more during the cold months of Nov and Dec, when the temperature is about 15-20ºC and also high soil moisture favour disease occurrence. The disease may attack at any growth stage. The symptom appears as a pale colour at the bottom leaves, then tips and edges die and leaves lastly die and drop off. A typical symptom of Verticillium wilt of tomato is the development of V-shaped lesions at leaf tips. There was a development of a light tan discoloration in the stem alike to that is produced by Fusarium wilt may be found but is typically restrained to lower parts of the plant. Infected plants generally persist the season but depending on the severity of an attack, plants become stunted and both fruits and yields.

Management

Numerous management practices (cultural, chemical, biological and use of resistant varieties) have been implemented to reduce the diseases. The integrated management of soil borne diseases of tomato are given in Table 1. Table 1: Integrated Management of Soil borne diseases of tomato

Diseases	Cultural practices	Chemical practices	Biological control
Damping off	1. Used raised seed bed. 2. Provide light, but frequent irrigation for better drainage.	1.Spray 0.2% Metalaxyl when there is cloudy weather. 2. Drench with Copper oxychloride 0.2% or Bordeaux mixture 1%. 3. Seed treatment with Thiram (3g/kg of seeds).	1. Seed treatment with *Trichoderma viride* (4 g/kg of seeds).
Fusarium wilt and Verticillium wilt	1. Affected plants should be removed and destroyed. 2. Avoid using any solanaceous crop (potato, tomato, pepper, eggplant) in the rotation, and 3. 4 to 5-year crop rotation with a non-host crop such as cereals. 4. Deep summer ploughing. 5. Proper drainage facilities 6. Use of resistant varieties like Better boy, First lady, Husky gold for verticillium wilt.	1. Soil fumigation and Spot drench with Carbendazim (0.1%). 2. Seed treatment with Thiram/Captan (3g/kg of seeds).	1. Seed treatment with *Trichoderma viride* (4 g/kg of seeds). 2. Use of Neem oil

Conclusion

Various abiotic and biotic factors unfavorably affect tomato productivity all over the world. Amongst the biotic stresses, soil borne diseases are a main limiting aspect for vegetables that caused huge yield reduction leading to severe economic losses. Thus, probable management options are dynamic to simplify the problem.

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Robotic Farming – The Future Revolution in Indian Agriculture

Article ID: 31647

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Introduction

The colluding of agriculture with technology might be the most revolutionary one that's ever been. Agriculture and its allied sectors contribute the major portion of growth and economic stability of our country. The idea of Robotic farming is not a new one in western countries but whereas in our country, the use of robots on farm is still lacking behind due to various reasons. In simple words, robotic farming can be defined as: use of smaller and smarter machines to perform all agriculture operations on farm at right time, in right place and right way.

As the population increases, there will be an increasing demand for food all the world. USA has predicted that the population of the world will increase to 10 billion by the year 2050 which will force the farmers to increase the yield of production with decreasing amount of resources.

The introduction of robotics in agriculture will not only increase the efficiency and yield but also encourages the youth towards farming. Robotics will play a major role in various agricultural operations right from the seedbed preparation to harvesting.

History

1. In the year 1920, the robotics was first introduced in agriculture.
2. To give a start to the automatic guidance of agricultural vehicles, the research had been carried out in the years between 1950-1960.
3. Agricultural robots have continued their development in the form of technologies in multiple sectors as well.
4. In 1980s, after the computers were developed, the guidance for the vision of the machine was made possible.
5. In countries like USA and France, a lot of development has taken place in harvesting of fruits with robots.
6. In almost all parts of the world, research has been carried out to use robots in fields and still it is continued.

Types of Agriculture Robots

Agriculture robots offers different types of services which are completely professional and they automize the operations which are difficult for humans. By this, agriculture robots play a major role in supporting the farmers and solving the challenges faced by farmers. Some of the types of robots are listed below:

1. Precision agriculture – used to monitor the health of the soil, photosynthesis of leaves and all biological aspects.
2. Monitoring the pollution – used to calculate the amount of carbon dioxide and nitrous oxide.
3. Livestock ranching – robots monitor the health of animals and amount of space enough for them to gaze or not.
4. Control the weeds – robots spray the chemicals on targeted area which decrease the exposure of crops to chemicals.

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5. Automation of nursery – robots are mainly used to move the plants around the greenhouse and give very good efficiencies to the crop nurseries. They are very much useful in shortage of labour.
6. Harvesting of crops – Robots can work round the clock for quick harvesting.
7. Harvesting of Fruits – robots detect and harvest the ripen fruits without damage.

Applications of Robotics in Farming

The development of robots in farming will be a solution for many of the problems. The following mentioned are few operations which can be done by agricultural robots precisely.

1. Nursery Planting.
2. Crop Seeding.
3. Monitoring the crop and giving analysis.
4. Micro Spraying.
5. Irrigation.
6. Weed mapping.
7. Crop weeding.
8. Thinning and Pruning.
9. Autonomous Tractors.
10. Harvesting and picking.
11. Shepherding.
12. Milking in dairy Farming.

Scope of Agricultural Robots

1. Robots will help in mobilization of farming. There would be remote-controlled drones moving on fields in order to check the crop health, spray chemicals and to check the herd.
2. Reduction in usage of pesticides and weedicides as robots target only specified area and thus less effect on environment.

3. Robots help in plantation and weed control.
4. There would be less labour requirement.
5. Motors can be operated electrically by using remotes which will be very helpful in areas where water is inadequate.
6. Employment generation for the youth.

In addition to the above mentioned, there are several ways where robotics can be used in agriculture which will be a boon for farmers.

Advantages and Disadvantages

The role of robotics in agriculture has several advantages and in addition to that there are few disadvantages also as mentioned.

Advantages	Disadvantages
Labour can be eliminated	Labour can be eliminated
Investment is done once and profits would be more	Implementation of robotics in agriculture is costly
Consumption of water can be reduced	Proper care should be taken by the controller
Drastic increase in outputs	Skilled labour is required to operate system
Employment generation	Power backup should be done if necessary
Reduction in inputs like seeds, chemicals and fertilizers	

Conclusion

Robots are useful in many ways. Robots work for people in industries, factories, warehouses and laboratories as well as in agriculture. Robots perform jobs better and faster than humans. Robotic farming is a boon for upcoming generations. The usage of robots in agriculture has many advantages and the work on fields can be done very effectively. Finally, as the technology improves, there will be new ways to use robots in agriculture which will increase productivity and generate profits. The robotics in agriculture will also encourage younger generations to opt for farming. Robotics helps in balancing the demand and supply of food for growing population.

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An Overview on Manure Spreader

Article ID: 31648

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Introduction

Organic manure plays a vital role to yield productivity of soil. It is an excellent quality source of nitrogen, phosphorus, calcium and potash. Soil fertilization is carried out by means of organic matter in the form of farmyard manure, liquid manure, plants or straw and mineral matters. The even spread of manure on farm field is very important for good health of plants and better produce. Manual application of fertilizer by scattering or placement close to the plants may be very effective, but it is laborious and can only be implemented where the land area is small. In India, manure is distributed traditionally with help of fork and other mechanical device which is very tedious and slow process. The manure should be handled in bulk. So, the problem faced during application of manure differs from that of other fertilizer not only with respect to the rate to be applied per hectare.

Manure Spreader

1. A manure spreader is an agricultural machine used to distribute manure over the field as a fertilizer.
2. A typical (modern) manure spreader consists of a trailer towed behind a tractor with a rotating mechanism driven by the tractor's power. Trailer type manure spreader fitted with beater drum for pulverizing the manure and spreading. The chain type manure conveyor is provided at the bottom of the trailer. The beater drum and manure conveyor are operated by tractor PTO. The PTO drive shaft is also to be supplied.
3. There are mainly two types of spreader viz:
    a. Tractor operated spreader.
    b. Animal drawn spreader.

Tractor Operated Spreader

A manure spreader can be operated by 45 hp tractors. The 540+ rpm PTO speed is used to operate the rotary blades of manure spreader. The actual average swath width of manure spreader is 7.4 m. The average field efficiency of the tractor operated manure spreader was found to be 71.5 per cent. The field application rate of farmyard manure was observed to be 5.435 to 5.89 tonnes per hectare. The saving in cost and time were 72 and 94 per cent, respectively.


Fig 1: Tractor operated spreader

Animal Drawn Spreader (CIAE)

The animal drawn manure spreader has 480 kg capacity and gave manure application rate of 5 to 10 tonnes per hectare. The manure delivery rate of 0.38 to 0.74 kg/s was observed at the operational speed of 2.4 km/h, respectively.

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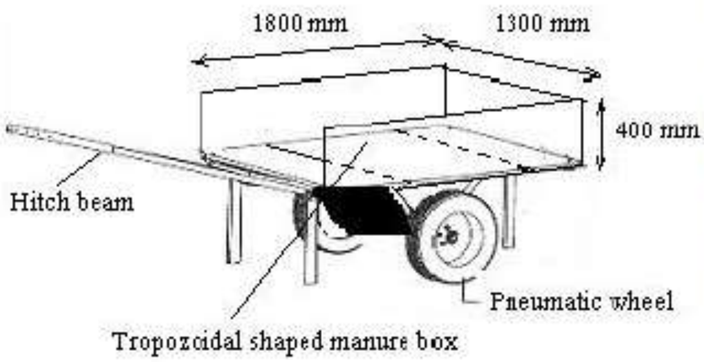

Fig 2: Animal drawn spreader (CIAE)

Conclusion

In developing countries, there is limited use of organic manure due to its high labour requirement, scarcity of machines for spreading it and also due to introduction of chemical fertilizer, which is easier to handle. Advancement in technology has brought about the development of different machines for the application of both chemical fertilizer and organic manure.

For application of organic manure in fields, the manure spreader had been developed and is usually power driven by the tractor P.T.O. With proper selection of hopper size and the spreading mechanism, and selecting the appropriate tractor power requirement, the machine can be used by farmers in developing countries. The parts required for the development of a manure spreader can be available locally. The machine requires only one person (the tractor operator) to operate.

The liquid manure spreader was also developed in few countries which is meant to distribute the fertilizer using mobile tank with a vacuum pump or centrifugal pump, which are both driven by the tractor P.T.O.

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Application of Thermal Foggers in Agriculture

Article ID: 31649

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Introduction

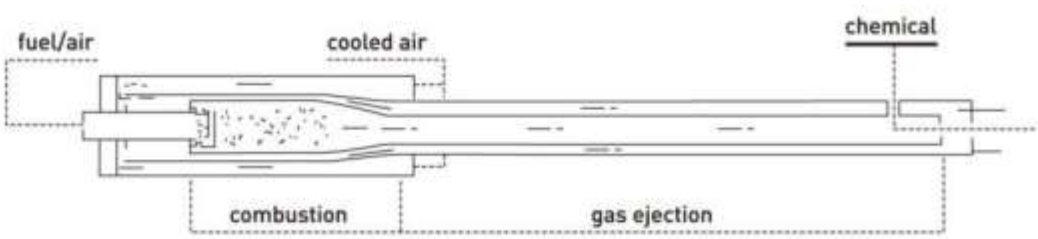
Technically a fog (aerosol) – is a liquid insecticide dispersed into the air in the form of hundreds of millions of tiny droplets less than 50 µm in diameter. It is only effective while the droplets remain airborne. Space sprays are mainly applied in two ways as thermal fogs or cold fogs. There are two main types of fogging machines: Thermal foggers and Cold foggers.

Thermal fogging is an outdoor space treatment in which the fog is produced by a device that uses heat to break up the insecticide formulation into very small droplets (5–30 µm in diameter) that disperse in the air. When the chemical, usually diluted in oil-based carriers, is heated, it is vaporized in a combustion chamber and expelled to form a dense cloud. Applications should be carried out early in the morning before thermal convection currents lift the fog from the ground. Foggers require a specially formulated carrier that is mixed with the pesticide to improve uniformity of droplet size and distribution of the spray material. Temperature and humidity also affect the spray droplets. Because of the noise associated with the jet engine, hearing protection is recommended.

Working Principle

In the operation of a thermal fogger, the pesticide is injected into an extremely hot, fast-moving air stream that vaporizes it into fog particles. Moving from one end of a greenhouse to the other, a thermal fogger can cover in as little as 15 minutes. Air circulation from a Horizontal Air Flow system will give more uniform coverage and better foliage penetration. The insecticide used in thermal fogs is diluted in a carrier liquid, which is usually oil-based. Hot gas is used to heat the pesticide spray, decreasing the viscosity of the oil carrier, and vaporizing it. When it leaves the nozzle the vapour hits colder air and condenses to form a dense white cloud of fog. Most of the droplets are smaller than 20 µm. The droplet size is affected by the interaction between the formulation, the flow rate and the temperature at the nozzle (usually > 500°C). The volume of spray mixture applied in vector control is usually 5–10 litres per hectare, with an absolute maximum of 50 litres per hectare. The hot emission gas is obtained from engine exhaust, friction plate/engine exhaust or from a pulse jet engine.

BASIC CONCEPT OF THERMAL FOGGING



Hand Carried Thermal Foggers

1. These are used for treating houses and certain outdoor areas of limited size or accessibility, e.g. markets, hotel grounds and parks.
2. There are two types of hand-carried thermal foggers:
    a. Pulse jet.

b. Friction Plate.

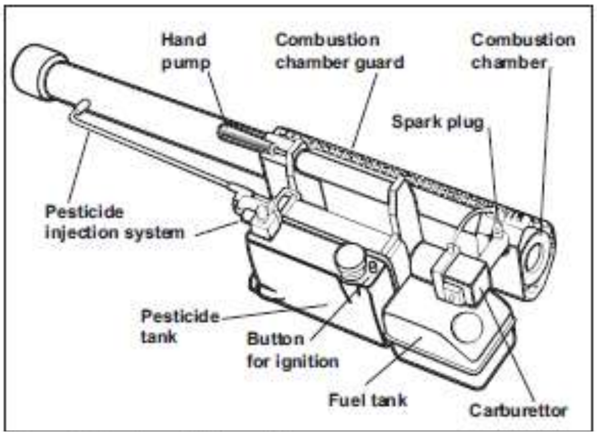


Fig 1: Hand carried Thermal Foggers

Vehicle mounted Thermal Foggers

Large thermal fog generators use an air-cooled motor to run an air blower, fuel pump and insecticide pump. Air from the "roots type air blower" is delivered into the combustion chamber. There it is mixed with gasoline vapor and ignited, so that temperatures reach 426–648 °C. The diluted insecticide liquid is pumped via a simple flow delivery valve and injected into a cup in the fog head or directly into the nozzle. The insecticide liquid is vaporized by the blast of hot gases. Despite this high temperature, trials with some insecticides recovered at the jet tip show very little degradation of active ingredient. This is because the time spent at that temperature is only a fraction of a second, which is not long enough to cause serious degradation. The hot gases then pass out of the machine. As the hot oil vapor is discharged through a relatively large nozzle into the cooler outside air, it condenses to form very small droplets of thick white fog. Delivery rates of up to 10 litres per minute can be achieved with larger machines.

Aircraft Mounted Thermal Foggers

For aircraft application of thermal fogs, the diluted insecticide formulation is fed into the aircraft exhaust. The exhaust is adapted with vanes to swirl the fog droplets as they are formed. The application of thermal fogs by aircraft has been very limited.

Advantages

1. Easily visible fog, so dispersal and penetration can be readily observed and monitored.
2. Good public relations in some circumstances as people can see something being done about the problem.
3. Low concentration of active ingredient in the spray mixture and reduced operator exposure.

Disadvantages

1. Large volumes of organic solvents are used as diluents, which may have bad odour and result in staining;
2. High cost of diluent and spray application;
3. Householders may object and obstruct penetration of fog into houses by closing windows and doors;
4. Fire risk from machinery operating at very high temperatures with flammable solvents and can cause traffic hazards in urban areas.

Conclusion

Thermal foggers are widely used in many areas. In agriculture, thermal foggers are used to spray the pesticides in the form of fog. The chemicals in the form of fog can easily penetrate and absorbed by the pests so that crop damage can be reduced. Thermal foggers are available in different models, sizes and shapes. They can be used for household purpose and to spray any disinfectants in the surroundings. Thermal fog spraying is to be done in early hours of the day.

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Good and Bad Fatty Acids- The Major Components of Vegetable Fats and Oil

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Abstract
Fats and oil are most abundant lipids in nature. They provide energy for living organisms, insulate body organs, transport fat-soluble vitamins through the blood. Fats and oils are called triglycerides because they are esters composed of three fatty acid units joined to glycerol, a trihydroxy alcohol. Fatty acids are classified based on the number of double bonds present in the long chain of hydrocarbon. Among the two types of fatty acid, unsaturated fatty acids are considered to be healthier. Essential fatty acids are those acids which the body cannot synthesized but is needed to supply through the diet. Essential fatty acids are long chain fatty acids derived from linolenic (omega-3 fatty acid), linoleic (omega-6). The study of fatty acid composition in vegetable oils and fats gave us an idea about prominent fatty acid composition of that particular vegetable oil and fat. It gave us an opportunity to choose oil of our choice. Vegetable oils which are rich in omega-3 fatty acid and omega-6 fatty acid are needed to be consumed as they are essential fatty acids which the body cannot synthesized. Recent researches have been done on the production of transgenic plants which can give the 2 essential fatty acid.

Keywords: fatty acid, triglyceride, fats, oil, omega-3,6, essential fatty acid.

Introduction
In the nature, the most important and abundant lipid are the fats and oil. They are involved in several roles like providing energy to living organisms, transportation of fat-soluble vitamins through the blood and also help in the insulation of body organ. Fats and oil have several physical and chemical properties. The most important component of fats and oil is triacyglycerol. Triacylglycerol are comprised predominantly of fatty acids present in the form of esters of glycerol.

Fatty acids are classified based on the number of double bonds present in the long chain of hydrocarbon. With differing in the number of double bonds, the properties as well as characters of the fatty acid is decided. If the hydrocarbon chain has only single chain of carbon atoms with no double bond then it is called saturated fatty acids but if the hydrocarbon chain has carbon chain of one or more double bond it will be either monounsaturated or polyunsaturated fatty acid based on the number of double bind present in it.

Fatty Acid for Better Health
Among the two types of fatty acid, unsaturated fatty acids are considered to be healthier. They possess several health benefits and they have lesser melting point which make them melt fast so that they don’t stay in the solid form. Consuming unsaturated fatty acids is believed to reduce the cholesterol level in the blood with lots of health benefits. So, it is better to know where these fatty acids are present. Unsaturated fatty acids are mainly present in plant and vegetable oil, avocado, sunflower oil, walnut, canola oil, flax, etc. whereas saturated fatty acids are mainly present in animal fats, palm oil and coconut oil. When unsaturated fatty acids are undergone burning, hydrogenation takes place which makes it to convert to trans fats which has similar configuration with saturated fatty acids. Trans- fats are unhealthy to consume and it is associated with many health problems like heart disease, cancer, diabetes, allergy, obesity, etc. Trans- fats are mainly found in the fried items as well as the bakery products. Use of those oils instead of solid fats (including butter, shortening, lard and hard stick margarine) and tropical oils (including palm and coconut oil) is better option.

Essential Fatty Acids

Essential fatty acids are those acids which the body cannot synthesized but is needed to supply through the diet. Essential fatty acids are long chain fatty acids derived from linolenic (omega-3 fatty acid), linoleic (omega-6). Omega-3 fatty acid is present in flaxseed, walnut, pumpkin seed for land-base-source and for marine-based source mackeral and salmon. While, omega-6 fatty acid is found in avocado, soybean oil, nuts etc. these two fatty acids need to be obtained from the outside to get long chain fatty acids like arachidonic acid (AA) and docosahexanoic acid (DHA). Essential fatty acids support the cardiovascular, reproductive, immune and nervous system.

Fatty Acids Composition of Vegetable Oils and Fats

Olive oil is mainly used and suitable for salad dressing, drizzling and it is not suitable for high heat cooking. Olive oil contains about 78% Monounsaturated fatty acid, 8% Polyunsaturated fatty acid and 14% Saturated fatty acid. It has several nutritional benefits like Lower risk of heart disease and breast cancer, reducing high blood pressure and stroke and lower cholesterol.

Canola oil is extracted from the crushed seeds of the canola plant. Fat outbreak of canola oil is 62% Monounsaturated, 31% Polyunsaturated and 7% Saturated fatty acid. It is mainly used for sauteing, baking and frying. It has several uses like smallest amount of saturated fat, most heart-healthy ω-3 fats, good source of vitamin E and K.

Coconut oil is extracted from the meat of coconut. Fat outbreak of coconut oil is 6% Monounsaturated, 2% Polyunsaturated, 92% Saturated fatty acid. It is mainly used for baking and low-heat sautéing. Although the oil is mostly saturated fat, it contains a type of fat that elevates good HDL cholesterol.

The oil extracted from soybean seeds is called soybean oil. It is a good source of ω-3 fatty acid and ω-6 fatty acid. It has fat breakthrough of 23% Monounsaturated, 58% Polyunsaturated, 16% Saturated.

Rice bran oil is oil extracted from the germ and inner husk of rice. It is a good source of vitamin E and antioxidants it helps in reducing blood pressure and improve cholesterol levels. It has fat outbreak of 39% Monounsaturated, 35% Polyunsaturated, 20% Saturated. It is used for high-heat sauteing, baking and salad dressing and needed less amount because of its thinner consistency.

Sunflower oil is oil extracted from sunflower seed. It has high concentration of vitamin E and are rich in ω-6 fats. The fat outbreak of sunflower oil is 45% Monounsaturated, 40% Polyunsaturated, 10% Saturated. It is mainly used for deep frying chips and vegetables.

Groundnut oil contain small amount of anti-cancer compound called resveratrol and good source of vitamin E. Fat outbreak of groundnut oil is 48% Monounsatured , 34% Polyunsaturated, 18% Saturated. Unrefined peanut oil used for medium-heat cooking or salad dressing and refined peanut is used for frying, grilling, sauteing or roasting.

Mustard oil Promotes hair growth, protects infection but it has high amount of erucic acid ranging from 35-48% Good for deep frying purpose but should not be used solely as cooking oil.

The fatty acid composition of safflower and sunflower oil contains a healthy mixture of all the types of saturated and unsaturated fatty acid in consideration of total percentage of unsaturated FA (MUFA + PUFA), sunflower oil appears superior.

In respect of total percentage of essential FA (linoleic and linolenic), soybean oil is superior. But on overall consideration, sunflower oil with the highest percentage of MUFA and PUFA appeared to be suitable for mass consumption.

Conclusion

The study of fatty acid composition in vegetable oils and fats gave us an idea about prominent fatty acid composition of that particular vegetable oil and fat. It gave us an opportunity to choose oil of our choice. From the study, it is been revealed that vegetable oils and fats with higher amount of unsaturated fatty acid are best to consume for our health. Higher saturated fatty acid content vegetable fats and oils are better to avoid as they prone to increase health-related issues. Vegetable oils which are rich in omega-3 fatty acid and omega-6 fatty acid are needed to be consumed as they are essential fatty acids which the body cannot synthesized. Recent researches have been done on the production of transgenic plants which can give the 2 essential fatty acid.

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Domestication and its Impact on Crop Plants

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Abstract

Most researchers believe that around ten thousand years ago human societies around the globe began to transit from hunting and gathering to agriculture, known as Neolithic revolution. One of the key technological elements of the transition to agriculture is domestication. Plant domestication is the genetic modification of a wild species to create a new form of a plant altered to meet human needs. There is a common suite of phenotypic traits that distinguishes most seed and fruit crops from their progenitors or wild ancestors termed the "domestication syndrome". The phenotypic changes associated with domestication are likely to have arisen via unconscious selection and conscious selection. Early farmers used only a limited number of individuals of the progenitor species. One common feature of the domesticated genomes is the reduction of genetic diversity in crops relative to the wild progenitors. This reduction has two causes: Genetic bottleneck and Selective sweep. This continuing reduction of genetic diversity in cultivated species has become a bottleneck for improvement of the cultivar itself. So, nowadays more research is being done to recollect the loss diversity by crossing with the wild species and trying to save the loss diversity to some extend because it is known nowadays that these wild species are the source of several biotic as well abiotic stress tolerant genes.

Keywords: Domestication, Genetic diversity, Selective sweep, Unconscious selection, Conscious selection.

Introduction

The practice of cultivation started around 12,000 to 10,000 years ago during the Neolithic revolution. Neolithic revolution taught people to cultivate and gathered the food instead of hunting and gathering. The people started to gather around and settle, started making villages and sedentism. The key secret of this technological transition is the practice of domestication. So, domestication is the practice of cultivation of bringing the wild form under human governance. And crop domestication is the bringing of wild species of crops under human cultivation practices. So, in other words, humans actively interfere and take part in the direct evolution of the crop. Domestication of crop for different crop species occurs in different places like for example, cotton, sweet potato, sorghum occurs at south America but at different timing of 6000bp, 4500 B.P and 4000 B.P respectively.

Factors and Agents Causing Domestication

In the previous period, domestication was performed with unconscious selection when man naturally preserved the most valued and destroying the less valued individual, without any idea of altering a breed. But later with the onset of practices of plant breeding, crops which possess characters of primary importance by humans are selected and continued with the trend by choosing the best one. So, the changes obtained in the domesticated crops are a result of continuous human cultivation practices as well as agro-ecological environment.

Effect of Selection During Domestication

The practice of continuous selection of wild species based on human interest has led to several effects. The main effects or drawbacks are- 1. Loss of genetic diversity (genetic bottleneck) 2. Selective sweep.

1. Genetic bottleneck: Genetic bottleneck is an event occurred in evolution in which a significant percentage of population or species is killed or otherwise prevent from reproducing. It can be quantified by the size of the population and the time period of the bottleneck. The loss of diversity was not experienced equally by all genes in the genome. Selection on neutral gene does not influenced the favoured phenotype. While selection in the selected gene that influenced favourable phenotype leads to drastic loss of diversity.

2. Selective sweep: It is the reduction or elimination of variation among the nucleotides in neighboring DNA of a mutation as the result of recent and strong positive natural selection. Selective sweep can be of hard selective sweep or soft selective sweep.

Hard selective sweep is the condition in which a beneficial mutation occurs and the mutation increase in frequency in the population along with the genomic background associated with it. While in Soft selective sweep a previous neutral mutation becomes beneficial due to the environmental change.

Characters of Domesticated Crop and their Wild Relatives

For maize, the wild type possesses characters like multiple stalks, long branches. Ear has its grains enclosed in the triangular casing that comprises the ear as well as hard glumes. The cultivated maize will possess the characters like single stalk, husk surrounding the ear. Maize ear bears its grain naked on the surface of the ear with soft outer glumes. Rice wild species has panicle with shattering quality but the domesticated one has non-shattering ability. Wild tomato is miniscule fruit while domesticated tomato is massive fruit. Cultivated wheat with the dominant allele of the Q gene has a condensed and tough spike. Wild sunflower plants have many heads borne on multiple slender stalks. Cultivated sunflower has a single large head borne on a thick stalk.

Conclusion

Domestication leads to better change in the crop species in one way but although it gives us more wanted characters of our choice still it leads to the loss of valuable diversity in the genome as we keep on discarding the unwanted characters. So, nowadays more research is being done to recollect the loss diversity by crossing with the wild species and trying to save the loss diversity to some extend because it is known nowadays that these wild species are the source of several biotic as well abiotic stress tolerant genes.

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Improvement Strategy of Shifting Cultivation or Jhum in NE India

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Introduction

Traditional shifting cultivation, also known as Jhum, has always been a major source of livelihood for the farming community of North Eastern Hill region of India. Jhum is a traditional land use system which involves forest clearance, crop cultivation in that site for a few years and then new site selection for new cultivation. In other words, it is changing of farms or cultivable fields from one place to another as a resource management strategy (Mertz et al., 2008). The process of shifting cultivation is called Jhuming and the farmers associated with it are called Jhumias. The forests are cleared generally in December/January and the cut trees, bushes, stumps etc. are then left to dry. Before the onset of monsoon, these cut materials are burnt to make the site ready for cultivation. The Jhumias carry out their farming in the same site for 3-5 years and then shift to another virgin forest area as new site for Jhum. When the cultivated site is abandoned for 10-15 years, the land regains its fertility which is beneficial for next cultivation. But, with the increasing population, the Jhum cycle has reduced to 2-3 years instead of 10-15 years. This has caused ecological imbalance and decrease in productivity from the Jhum sites.

Out of 0.94m ha of total Jhum area in India, the states of NE India alone cover 0.76m ha which is more than 84% of total Jhum area (NRSC 2011).

Characteristics of Shifting Cultivation

1. It is normally practiced in hills and hill slopes.
2. A group of 10-15 families cultivate in one Jhum site for several years.
3. Mixed cropping of 15-20 crops are followed in an area of 1-4 ha (Raman, 2001).
4. The Jhumias cultivate traditionally with locally available seeds, tools and implements.
5. Major crops grown are paddy, maize, ginger, turmeric, cucumber, chilli, beans, pumpkin, squash, chow-chow, colocasia, pineapple, banana, orange and lemon.
6. It is a labour-intensive farming.

Impact of Shifting Cultivation

Fig 1: Jhum cultivation activity cycle (Jamir, 2015)

1. Conservation of agro-biodiversity, especially the local and native crop species and varieties.

2. Controls weeds, pests and diseases in crops as they burn their fields before shifting to new places.
3. Fire also adds ashes to the soil thereby correcting soil acidity.
4. Soil erosion occurs due to vegetation loss.
5. Deforestation occurs due to land clearance for jhum.
6. Provides food security to the Jhumias and their families.
7. Generate more income per unit area as they utilize every inch of land for cultivation as compared to monocropping in plains.

Strategies for Improving Shifting Cultivation

Verma et al. suggested some strategies to improve or transform jhum to settled cultivation are as follows:
1. Jhum fallow management: The soil fertility and nutrient status of Jhum fallows can be improved by soil incorporation of green manure crops like Crotolaria juncea, Sesbania bispinosa, Thysanolaena maxima etc.

2. Integrated farming system: The principle behind IFS is to use the by-product of one component as the input of another component for resource cycling within the whole farming system. The farming system of various components like crop production, horticulture, livestock, fishery and apiary.

3. Multistorey agroforestry: Crops of various canopy orientation and root length are to be grown in a particular area in order to maximize the use of vertical and horizontal spaces. For example- Coconut + Black pepper + Pineapple and Arecanut + Patchouli + Betelvine.

4. Watershed management: Contour trenches or terrace farming conserves both water and soil in hills. This is practiced in Nagaland and Meghalaya. Crops like paddy, cabbage, potato, carrot etc. are grown in this system. Jalkunds can also be excavated to harvest the monsoon rain water and utilize it in the dry spells.

Conclusion

Among various factors affecting shifting cultivation, economic factor is the dominant one. Therefore, other allied enterprises like piggery, apiary, mushroom cultivation, dairy and agroforestry should be encouraged to provide both food and financial security to the Jhumias.

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Processing in Tomato

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Introduction

The tomato originated in the mountain reason of South America. The tomato is an edible fruit of solanum lycopersicum, commonly known as a tomato plant. The tomato is belonging to the solanaceae family. The tomato is consumed because is a rich source of vitamins and minerals and use as an ingredient in many dishes' sauces, salads etc. Tomato is a valuable raw material used for processed products such as tomato juice, ketchup, sauce, canned fruit, puree, paste. These products are consumed by people of all age groups and demand is going up. Today in the developed countries, nearly 80% of the fresh tomatoes are processed into various products.

Tomatoes can be processed into a number of products:
1. Tomato juices.
2. Tomato sauces/ ketchup.
3. Tomato soup.
4. Tomato puree and paste.
5. Tomato chutney.

Preparation of Tomato Juices

A good quality juice contains about 0.4% acid (citric acid), 0.5% salt and 1.0% sugar. Select deep red ripe tomatoes wash and trimmed to remove tops, green/yellow portions cut or crushed the tomato and cooked till soft (8 - 10) minutes. Passed the lot through pulper to collect the juice/pulp or stainless-steel sieve may be used at home. The air from the extracted juice removed by using a deaerator under high vacuum. Add sugar, salt and flavouring substances. After flash pasteurization at 130-150 0c for 8 to 12 seconds the juice is cooled at 90 0c filled in cans or glass bottles at the same temperature 90 0c. Containers are closed followed by their inversion for about 5 to 7 minutes to sterilize the container and closure and then cooled.

Preparation of Tomato Sauce and Ketchup

It is made from strained tomato juice or pulp and spices, salt, sugar and vinegar, with or without onion and garlic, and contains not less than 12% tomato solids and 25% total solids.

Flow Sheet for Tomato Sauce / Ketchup

Tomatoes → washing → shorting / trimming → cutting / chopping → heating at 70 - 900c for 3 to 5 minutes → pulping → straining tomato pulp/ juice → cooking pulp with 1/3 of sugar → putting spice bags pressure occasion- cooking to 1/3 original value of pulp/juice → removal of spice bag → add of remaining sugar and salt-cooking → judging of end point → addition of vinegar/acetic acid and preservative → filling hot into bottles at about 88°c → crown cracking → pasteurization-cooling → storage at ambient temperature.

Preparation of Tomato Soup

The tomato soup should contain minimum 5% TSS and mould count not is excess at 30% of the field examined. Reduce flame / steam, and water extract of all the spices /or liquid spices. Mix well and fill into sterllized, dry bottles (temperature 800c) seal the bottles with sterlized, crown crok. Place the bottles for boiling in water for 15 minutes to pasteurize the product. Allow the bottles to cool and label.

Preparation of Tomato Puree and Paste

Tomato puree and paste are concentrated form of tomato juice and is most popular product. Tomato puree is of two types medium tomato puree contains not less than 9.0 % of salt free tomato solids, while. Heavy tomato Puree contains not less than 12.0 % solids. Tomato paste contains not less than 25.0 % tomato solids. There are three main steps in preparation of tomato puree and paste. Preparation of tomato juice, juice concentration,

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tomato puree and paste pasteurization. The tomato pulp or juice extraction is done from ripe tomatoes in the same manner as tomato juice preparation. Concentration of the pulp or juice is carried out either in an open cooker on in vacuum pan. The end point is judged by determining the TSS by using refractometer. The tomato paste is prepared similar to tomato puree but it is concentrated more to have not less than 25% tomato solids the product is judged by using refractometer. The paste with required PSS is then pasteurized and filled into containers in the same manner as explained under tomato puree. Unpasteurized Puree and paste can be preserved by addition of chemical preservative i.e. sodium Benzoate @ 0.75 gram /kg of finished product.

Preparation of Tomato Chutney

Chutney is an integral part of the Indian cuisine. It forms a part of the main cuisine and serves as an essential ingredient with snacks and appetizers. Indians have mastered the art of making chatney from anything and everything available.

There are many chutneys which have not only found their fame in Indian but are famous all across the world. A few chutneys like tomato chutney can be prepared with a few ingredients making it quite popular among the masses. Tomato chutney is easy to prepare and is quite nutritious because of the ingredients used in it. Tomatoes themselves are rich in vitamin A, B and C along with iron, phosphorus and potassium. Many people like to have their meals with tomato chutney everyday thus ensuring their health and well-being. Tomato chutney also contains onion and garlic. As per FSSAI specification chatney should have minimum 50% TSS and

40% fruit part. Heat 2 tsp of oil in a pan add the gram pulse, black gram pulse and curry leaves on a medium flame for 1 minute or till the pulses turn light brown in colour. Add chopped onion to the pan while keeping the flame on medium level. Saute the mixture for 1 minuter. Add the chopped tomatoes and 2 tbsp of water mix well and cook on medium flame for 3 to 4 minutes. Add salt and mix well and cook on a medium flame for 1 minute. Allow it to cool completely and blend in a mixer til smooth keep aside since we are going to add a tempering to it.

Now it is time to prepare tempering for our tomato chutney. Heat the remaining 1 tsp of oil in small non-stick pan and add the mustard seeds. When the seeds crackle, add the red chillies while keeping the flame on medium take care you don't burn the seeds and chillies keep it on the flame for 30 seconds. Remove from the flame and pour this tempering over the chutney and mix well. Tomato chutney can be stored for two days in the refrigerator.

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Impacts of Covid-19 Pandemic on Agriculture

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Summary

The article gives an overview of the challenging pandemic and assesses the immediate challenges that COVID-19 has posed to the farm sector directly or indirectly. It also suggests some mitigation measures also to ensure a sustainable food system in the post-crisis period.

Introduction

Novel corona virus has become a global pandemic. India is also facing worst of the pandemic in recent times. The ongoing health crisis due to COVID-19 has affected the lives of every individual. Governments took action since the Corona virus spread created an unprecedented situation. Indian government declared a three-week nation-wide lockdown till mid-April in the initial phase, which has subsequently been extended till May 3 for achieving satisfactory containment of the virus spread.

Agriculture is the backbone of any economy. It is the primary sector which generates employment so that the entire circle of economic circulation goes on. When we talk about the Indian economy, the majority of the population is restricted to this sector.

Preparation of Tomato Sauce and Ketchup

It is made from strained tomato juice or pulp and spices, salt, sugar and vinegar, with or without onion and garlic, and contains not less than 12% tomato solids and 25% total solids.

Covid-19 Impact on Sustainable Crop Production

1. The immediate, or short-term, impacts of the COVID-19 pandemic on sustainable crop production systems derive from the near universal response of governments to impose lockdowns in countries. This has resulted in the inability of farmers, farm labourers, farm service providers, extension officers, input suppliers, processors and other various actors in the food system to perform their tasks. These constraints may manifest themselves in the failure to plant crops in a timely manner, or to use the optimal quality and quantities of inputs needed (such as seeds, fertilizers, pesticides), to carry out varied cultural practices, and harvest and post-harvest activities.

2. Markets and related services, such as transport, are being disrupted or shut down. Farmers producing perishable products with labour-intense value chains, such as fruits and vegetables, are in an especially vulnerable position. Reduced labour mobility threatens to leave some high value crops rotting in the fields and without adequate storage, the window of time to sell these products before they become unmarketable is short. Changes in market demand and consumer behaviour have been observed in some countries (for example, increased demand for staples and canned food with longer shelf lives). As a consequence, there is a higher risk of food loss of fruits and vegetables brought about by COVID-19. This translates into lower incomes and money for smallholder farmers, which then negatively affects their household food security.

3. Public services supporting crop production, such as extension diagnostics, and official support services including training, coordination meetings, field visits, and pest monitoring and surveillance have also been

disrupted during the pandemic. The support received through these services is crucial for farmers to continue their farming activities in a sustainable manner.

4. In the medium term, the impacts of the disruptions will be felt in the scarcity of inputs. For instance, the failure to plant or harvest at the right times or to conduct necessary field inspections may result in a lack of quality assured seeds. This scarcity may also be replicated with other inputs if their production has been disrupted or input-related businesses have gone under. In addition, critical research and development (R&D) activities may have been disrupted with significant consequences. For instance, trials may not have been set up, and data may not have been collected and/or harvested when it should have been, impacting institutions' abilities to release new crop varieties or provide evidence-based extension guidelines. Additionally, gene banks (seed, in vitro and field) may not have been managed optimally, leading to the loss of critically important sources of traits for improving our crops.

5. Some of the medium-term impacts may persist into long-term constraints. A prolonged economic shock will affect the purchasing capacity of farmers for inputs and other foods that they do not produce. Likewise, the effective demands by consumers, which spur production, may also be lost thereby removing a critical incentive for farming. The domino effect may lead to the failure of many businesses, especially small- and medium-scale enterprises that either service crop production or are dependent on the produce.

Mitigation Measures

1. The focus of the Government has to be to protect the lives of every citizen. However, people living on agriculture and allied activities, mostly those losing their income from informal employment at this lockdown period, have to be provided with alternative avenues (cash transfers) till the economy bounces back (when this health crisis is successfully overcome).

2. To sustain the demand for agricultural commodities, investments in key logistics must be enhanced. Moreover, e-commerce and delivery companies and start-ups need to be encouraged with suitable policies and incentives.

3. The small and medium enterprises, running with raw materials from the agriculture and allied sector or otherwise, also need special attention so that the rural economy doesn't collapse.

4. To eliminate the immediate concerns of scarcity of farm labour, policies must facilitate easy availability of machinery through state entities, Farmer Producer Organizations (FPOs) or custom hiring centers (CHCs) with suitable incentives. It is also suggested to explore leveraging NREGS funds to pay part of the farm labor (with farmers paying the balance wage amount) to lessen the monetary burden on the farmer, while ensuring wage employment to the landless labourers and workers.

5. As the kharif (rainy/wet) season has approached, institutional lending of crop loans should be expanded and facilitated for smooth (and sufficient) flow of credit to borrowing farmers. Agri-inputs – seeds, fertilizers, agro-chemicals, etc. – have to be pre-positioned for easy availability. Private sector must play a significant role with necessary policy support.

6. Relaxation of the norms by Agricultural Produce Market Committees (APMCs) allowing farmers to sell their produce beyond the designated mandis will certainly ease the burdens of farmers. State Governments must gear up their machineries for smooth procurement operations of farmers' marketable surpluses at MSP (minimum support price) or through other price support schemes.

7. Structural reforms such as land leasing, contract farming and private agricultural markets, etc. have long been advocated to bring enhanced investments into the agriculture sector and to push its growth. However, there has not been uniform implementation of these legislations by State Governments and so the full potential of the sector is unrealized. These reforms need significant political will. Concerns of a slowdown in the zeal of States, post-COVID scenario, could be tackled with suitable incentive mechanisms by the Federal Government to the States.

8. With a burgeoning population, there is a corresponding rise in food demand in India. However, the negative externalities of the Green Revolution, particularly the environmental trade-off and staple cereals fundamentalism, have since been realized. It is thus desirable to switch over to a suitable model with a far stronger nutrition focus where diets are more diverse. A post-COVID situation offers that unique opportunity to repurpose the existing food and agriculture policies for a healthier population.

9. There have been global concerns, rather speculations, on restriction of exports of agricultural commodities by a few global players. India, being trade-surplus on commodities like rice, meat, milk products, tea, honey, horticultural products, etc. may seize the opportunities by exporting such products with a stable agri-exports policy. India's agricultural exports are valued at 38 billion US Dollars in 2018-19 and can rise up further with conducive policies. Development of export-supportive infrastructure and logistics would need investments and support of the private sector that will be in the long-term interests of farmers in boosting their income.

10. Many climate models predict a favourable monsoon in the 2020 season (The India Meteorological Department has also since officially announced) as the El-Nino weather phenomenon, that disrupts rainfall in India, is not evident. This is indeed good news in the COVID scenario, assuming agriculture can practice largely unscathed.

Conclusion

While COVID-19 is the current disruptive force, we also need to build resilience to economic shocks, climate change, land degradation, biodiversity loss, water scarcity, and pests and diseases. It is time to turn this crisis into an opportunity to move us towards a better "new normal", i.e. to transform current cropping systems to more sustainable and resilient ones that have the ability to reduce risks and vulnerabilities to multiple threats, and to absorb, adapt and recover in a timely manner. Any global response to the COVID-19 crisis must include farmers and designate crop production as one of the vulnerable yet essential services.

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Cell Line Concept in Baculovirus

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Introduction

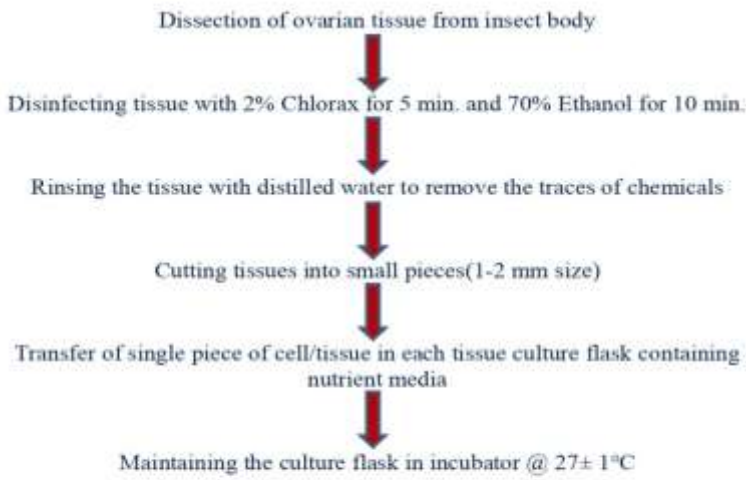
Baculovirus is the best known entomopathogenic virus. It has high host searching specificity and environmentally safe. It causes infection to the host through mouth and acts as a stomach poison. Its virulent mortality agents are capable of causing natural epizootics. Their virions in large proteinaceous crystals called as 'Occlusion Bodies' (OB's). It has potential to develop as a microbial pest control agent. Due to establishment of its cell culture system for in vitro propagation, it provides basis for understanding nature of virus-host interaction, pathogenicity or virulence, host range and latency.

Concept of Cell Line

Cell which grow and replicate continuously outside the living organism is called as 'Cell Line'. Cell lines can be developed from various tissues of insect body such as ovarian tissues, embryonic tissues, fat body tissues, midgut epithelial tissues etc. depending upon the object of the study.

Steps in In-Vitro Baculovirus Production

1. Establishment of cell line: Establishment of cell line is the most serious task. It is always better to procure cell lines directly from well reputed cell depository for having maximum success. Simple method suggested by Vaughn and Stanley (1970) for ovarian cell line establishment is as follows:



Most commonly used insect cell lines are:

Sr. No.	Cell line designation	Types of Cell line	Source
1.	Sf-9	Ovarian cell lines of *Spodoptera frugiperda*	NCCS, Pune
2.	Sf-21		
3.	Ha-197	Ovarian cell lines of *Helicoverpa armigera*	NIV, Pune
4.	Tn-368	Ovarian cell lines of *Trichoplusia ni*	-

5.	IPLB-Hz-1075	Cell line of *Helicoverpa zea*	-

2. Insect cell culture media: Most commonly used insect cell culture media are:

a. Grace's media(Both liquid and powdered).
b. Hinks TNM - FH medium.
c. Goodwin's IPL - 45 media.
d. TC-199 MK media.
e. TC-100 media.
f. Sf -900 - II SFM(Serum Free Medium).

Composition of Grace's Medium:

Sr. No.	Key Components	Quantity(g/lit)
1.	Lactoalbumin hydrolysate	3.3
2.	Yestolate	3.3
3.	L-glutamine	0.06

Add 0.03 g/lit Sodium bicarbonate(in case of powdered media) in Grace's medium

↓

Add 20-30 ml 1 M solution of KOH to maintain pH round 6.2

↓

Add 25 μg/ml Gentamycin(or any suitable antibiotic)

↓

Store the media in well labelled bottles in a refrigerator @ 4°C temperature

3. Transfer of cells to culture media: Aseptically transfer about 4.5 ml culture media in each 25 cm2 tissue culture flask. Add 10% of fetal bovine serum (FBS) into the transfer culture. With the help of sterile pipette add 0.5 ml cell suspension (0.5 ml = 1 x 105 cells/ml) into the same culture. Thus, make total volume in the flask 5 ml by performing 1:10 split ratio.

4. Maintaining cell cultures: Maintain the cell cultures at 27-28°C in an incubator. Sub culturing should be following at weekly interval by using appropriate split ratio. Use 0.6 per cent Methyl cellulose as an over lay material in the medium. Ensure formation of uniform monolayer of attached cells in culture.

Four Marked Phases During Cell Growth are

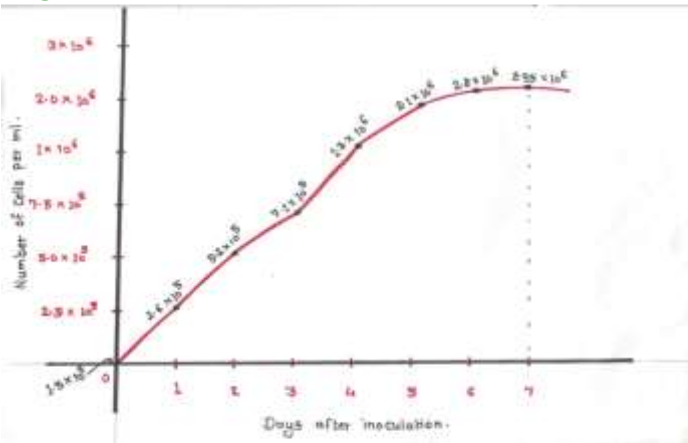


Fig. Growth curve of Sf-9 cell line in in vitro(Source: Nakat, 2005)

Lag Phase: Slowly increasing rate of cell growth during cell formation.

Log. Phase/exponential Phase: Rapidly increasing rate of cell growth during cell elongation. It is also called 'Grand Growth Period'.
Stationary or Maturation Phase: Steady rate of cell growth
Declining Phase: Slowly decreasing rate of cell growth, cell starts dying due to aging or senescene.

5. Inoculation of NPV to cell culture: After fifth day of cell transfer, we get 3 x 105 cells /ml from an aliquat of 1 x 105 cells/ml. Add 0.5 ml virus culture obtained from NPV infected 5th instar larvae to the 5th day old culture. Then remove virus inoculum from cell culture after 1 hour with the help of micropipette. In this way, POB's obtained in vitro are similar in their morphology to those obtained in vivo.

6. Harvesting viral plaques and enumeration of PIBs: Virus replicates in the cells and forms viral plaques. Cell gets infected with NPV within 24 hours of inoculation. PIB's can be seen in cultured cells after 5th day of inoculation. Detach the cell monolayer gently. Then Centrifuge it @ 1200 rpm for 20 minutes. Repellet of Supernatant after the centrifugation process. Suspend Pellets in phosphate buffer saline solution. Enumerate PIB's in haemocytometer. Maximum PIB yield = 1.9 x 107 /ml (on 6th day of inoculation). Vail et al. (1973), Yamada et al. (1982).

Precautions to be Taken

1. Avoid microbial contamination.
2. Proper labelling of medium bottle cultured flasks.
3. If you have not used all the cells from the mature culture, add some fresh medium into the old culture.
4. Fetal Bovine Serum(FBS) used in cell culture medium, contains trypsin-inhibitors, which stops the enzyme activity when the fresh medium is added to the culture.
5. Add some other trypsin inhibiting solutions if you want to maintain the cell culture in a serum-free medium.
6. Proper storage of cell cultures and culture media should be adopting.
7. Avoid cross contamination.
8. The cell cultures should be maintained @ 27℃ (26℃ - 28℃ range) in an incubator for more healthy growth.

Advantages

1. Absence of microbial contaminants.
2. Production of virus relatively free of insect debris is possible.
3. Possibility of virus production round the year.
4. Successful continuous commercial production of virus in in vitro could be a significant development which would facilitate storage and maintenance of continuously available supply of specific clones of highly virus productive cells.
5. Use of in vitro system might also lower the production costs as compared to in vivo system.
6. No need of maintaining and rearing the host insects for virus production.
7. More homogenous culture than other cultures in living insects.
8. Host reactions to virus are not present and thus these variable factors affecting sensitivity may be eliminating.

Limitations

1. Highly scientific and technical knowledge based.
2. Possibility of microbial contaminations.
3. Highly costly (well-equipped laboratory with advanced facilities).
4. Serial passaging for numerous times lead to variety of mutation or defective viral populations.

Conclusion

1. Important advance in production of viral biopesticides.
2. Facilitates continuous production of viral pest control agents.
3. Virus production relatively free of contamination.

4. Serial passaging limits the use of in vitro method.
5. More detailed research is needed to develop cost effective technology for in vitro virus production.

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Increasing Crop Productivity in Flood Prone Areas

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Introduction

Flood is part and parcel of living for a large number of people in Asia and the Pacific. It is a regular phenomenon particularly in such countries as Bangladesh, Myanmar, Thailand, India, Vietnam and Cambodia, where the loss of human lives, natural resources, crops and livestock have at times destroyed the financial backbone of farmers. There are about 31 million hectares of flood-prone areas in South and South East Asia, of which 13 million are used for agriculture, mainly for the planting of some form of deep-water rice (Singh, 2001). Flood is defined as the inundation of the land surface and it is caused by seasonal accumulation of rainwater, river discharge or tidal phenomenon. Flash floods also occur because of unexpected rainfall, excessive river flow, cyclonic storms and tidal surge. Many parts of Asia and the Pacific are prone to them. They take place without prior warning but last no more than 10 days, and can be due to a number of factors such as unexpected high rainfall, tidal movement, and breaches in flood control structures. In India, Bihar and Odisha account for about 12.7% and 4.2% of the total flood prone area of the country (40 Million / ha), respectively. Muzaffarpur and East Champaran Districts of Bihar and Puri District of Odisha are extremely susceptible to the floods due to the extreme climatic rainfall events, poor drainage and breaching of river embankment. The flood water remains in the agricultural fields for 6 to 15 days causing severe damage to the Kharif crops, mainly rice.

Flood Prone Areas in India

The major flood prone areas in India are located in the east, namely, in eastern Uttar Pradesh, West Bengal and Orissa (Singh, 2001). There are approximately 2.30 million hectares of such land in the Ganges-Brahmaputra basin. Despite efforts made to control floods, evidence exists to indicate that their frequency is increasing.

Flood Prone Cropping Patterns in India

Deepwater rice is a predominant crop in the flood prone areas of India. There is little genetic erosion in such terrain in eastern India because of the release of only a few high yielding varieties for planting (Singh, 2000). The rate of replacement with new ones is slow due to poor seed distribution and farmers' preference for specific traits. This is the case in the rain-fed lowlands and more so in deep water areas. However, in more favourable sections of the latter, modern varieties have started to make an impact. Farmers only adopt them in carefully chosen fields that can provide a good harvest and they also manage the crop better. They have as yet to make inroads in flood prone deep-water terrain. In these areas boro-season rice gives a higher yield and more profit to farmers (Thakur and Singh, 2000).

How to Increase Productivity of Flood-Based Farming Systems

Improving the following aspects has potential to drastically increase the productivity of these flood-based farming systems:

1. Agronomic practices: Apart from improving drainage and other preventive measures, farmers can adopt flood tolerant varieties that can withstand inundation for an extended period and reduce the risk from flood damage. Such as for example rice varieties Swarna-sub1, MTU-1010, MTU-1001 and MTU-1140 are high yielding with good grain quality apart from possessing submergence tolerance and perform better under flood situation. Demonstration of these varieties in flood-prone areas showed that Swarna-sub1, a variety developed by IRRI and CRRI, Cuttack and released in 2009, could tolerate submergence up to two weeks and could perform significantly better compared to other improved and local cultivars. MTU-1010 is a short duration, dwarf variety resistant to lodging and can withstand moderate wind velocity. This attribute of lodging resistance saves from not only loss in grain but also straw yield which is the main source of dry fodder. MTU- 1140 is also a promising, non- lodging variety comparable in grain quality to BPT-5204. The dapog method of seedling production could be promoted and quality seed production of existing popular deep-water varieties undertaken. Boro followed by transplanted deep-water types should be expanded whenever feasible. Early maturing varieties to avoid flash-flood damage at maturity stage should be developed. In some areas, modern technologies for maize, pulse and oilseed production are absent. There is thus an urgent need to introduce and popularize them.

2. Water distribution: Floods may vary in intensity and duration, from a few hours to a period of months, and may also at times be forceful and unpredictable. Improving water distribution, by putting in place water control structures, can allow better control of water and reduce erosion, water logging and other risks.

Dividing the floodwater into smaller portions, and avoiding steep slopes where water can pick up speed, can help safely steer water. Other relevant flow diversion structures can be put place, including drop structures (to transition between levels), flood bed stabilizers (to prevent uncontrolled runoff) and water-spreading weirs (to reduce erosion).

3. Field water management: Being able to manage the rise and drainage of floodwater within a field is also essential to be able to use the water productively. Several mechanisms can help in this matter, Dikes and soil bunds can help protect fields from unexpected floods and they can also allow farmers to drain or retain water as needed; drainage ditches can be used to channel away excess floodwaters; and reuse agreements can enable farmers to take turns using water from the same source.

4. Groundwater use: In most area where flood-based farming can be practiced, groundwater is will be shallow. This means that potential exists to access and use groundwater to extend the cropping season. Several approaches can be considered, including accessing groundwater through hand-drilled tube wells, which can be established for low costs and using only local labour. Other groundwater-lifting technologies include rope pumps, treadle pumps, motor pumps and solar-powered pumps. Most importantly in assessing and mapping groundwater resources to avoid overexploitation.

5. Multi-functional use: The productivity of flood-based farming systems can also be boosted by considering the multiple ways that floodplains provide benefits, such as through fishery, flood pastures, fuel wood collection and water supply. For example, fishponds and aquaculture can supply local communities with protein, while requiring fewer inputs than other agricultural practices.

6. Internal governance: Flood-based farming systems are underappreciated and poorly understood by governments, donors and development agencies. To realize the full potential, governance must be improved, including by familiarizing policy makers, extension workers, academics and other water professionals with the potential for and benefits of floods-based farming.

Constraints to Adoption of Farming Systems

1. Non-availability of improved plant type, non-availability of good quality seeds, lack of diseases and pest's resistant variety.
2. Farmer's traditional method of seed selection and storing, and poor maintenance of seed purity.
3. Non-availability of improved cultivation technology, fertilizer and other inputs.

Conclusion

Flood has been part and parcel of life for many people in the Asia and Pacific region. It indirectly affects even those living outside of flood prone areas. Farmers have developed different kinds of farming systems and a unique way of life to cope with floods that vary in depth and duration. Their special understanding of this natural adversity and its consequences has helped them live with it and adopt the kind of farming that is suited to it.

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Biofertilizer: A Potent Tool in Augmenting Soil Fertility and Crop Production

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Introduction

The inception of green revolution in the1960s lead to the increased agricultural production of food grains (especially wheat and rice) worldwide due to adoption of modern technology and methods such as use of high yielding variety seeds, fertilizer, pesticides, tractors, irrigation facilities etc. simultaneously in long term it resulted in the reduction of natural soil fertility and productivity due to injudicious use of fertilizer and pesticides, reduction in genetic diversity, endangering health of plants and beneficial microorganisms and predators, environmental pollution, deteoration and hence impacting the sustainability of an agro-ecosystem. To overcome these challenges, there is a need of sustainable system, a system which maintains its own viability by using techniques which allows for its continuous reuse. According to Gips, 1986 a sustainable system posse features as, ecologically sound, economically viable, socially just, humane, adaptable. In this scenario, organic agriculture and management practices can help in achieving a self-sustaining, production system which sustains the health of soil, ecosystem and people by largely excluding or avoiding the use of synthetic fertilizer, pesticides and growth regulators and promoters. 'Biofertilizers' has been proved to be a novel tool in organic agriculture. Biofertilizers are the products containing living cells or latent cells of efficient strains of microorganisms which have ability to mobilize nutritionally important elements from unusable to usable form through biological process thus, helping crop plant in uptake nutrient uptake through its interaction in the rhizosphere. Biofertilizers play a key role in improving nutrient supplies, enhancing soil fertility and yield of crops by rendering unavailable sources of elemental nitrogen, bound phosphates and decomposed plant residues into easily accessible form in order to facilitate the plants to absorb the nutrients or supply nutrients to the host plants. Biofertilizers are the bio-inoculants containing cells of microorganisms which can add nutrient through natural process of nitrogen fixation, phosphorus solubilisation and mobilisation, potassium mobilisation *(Frateuria aurentia),* sulphur oxidisation, organic matter decomposition etc.

During 9th Five Year Plan Ministry of Agriculture, GOI implemented a central sector scheme "National Project on Development and use of Biofertilizers (NPDB) but this scheme was merged in "The National Project on Organic Farming (NPOF)" launched during 10th Five Year Plan. In the recent years the need and demand and organic manure and biofertilizers are increasing as overdose of chemical fertilizers is harmful for soil and degrading soil quality and fertility. Recently, Delhi government has suggested make purchase of biofertilizers with bags of urea to cut dependence on chemical fertilizers, to promote organic nutrients to achieve sustainability.

Importance of Biofertilizers

Biofertilizers are believed to be an important component of integrated nutrient management (INM) which have shown encouraging results in terms of increase in crop yield and income.

1. Biofertilizers are eco-friendly, low cost agricultural inputs and have supplementary role with chemical fertilizers which improves soil fertility and so improving the nutrient supply to the plants.
2. Biofertilizers strengthen soil structure, improves aeration, water holding capacity and soil biological properties.

3. On an average, biofertilizers add up to 20-30 % increase crop yields.
4. It provides a better option to augment the fertilizer use efficiency (FUE) and maintain soil health and quality of produce.
5. Biofertilizers are non-toxic in nature and they don't have any residual effects unlike chemical fertilizers.
6. They produce phytohormones, like auxins (IAA) and gibberellins helpful in promoting root growth and development.

Table 1. Classification of biofertilizers

S. No.	Groups	Examples
	Nitrogen fixing biofertilizers (NFB)	
1.	Free –living	*Azotobacter, Clostridium, Aulosira, Anabaena, Nostoc*
2.	Symbiotic	*Rhizobium, Frankia, Anabaena, Azolla*
3.	Associative symbiotic	*Azospirillum*
	Phosphorus Solubilizing biofertilizers (PSB)	
1.	Bacteria	*Bacillus subtills, Bacillus megaterium var. phosphaticum,Bacillus polymyxa,* *Bacillus circulans, Pseudomonas striata*
2.	Fungi	*Asergillus awamori, Penicillum spp.*
	Phosphorus Mobilizing biofertilizers (PMB)	
1.	Arbuscular mycorrhiza	*Glomus fasciculatum, Scutellaspora spp., Gigaspora spp., Acaulospora spp., Sclerocystis spp.*
2.	Ectomycorrhiza	*Laccaris spp., Pisolithus spp., Bolitus spp., Amanita spp.*
3.	Orchid mycorrhizae	*Rhizoctonia solani*
4.	Ericoid mycorrhiza	*Pezizella ericae*
	Biofertilizer for micro-nutrients	
1.	Silicate and Zinc solubilizers	*Bacillus spp.*
	Plant Growth Promoting Rhizobacteria	
1.	Pseudomonas	*Psuedomonas fluorescence*

Rhizobium

Rhizobium is a genus of bacteria associated with the formation of root nodules on plants. These bacteria live in symbiosis with legumes. They take in nitrogen from the atmosphere and pass it on to the plant, allowing it to grow in soil low in nitrogen. Rhizobia are diazotrophic bacteria that fix nitrogen after becoming established inside the root nodules of legumes. To express genes for nitrogen fixation, rhizobia require a plant host; they cannot independently fix nitrogen. Species of rhizobium viz. *Rhizobium leguminosarum*, *R. meliloti, R. trifoli* are associated with nitrogen fixation in alfalfa, lentil, peas, clover etc. fixing 200-250 kg N ha-1year-1 in different legumes

Azolla

Azolla is a fast growing, free floating fresh water fern having a symbiotic relationship with BGA *Anabaena azollae.* It is a potent biofertilizer often grown is shallow water or submerged rice fields in tropical and subtropical climates. There are six species of azolla distributed widely throughout different regions of world, only *Azolla pinnata* is found in India. Azolla fixes upto 40-60 kg ha^{-1} of nitrogen in wetland rice. It is able to fix the atmospheric nitrogen symbiotically, can harvest the solar energy.

Azotobacter

Azotobacter is a free-living nitrogen fixing aerobic bacteria which is commonly found in neutral to alkaline soils. It is used for non-leguminous plants especially rice, cotton and vegetables; vegetables respond better to azotobacter compare to other crops. It fixes atmospheric nitrogen and is able to produce growth promoting and antifungal substances against pathogens like *Alternaria, Fusarium* etc. It increases yield of crops by 10-15% and adds about 20-25 kg N ha^{-1} (Boraste *et al.,* 2009).

Azosprillium

Azosprillium is a free living, nitrogen fixing bacterium found in the rhizosphere of several grass species which fixes nitrogen in association with the roots of monocots. It fixes 20- 40 kg N ha-1 in case of cereals, cotton, oilseed and millets. It produces auxins, gibbrellins and cytokinins. Inoculation of *A. brsailense* has resulted in increase in yield in barley, sorghum and millets.

Cyanobacteria

Cyanobacteria also known as blue-green algae (BGA) is aquatic and photosynthetic bacteria, widely distributed all over the earth which fixes biological nitrogen in submerged rice fields. In a season it contributes about 20-30 kg N ha-1 as well as organic matter to the soil (Issa et al., 2014). Cyanobacteria improves crop growth by producing growth substances such as IAA, gibbrellins, vitamin B12 etc. which also stimulates the growth of crop plants and improves soil structure, WHC and aeration (El-Enany and Issa, 2000).

Phosphate Solubilising Micro Organism (PSM)

Phosphorus solubilising microorganisms such as *Psuedomonas and Bacillus* helps in converting insoluble inorganic phosphate into simple and soluble forms. These bacteria are useful in utilization of rock phosphate with low content of phosphorus penta oxide (P_2O_5). Incorporation of these organisms in agricultural fields can save upto 30 kg P_2O_5 ha^{-1}. Sundara *et al.,* 2002 reported that application of rock phosphate with *B. megaterium* var. phosphaticum resulted in improved juice quality and 12.6% increase in sugarcane yield.

Potassium Solubilising Micro Organism (KSM)

Potassium solubilising microorganism helps in K solubilisation by solventing the fixed source of potassium from different minerals (e.g. biotite, feldspar, muscovite, illite, mica, orthoclase) through the production of organic and inorganic acids. These microorganisms involve *Pseudomonas spp., Bacillus mucilaginous, B. circulans* etc. Bacteria like *Frateuria aurentia has the* capability of mobilizing potassium at the rate of 40-60 kg ha^{-1}.

Plant Growth Prompting Rhizobacteria (PGPR)

PGPRs are a wide group of microorganisms used as biofertilizer which stimulates plant growth through nitrogen fixation, phytohormone production, phytoremediation etc. They act as bio-control agent which colonizes plant roots and promote plant growth and acts against certain stress and diseases. They produce secondary metabolites and certain compounds which are known to improve the health of soil and plants.

Liquid Biofertilizer

For liquid biofertilizer no solid carrier is needed. It has potential application in hydroponics, aeroponics and fertigation. It is very easy to use, has longer shelf life of 1-2 years and nutrient use efficiency is greater. There are three ways which is most commonly used for biofertilizer application seed treatment (200 gm inoculants packet is sufficient to treat 10 kg of seeds), seedling root dip (common for transplanted crops and 400 gm of inoculants can be mixed with 40 liters of water for treatment purpose) and main field application (just before sowing or transplanting 4 packets of inoculants are mixed with 20 kg of well dried powdered farm yard manure and broadcasted).

Constraints in Biofertilizer Production and Adoption

There are several constraints i.e. technological, environmental, infrastructural, financial, unawareness, marketing etc. which limits the production and application of this technology to farmer's field at larger scale.
1. Lack of efficient strains resulting in use of native, ineffective strains used for production.

2. Shorter shelf life of inoculants. e.g. *Azolla* can't withstand desiccation hence it is difficult to transport long distance.
3. Lack of technical know-how and the production units.
4. Soil characteristics like acidity, salinity etc. affects the growth and multiplication rate of microorganisms. As fungi performs better in acid soils while bacteria in neutral to alkaline soils.
5. Lack of suitable carrier (medium in which rhizobia are allowed to multiply) and high sensitivity to temperature variation.
6. Lack of awareness regarding its production, methods of inoculation and advantages.

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Public-Private Partnership (PPP) in Agriculture to Cope with COVID-19 Distress

Article ID: 31658

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Introduction

International Monetary Fund (IMF) has estimated the growth rate of 1.9% for India during FY 21 warning that it is the "worst recession since the Great Depression". But the silver lining amidst this situation is the IMF also said that India and China would be the only two major economies likely to register growth, once the situation improves.

Agriculture is still the mainstay of Indian economy, employing more than 50% population of the country. Owing to different reasons like weather dependence, consumer's preferences etc. agricultural operations like Production, processing and marketing situations remain dynamic. Though agriculture sector in the country was already facing various sustainability threats due to global climate change, persistent resource depletion etc., COVID-19 has dampened the situation further. To combat this situation and give a lift to the economy government has put in place a slew of measures; 'Atmanirbhar Bharat Abhiyan (or Self-reliant India Mission)' is being one of them. This Abhiyan has been launched with a special economic and comprehensive package of Rs 20 lakh crore – equivalent to 10% of India's GDP in 2019-20. The 3rd Tranche of this Abhiyan focuses on Agriculture and includes measures to strengthen Infrastructure Logistics, Capacity Building, Governance and Administrative Reforms for Agriculture, Fisheries and Food Processing Sectors.

In addition, targeting the goal of a self-reliant India, ''Vocal for Local" a fresh mantra has been introduced which highlights the importance of country's local market and its potential to take its local products global. Instead of moving single-handedly in this Abhiyan, can switching into Public Private Partnership (PPP) be more thriving?

Rationale for PPP Model in Agriculture

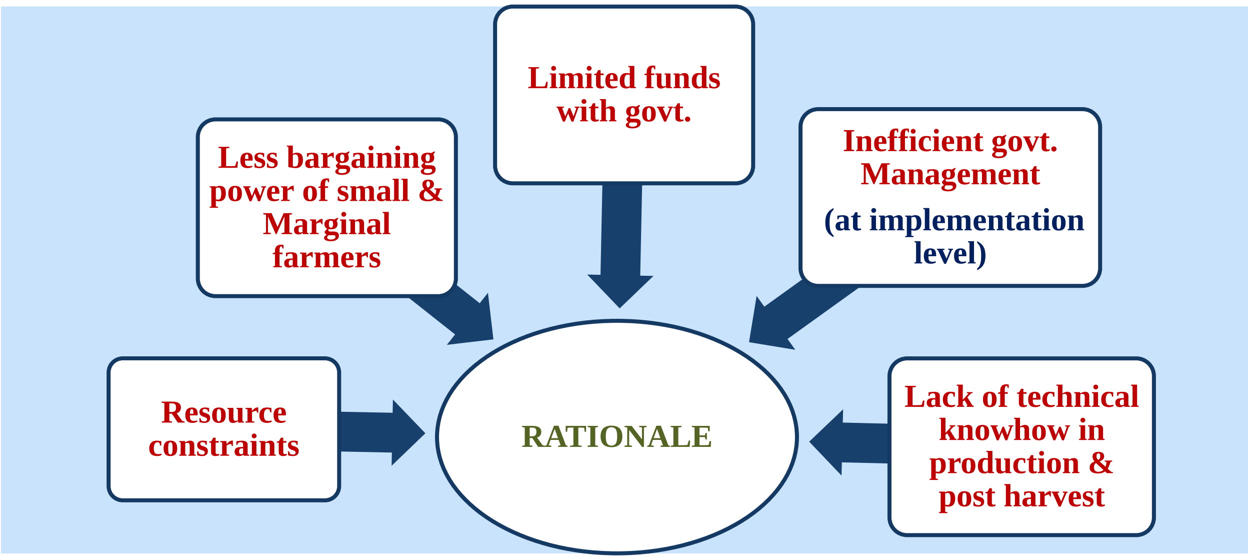

Fig.1 Rationale of PPP model in Agriculture

Figure 1 illustrates the motives behind the need of public-private partnership in Agriculture sector. Resource poor farmers lack capacity to raise their own capital to finance production, marketing, storage or processing infrastructure. PPPs in agriculture may enable small-scale farmers and traders to enter into the formal economy and compete better in value chains by making them more modernized and competitive. The drawbacks vested in government organizations like inefficient management, lack of advanced technical knowhow and limited funds etc can be taken care of by collaborating with private administration. Through guarantying plethora of services through these partnerships, farmers can be incentivized to enhance their productivity and product quality. PPPs can also be instrumental in enhancing market transparency for agricultural commodities through improved dissemination of price information.

Dimensions of PPP Model in Agriculture

Figure 2 outlines the scope or various dimensions for PPP model in the agricultural sector. Multidisciplinary and multi-institutional efforts with use of advanced technologies can aid in development of agriculture and upliftment of farming community. A collaborative management in the form of PPP model can be brought in diverse tranches of agriculture sector namely viz., Research & Development, Quality enhancement, crop production, extension services as well as marketing and infrastructure development.

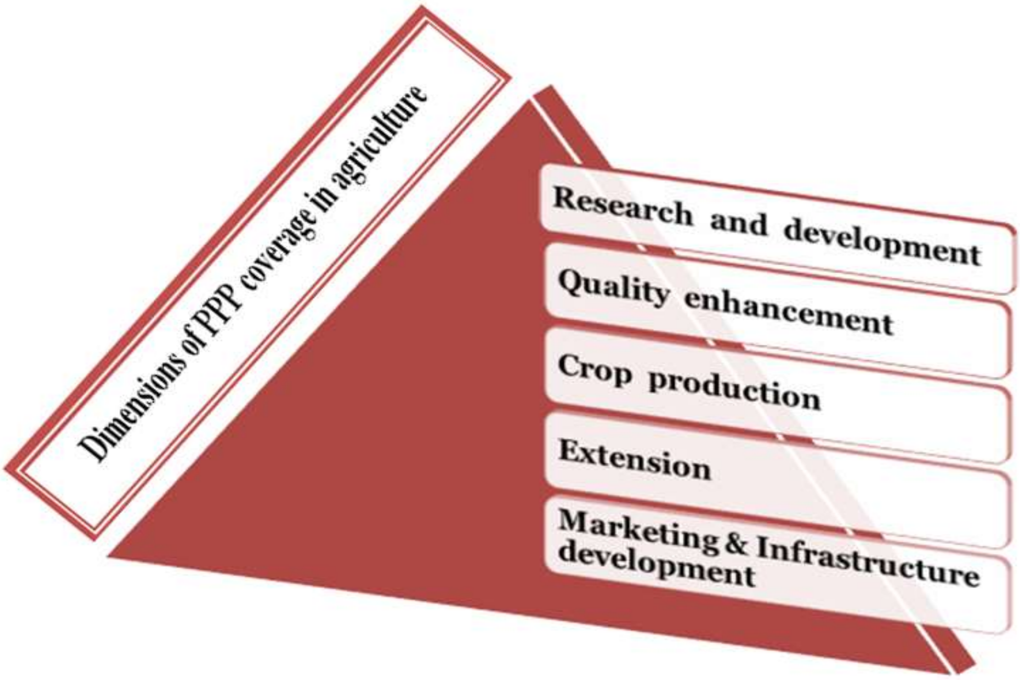

Fig.2 Dimensions of PPP model in Agriculture

Ineffective supply chain of perishable products is another area of concern. Presence of multiple layers of middlemen in marketing of agricultural commodities causes increased price spread. Under agricultural marketing and infrastructure development PPP model can be put forth for Value addition though agro-processing, manufacturing and packaging facilities, Wholesale markets and agricultural trading centres or hubs (all physical structures and related facilities for the pre- and post-harvest storage and warehousing, market yards, crop and livestock auction points, crop collection points, producer assembly and packaging facilities, shared pre-distribution of agricultural inputs), e-Marketing, ITC e-choupal, Contract faming with logistic companies, Telecommunication and logistics management services, Vehicle and machinery servicing, DBT, Direct marketing to enable the farmers get the best price for their produce etc.

Another area with huge untapped potential for bringing in PPP model is developing water efficient irrigation methods aiming at to produce more food per drop of water. Integrated micro-irrigation networks can be developed through PPPs to integrate common infrastructure that supply water from canals to the farm gate with on-farm micro-irrigation infrastructure.

In few of these areas PPP model is already being introduced. For eg. To address the challenges pertaining to the storage of food grains, the government, through Food Corporation of India (FCI) and initiatives of various state governments, adopted a phased implementation plan to build modern steel grain silos with a capacity of 10 million metric tons by 2020 through PPPs.

Challenges of PPP Model

1. There is a gap in ideologies of private sector and government. Government's motive is social welfare whereas private sector focuses on maximizing profits. If come in collaboration, Private sector may do for what they are paid, govt.'s responsibilities continue. Coordination between the partners is highly essential to achieve the planned target.
2. Inaccurate mapping of proprietary assets and responsibilities between the partners at times becomes problematic.
3. Inadequate supporting infrastructure may create hindrances in the success of PPP projects. For instance, if PPPs is there for developing horticultural trading centres, clean water and waste management systems and connecting roads will be essential for reducing post-harvest losses in transit, which may not be available.
4. Financial issues like delays in payments and overspending may significantly inhibit the performance of PPPs for developing agricultural market infrastructure.
5. PPP in agro-processing suffers due to problems associated with surety of supply of raw materials, mode of procurement and rate fixing and thereby affecting cooperation and coordination between the partners.
6. Inadequate legal and regulatory framework may be another challenge.
7. It is difficult to identify all possible contingencies during project development.
8. Inadequate attention to monitoring and evaluation may pose threat to the success of PPP.

Conclusion

Bearing in mind the capacity and resource constraints of the government, there exist a pressing need to develop a more structured approach for increasing the number of promising agri-infrastructure projects by adding in the private sector investment. Therefore, public private partnership (PPP) may be viewed as a kind of experimented strategy in agriculture specifically to modernize services and infrastructure at this difficult hour.

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Giant Cell: Feeding Abode of Invisible Serpentine

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Introduction

The root-knot nematodes (RKNs) are obligate sedentary endoparasites of plants having key feature a formation of galls on plant roots. Successful biotrophic relationship of nematode with host plant cells over a period of several weeks lead to the formation of feeding cells which is "Giant cell" in case of root-knot nematodes. RKN induced giant cells (Nutrient sink) by morphological, biochemical and physiological modification of host cell, resulting in formation of multinucleate and active feeding site (Hewezi and Baum, 2013).

Mechanism of Giant Cells Formation

The nematode and host plant interaction starts when pre-parasitic second-stage juveniles (J2) pierce the root apex with aid of needle like structure i.e. stylet and wander between cells until they reach the vascular system of plant tissue. There, second stage juvenile becomes sessile in the intercellular space, puncture the plant cell walls with a protrusible stylet and initiate the giant cells formation process.

Giant cells are hypertrophied (increased cell size), multinucleated and metabolically hyperactive cells that result from numerous rounds of repeated mitosis without cytokinesis (Caillaud et al., 2008). After feeding site i.e. giant cell initiation, parasitic J2 starts feeding and develop continuously into further juvenile stages J3 (spike tail stage) and J4 and at last into mature ones. Females remain sedentarily fixed in plant tissue and affect five to seven giant cells which provide nourishment to them until eggs are released in gelatinous matrix on the root surface.

It is anticipated that enzyme secreted by the esophageal glands through stylet in plant cells contribute to initiation of giant cell formation process (Rosso et al., 2011). Giant cell development is accompanied with imbalancing of several plant hormones, alternation in gene expression, and structural changes. (Jones and Goto, 2011).

Physiology of Giant Cells

Second stage juveniles attracted towards the plant root due to perception of gradients of attractants (carbon dioxide) emanating from the plant root. These attractants include many organic (secondary metabolites) and inorganic compounds excreted by the roots form gradient from root surface in to the soil and influence the movement of nematode. Penetration by the pre-parasitic J2 through stylet generally includes the cocktail of several cellulolytic and pectolytic enzymes which help to interrupt the plant self-defence system.

During giant cell formation root tissues undergo hyperplasia and hypertrophy and causes the root gall which is the main characteristics of *Meloidogyne* infections. Plant growth regulators have been implicated in the development of giant cells and galls (Plant hormones also help in development of galls and giant cell). Auxins (cell growth promoters) and Cytokinins (cell division promoters) have been identified in the high concentrations in root knot infected tissue than in non-galled tissue.

In *Meloidogyne* sp. infected plants concentration of cytokinins increased and ethylene may be involved in increasing the size of cortical parenchyma tissue. Another plant growth regulator ethylene may be involved in the hypertrophy of cortical parenchyma tissue during gall formation (Perry and Moens, 2013).

Host Plant Response Due to Giant Cells Formation

Root-knot nematodes don't produce clear cut above-ground symptoms. Affected plants possess an unthrifty appearance and sometimes exhibit symptoms of stunting, wilting, necrosis and chlorosis. Symptoms are particularly severe when plants are infected at nursery stage.

During parasitism, RKN set up and uphold a close relationship with their host. Intracellular (In root knot nematode migration is intercellular) migration of nematode is the reason of necrosis and galls are produced under the host response.

Initially wilting is temporary, plant try to cover it by the evening but as the nematode population build up, plant's xylem and vascular system (responsible for water transport from root to shoot and responsible for transport of food from leaves to various parts of the plants, respectively) fails to overcome this problem and ultimately plant wilt permanently (Walia and Bajaj, 2003).

Increased Susceptibility of Host Plant for Other Micro-Organism

Qualitative and quantitative changes in root exudates of root-knot nematode infected plants are accountable for attraction of several soil pathogens. Giant cells are hub of the many nutrients which permit the proliferation of wilt fungi like *Fusarium* spp. and bacterium *Ralstonia solanacearum* (Walia and Bajaj, 2003).

Preferred Host Plant

Favourable host plants of root-knot nematode include almost all major crops belonging to different groups, but vegetables are considered as most favoured host plant for this nematode.

In Vegetables crops: Tomato, brinjal, okra, chilli, potato, cucurbits and radish.

In Fruit crops: Grapes, guava, papaya, peach, mulberry and pomegranate.

In Fibre crops: Cotton and jute.

In Pulse crops: Chickpea, cowpea, greengram and blackgram.

In Oilseed crops: Sunflower and groundnut.

In Plantation crops: Tea, coffee, turmeric, ginger and pepper.

Management of Giant Cell Forming Root-Knot Nematode

Cultural methods: Two to three deep summers ploughing during May and June is extremely effective, nematodes will die due to desiccation. Rotation of crops with non-host crops as it will reduce the initial nematode population led to barrier in nematode population build up.

Incorporation of antagonistic crops (e. g. Tagetes sp.) in cropping system, is additionally beneficial as it secrets many chemicals which are toxic for nematodes.

Another method for control of this nematode in polyhouses includes soil solarization in which a transparent polythene sheet (having thickness of 25 micron) is spread on beds after light irrigation, Nematode die due to heat accumulation under the sheet.

Biological control: *Purpureocillium lilacinum* (egg parasitic), *Trichoderma* sp. (egg and juveniles parasitic) and *Pseudomonas fluorescens* (PGPR).

Resistant cultivars: A lot of root-knot nematode resistant varieties are available like tomato varieties Hisar lalit, PNR-7, Karnatka hybrid and Mangla hybrid etc.

Conclusion

It is concluded that by understanding the proper physiology and biology of plant parasitic nematode (root-knot nematode) and their host parasitic relationship with plant we can effectively manage these tiny organisms.

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Forage Cropping Systems for Improved Soil and Animal Health

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Summary
Burgeoning population of human as well as animals on limited land resources are the serious concern for forage production in India. While, success of animal husbandry is largely depending upon the availability of quality feed and fodder in sufficient amount but unfortunately huge gap in demand and supply is exists in our country due to above cited reasons. Therefore, under such conditions it is imperative to grow multiple fodder crops simultaneously or sequentially over the limited land allotted to the forage production so as to fulfil the nutritional requirements of the livestock resources of our country. In this context, cereal-legume crop rotation, intercropping and mixed cropping including forage crop as one of the components proved to be the effective solution for not only to improve the soil health by way of soil fertility enhancement but also helps to ensure better animal health by improving supplying balanced nutritional fodder.

Keywords: Forage, Cropping systems, Soil and animal health.

Introduction
Despite of low productivity of animals in India compared to other countries, livestock plays an important role in Indian economy as it provides employment to about 8.8 percent population besides its role in proving livelihood to about two-third rural community. Availability of quality feed and forages has been considered as the major bottleneck in harnessing the potential of the livestock sector in India. Cultivated fodder is limited to less than 4.5% of the total cropped area which is inadequate to produce sufficient fodder for livestock. Thus, under such conditions integration of multiple fodder crops in the cropping system may be one of the ways to overcome the present fodder deficit besides improving the forage productivity per unit area. Combining cereal and legume crops under fodder cropping system will help to supply protein, carbohydrate and minerals that improve animal health and productivity besides maintaining soil health. Therefore, cropping sequence, intercropping, and mixed cropping-based strategies need to be followed and also popularized among the farmers to give boost to dairy industry and also to sustain the soil health.

Cropping Systems for Effective Utilization of Resources and Sustainable Yield
The cropping pattern followed on farm includes cropping sequence or intercropping or mixed cropping. Under irrigated situations, intensive forage crop sequences or intercropping system have been identified to increase the biomass yield, to improve forage quality and full utilization of land, labour and agricultural inputs. Intensive forage production systems aim at efficient utilization of land and other inputs for maximum fodder production per unit area per unit time. The cropping sequences aimed to get maximum quality green herbage without damaging soil health rather it is meant to improve the soil fertility. Most promising cropping systems recommended for different agro-climatic and soil conditions are given in Table 1.

Table -1 Cropping systems for different agro-climatic region of India:

Crop rotation / Soil and climate	Green forage yield (t/ha/ year)
1. **Hill and Northern region**	
a. Sub temperate, moist and red soil	
Maize + Cowpea – Lucerne + Oat – Mustard	85
b. Tarai red and yellow soil	
N B Hybrid + Berseem– Cowpea	121
c. Semi-arid, sandy loam soil	
NB Hybrid + Berseem	212
2. **Central and western region**	
a. Semi-arid, Red soil	
N B Hybrid + Cowpea - Berseem+ Mustard	255
b. Sub humid, Black soil	
N B Hybrid + Cowpea - Berseem	176
c. Semi-arid, Black soil	
N B Hybrid+ Cowpea - Lucerne	253
3. Eastern Region	
a. Sub humid, Red acidic soil	
Pearl millet + Cowpea - Maize + Cowpea - Oat	103
b. Sub humid, Alluvial soil	
Maize + Cowpea - Dinanath grass – Oat	131
c. Humid, Acidic soil	
Maize + Cowpea - Maize + Cowpea - Maize + Cowpea	85
4. Southern Region	
a. Sub-humid, Black soil	
N B Hybrid + Lucerne	225
b. Humid, Red soil	
Guinea grass in coconut plantation	135

(Sunil Kumar et al., 2012)

Cropping Systems for Improving Soil and Animal Health

Crop rotation helps to ensure agroecosystem biodiversity by enhancing soil health, repressing pests and disease outbreaks (Barbieri et al., 2019), and thus improves the yield. Crop rotations can provide better opportunities for some soil micro-organisms growth and also helps to break the life cycle of soil-borne pathogens associated with specific crop or crop genotype, and thus limits the disease incidence. Intercropping practices reduces the chemical pollution and enhances soil health (Lemaire et al., 2014).

Inclusion of different fodder crops i.e. cereal and legume provides balanced nutrition to the animals during entire year since cereal fodders are rich in carbohydrate and legume fodders are rich in protein and minerals. Tripathi (1989) reported that intercropping of botanically diverse forage species appears to be one of the feasible approaches for increasing the fodder yield, more efficient utilization of land, improving fodder quality and providing stability to production. Maximum soil nitrogen and phosphorus was observed under maize + cowpea intercropping system planted when planted at 1:2 intercropping ratio compared to 1:1 ratio (Tamta et al., 2019).

Conclusion

Inclusion of forage and cereal cropping systems not only helps to meet the nutritional needs of the animals but also the nutritional needs of the soil as well. Thus, cropping system-based approaches are the need of the hour to maintain and improve the animal health and productivity but to sustain the soil health and quality.

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Epilachna beetle, *Epilachna vigintioctopnctata*: A Serious Pest of Brinjal, *Solanum melongena* L.

Article ID: 31661

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Introduction

Brinjal or eggplant (*Solanum melongena* L.) is a common and popular vegetable crop grown in the subtropics and tropics (Sarker *et al*., 2006) and one the major vegetable crop in India. It is a native of India and is grown throughout the country. It can be grown in all the seasons having sufficient amount of moisture in the soil. It is being cultivated in an area of about 733 thousand hectares in India with a production of 13510 thousand MT (Anonymous, 2019). As this is the fruit vegetable, various major and minor insect pests viz. shoot and fruit borer (*Leucinodes orbonalis*), epilachna beetle (*Epilachna vigintioctopunctata*), jassids (*Amrasca biguttula biguttula*), leaf roller (*Eublemma olivacae*), aphids (*Aphis gossypii*), white fly (*Bemisia tabaci*) are found attacking on this crop. But among them, brinjal shoot and fruit borer (*L. orbonalis*) has been recorded as major and most destructive pest. While, epilachna beetle (*E. viginitioctopunctata* F.), Aphids (*A. gossypii* Glov.) and Jassids (*A. biguttula biguttula* Ishida) are found damaging the crop in moderate way.

Epilachna/Hadda beetle is the genus of beetle in the family coccinellidae and order Coleoptera. *E. vigintioctopunctata* is a major pest of eggplant in India (NBAII, 2013) and identified as a serious pest in eggplant (Naz *et al*., 2012). This pest is widely distributed in Southeast Asian countries, Korea, Australia, and it is common in South India, also occurs in other parts of India (Kapur, 1950). The infestation of this pest is more in *Kharif* season. The incidence of this pest occures for shorter period in summer brinjal, but severe infestation noticed on *Kharif* crop up to August with the population level of 136 grubs/150 plants. (Natekar, 1990). The grub and adult feeds on leaves, retarding the plant growth, which leads to loss of fruit production. Fruit reduction in yield up to 60% (Mall *et al*., 1992).

Host Plants

Solanaceae crops are preferred hosts, with some cucurbits (Shirai and Katakura, 2013). Other than Brinjal, this pest also found on Potato, Tobacco, Tomato and other solanaceous plants (NBAII, 2013). In Bangladesh, *E. vigintioctopnctata* was found on the following cucurbit crops: *Momordica charantia* (Bitter gourd), *Cucurbita moshchata* (Sweet gourd), *Luffa acutangula* (Ridge gourd), *Trichosanthes asguina* (Snake gourd), Cucumber and *Momordica diocia* (Teasle gourd)(DAE, 2010).

Marks of Identification

The eggs are yellowish in colour and cigar shaped. The grub is stout, yellowish in colour and with short spine like hair on the entire body. The adult beetle (8 mm) is spherical shaped, copper or brownish coloured and 'D' like when observed from side. It has round black spots on elytra wings (12 in *E. dodecastigma* and 28 in E. *vigintioctopunctata).*

Life Cycle

Eggs: The female lays about 100 to 400 eggs in a cluster of 10 to 40 mostly on the lower surface of leaves. The eggs are spindle-shaped and yellowish in colour. The egg period is of generally 2 to 5 days.

Larvae: Newly hatched spiny, yellowish grubs start feeding on epidermis of leaves. The larval period lasts for about 14 to 35 days. Before goes into the pupation stage, larva passes through four moulting stages. In this way, after completing larval period grub goes into pupation on leaves.

Pupa: The pupa resembles the grub but is mostly darker in colour, although it sometimes is yellowish in colour. The pupa bears spiny hairs on the posterior part of body. The pupa period is 7 to 14 days.

After completing pupal stage, adult beetle emerges out from the pauperum and start reproducing itself. In this way, the entire lifecycle is completed in 18 to 25 days during summer season and it may be as long as 50 days in winter season. This pest completes about 7 generations in a one year.

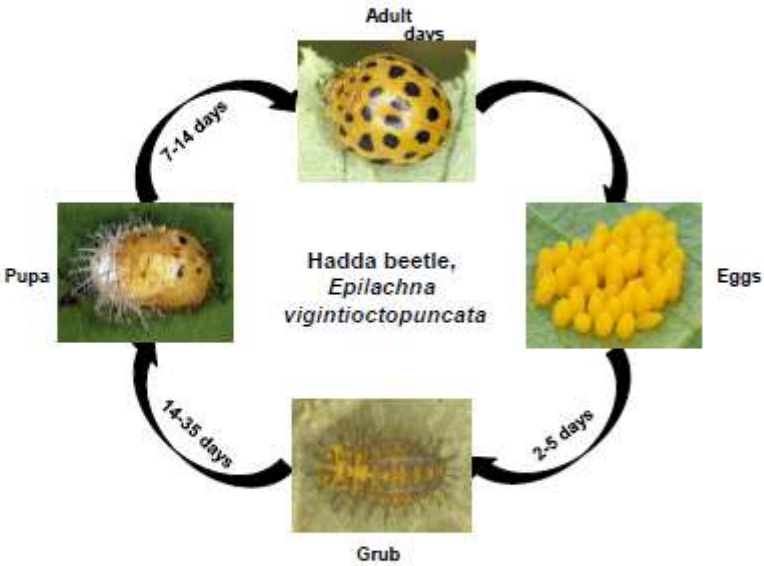

Fig. Life cycle of Hadda beetle, *Epilachna vigintioctopunctata*

Nature of Damage

The eggs, the larvae and the pupae found on leaves. Both the grub and adult of Epilachna beetle have chewing type of mouthpart. They scrape the chlorophyll from the epidermal layer of leaves. This results to typical ladder-like window on leaf surface. The windows will dry and drop off, leaving holes in the leaves. This affects the vigour and yield of the plant.


Damaged host plants by Hadda/Epilachna beetle

Integrated Pest Management

1. In the early infestation, collect the grubs and adults and destroy them in kerosinized water.

2. Grow resist genotype/cultivars available in the region. Varieties such as Arka shirish, Hissar selection 14 and Shankar vijay have been reported to be tolerant or resistant to epilachna beetle especially *E. Vigintionctopunctata*.

3. Maintain the population of natural enemies viz. *Pediobius foveolatus* (Crawford).

4. Release of parasitoids such as *Tetrastichus ovulorum* Ferr. and *Achrysocharis appannai* to the crop to parasitize the eggs of Epilachna beetle (For grubs *Solindenia vermai*, *Pleurotropis epilachinae*, *Tetrastichus* sps, *Uga menoni*, while pupa is parasitized by *Pleurotropis foveolatus*).

5. Use wood ash on leaves to keep grubs and adults away from the host plants.

6. Spay 5% Neem Seed Kernel Extract (NSKE) or Neem oil 2% at fortnightly intervals or make the solution of 1 lit of neem oil with 60 g of soap dissolved in ½ L. of water.

7. In the severe infestation, spray the crop with suitable pesticides viz. Carbaryl 50WP (0.2%), Fipronil 5SC and Lamda cyhalothrin 5SC or dusting of Carbaryl 10D @ 20 kg/ha.

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Annual Growth Rate in Cost of Cultivation of Principal Crops with Major Emphasis on Cereals

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Introduction

The cost of cultivation of crops has been increasing over the years because of increase in wage rate of labour, input prices and other managerial costs (Narayanamoorthy, 2007; Raghvan, 2008). Previous studies have unanimously reported rising input cost as a major cause for agrarian distress. Among all the strong measures needed to harness all possible sources for agricultural growth, resource use efficiency and minimizing cost of cultivation/production is critical. This is particularly important from the perspective of enhancing net returns from a farming activity. The cost of cultivation has been on the rise, eroding the profits. Lowering the costs without compromising on the output can increase the net income. It is possible to do so as there is a general tendency on the part of farmers to apply overdose of inputs in expectation of higher yields. Therefore, innovating input managerial solutions to maximize farmers' welfare rather than relying solely on modern farming to raise productivity and production is should be a preferred option.

Although increased productivity is necessary for augmenting the farm income, many fails to understand that rising productivity alone would not help to increase the farm income since it depends upon many other factors. Well-structured market is a key requirement for raising farm income. If procurement arrangements are not made adequately at appropriate time, any amount of increase in productivity would not benefit the farmers. Similarly, if the increase in cost of cultivation is higher than that of the income realised through increased productivity, then farmers would not get benefitted from increased productivity. According to the latest available data in Situation Assessment Survey of Agricultural Households conducted by the National Sample Survey Office (NSSSAS), nearly half of the farmers' income comes from crop cultivation. The economic viability of crop production sector, therefore, becomes an essential condition to sustain interests of the farming community. In this context, accurate information on the cost of cultivation (COC) is indispensable. In this regard, one among the 7- pronged strategies for Doubling of Income, which is the cost of cultivation component is analysed throughout this section.

Cost of Cultivation

The Commission for Agricultural Costs and Prices (CACP) mainly uses the cost of cultivation data as a supplementary tool. Eight types of cost concepts are used for working out the alternative incomes from crop production based on the cost of cultivation survey data.

Among these costs, Cost A2 is the paid-out cost and is widely used for analytical purposes to track changes in the welfare of farmers. Cost A2 includes all actual expenses in cash and kind incurred by cultivators, and the rent paid for leased-in land. However, the CACP uses the total (full) cost given in the form of Cost C2 for fixing of the minimum support price.

The Cost C2 includes the rental value of owned land and interest on fixed capital. These cost components have been estimated through the method of imputation, which is considered to be defective as it does not reflect the actual prevalent rates. Nevertheless, Cost C2 is also used to analyse the changes in crop income.

Accordingly, in this section, Cost C2 of principal crops are taken to compute Compound Growth Rate as shown in Table 1. Table 1. Compound Growth Rate of Cost C2 of principal crops (percent/annum):

CROP	1996-97 to 2005-06	2006-07 to 2015-16
Paddy	4.73	10.33
Wheat	4.19	7.86
Maize	5.34	13.49
Cotton	4.86	10.18
Gram	4.54	10.57
Redgram	7.51	13.46
Groundnut	3.89	13.28
Soyabean	4.25	9.33

Source: Computed using data from CACP (various years)

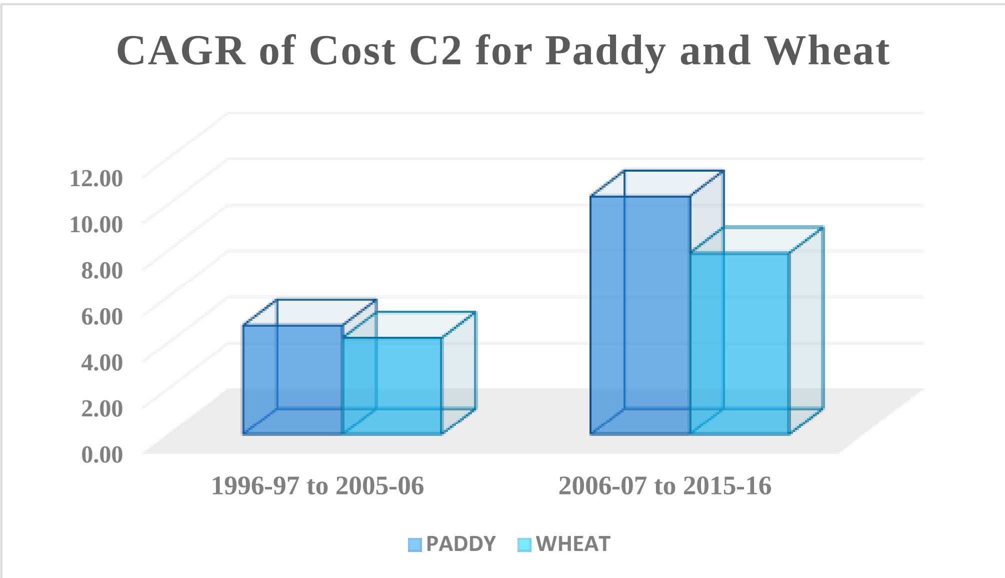
Cereals

Paddy and wheat are the major cereals produced in the country and are corner stones of national food security. The cost of cultivation computed from the major producing states of paddy (Andhra Pradesh, Punjab, Uttar Pradesh and West Bengal) and wheat (Uttar Pradesh, Madhya Pradesh, Punjab and Haryana) gives the national average for the respective crops. From the table it is very clear that the cost of cultivation for the crops has increased to more than two folds.

For paddy, during the period 1996-97 to 2005-06, the compound growth rate in Cost C2 was 4.73 percent whereas during 2006-07 to 2015-16 period, the growth rate shows an alarming figure of 10.33 percent. Similarly, in case of wheat the growth rate during the same period ranges from 4.19 to 7.86.

In several literatures it is mentioned that use of high yielding varieties may be the reason for increase in cost of these crops. The seed used for wheat in Haryana has also declined in the last decade. However, the use of the planting material for wheat has increased marginally in other major producing states over the same time period. The share of seed cost in total operational cost has marginally changed or remained constant in case of both the major crops. It is noteworthy to mention, that the share of seed cost in case of paddy has been comparatively lower than that of wheat in their respective major producing states, indicating that the planting material of paddy is more cost efficient than that of another major cereal i.e. wheat (Report on DFI,2017). It is no gainsay, that human labour accounts for a prominent share in operational cost in paddy cultivation. In case of wheat, unlike paddy, both human and machine labour constitutes a major cost component. Extensive mechanization prevails in wheat cultivation in Punjab. In Punjab alone, CAGR for Cost C2 of paddy was 6.08 percent during 1970-71 to 1995-1996 and 7.29 during 1995-96 to 2013-14 (A. Narayanamoorthy, 2016).

In case of Maize, the growth rate is ranging from 5.34 to 13.49 during the periods under consideration.



Conclusion

There is no doubt that any increase in productivity of crops would definitely benefit the farmers. However, augmenting productivity of crops is only a necessary condition but not a sufficient condition to increase the farm income. Without adopting new technologies in crops cultivation, productivity of crops cannot be increased significantly. Farmers would hesitate to adopt the new technologies unless they are capable of generating increased income with reduced cost. Increased cost of cultivation (not only costs A2 but C2 as well) has been the major issue encountered by the farmers in the recent years, which needs to be controlled by all means. Even if MSP is announced in consonance with the cost of cultivation (cost C2) for crops, it would not guarantee better income for farmers unless procurement infrastructures are strengthened sufficiently.

There is a need to catalogue all such practices which reduce the cost of cultivation, and then take up large-scale multi-location on-farm trials, let tens of thousands of on-farm trials take place, these will spur a revolution of bottom-up extremely affordable farming solutions. Wherever, farmers knowledge can be blended with the solutions developed by agricultural and other scientists, we should encourage that.

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Ways to Maximize Nitrogen Use Efficiency of Fertilizers

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Introduction

Use of any fertilizer, both inorganic and organic form, can pose a threat to the environment if misused. Nitrogen (N), an essential nutrient for growth and development of plants, is added to agricultural fields to boost crop yields but is also limiting in the aquatic ecosystems. For example, accelerated surface water eutrophication, algal blooms, hypoxia, and public health issues due to consumption of contaminated groundwater have been linked to enrichment of excess use of N (and/or phosphorous, P) that can be lost to the environment through leaching to the groundwater, and transportation to the nearby surface waters via surface runoff or directly via tile drainage bypassing stream buffer. In addition, significant fractions of the applied N are lost in the air through emission of ammonia (NH_3), which contributes to eutrophication and acidification when redeposited on the land; nitrous oxide (N_2O) is a potent greenhouse gas; and nitric oxide (NO) plays a role in tropospheric ozone chemistry. These losses can be reduced by adoption of appropriate methods or best management practices that increase the accessibility of N for plant use, enhance plants' N uptake ability, and match nutrient applications with agronomic needs. Thus, the challenge with farming would be balancing crop-nutrient requirements while minimizing losses to maintain a sustainable environment and economic benefits to the farmers.

Current Nitrogen Fertilizer Demand and Nutrient Use Efficiency

Total global consumption of N fertilizer was 112.5 million tons in 2015 and is projected to reach 118.2 million tonnes in 2019 with world population growth (likely to reach 7.9– 10.5 billion by 2050 and the need for food, feed, fibre, and fuel. It is reported that China, India and Pakistan together consume approximately 70% of nitrogen fertilizer consumed globally. These figures of nitrogen fertilizer consumption point towards emerging environmental pollution issues. The estimated food production demands would require application of N fertilizer to the tune of 116.0 million tonnes in 2016 and 58% of it would be required in Asia alone of which India's share would be 30% (FAO Report, 2012). The consumption of N fertilizer in form of urea has increased many folds after green revolution in India Although large amounts of N fertilizers were used throughout the world, the recovery or efficiency of N fertilizers by crops in arable lands is relatively low, ranging from 25% to 50% of the applied N. Low nitrogen use efficiency (NUE) may lead to an alarming situation from environmental, economic, and resource conservation points of view, and suggests an urgent need for improving N use efficiency (NUE).

Reasons Behind for Low Nitrogen Use Efficiency

1. Indiscriminate use of nitrogen fertilizers: Indian agriculture practices are coming from ancient times and depends mainly on conventional methods of fertilizer application like broadcasting alone or mixed with seeds manually. This method is unscientific and on one hand leads to consumption of excessive fertilizer quantity that the required or recommended levels and on the other hand leads to leaching and runoff losses.

2. Lack of knowledge: Most of the farmers are illiterate and unaware of modern tools and techniques used in agriculture.

3. Nutrient status of field: There is lot of variations in soil type and health because of vast area and different topographies of the country. Even at district level there are tremendous variations in soil nutrient status. Hence, a majority of farmers do not know the soil nutrient status and also unaware of the importance of knowing it. Application of fertilizers without knowing the soil nutrient supplying ability also leads to excess use and wastage of fertilizers.

4. Farmer's greediness: As increased application of N increases overall biomass and healthiness of crop canopy and gives an impression of attractive dark green attractive look. Hence, farmers unnecessarily apply overdose of N only for the sake of high biomass, yield and money.

5. Government subsidy schemes: Nutrient based subsidy scheme reduced the price of unit cost of nitrogenous fertilizers in the market leads to higher availability of fertilizers to the farmers in their home towns. Hence, farmers are applying more amount of fertilizers to crops.

6. Poor Extension Activities: Supply of desired inputs and transfer of technology from farm institutions to the farmer is very poor.

Conventional Methods to Improve Nitrogen Use Efficiency

1. Use of organic manures and biofertilizers to supplement nutrients and also to bring ideal conditions for crop growth.
2. Inclusion of legumes in the cropping system as intercrop.
3. The crops should be irrigated at least to save life at critical growth stages.
4. Fertilizer scheduling must be based on soil test values to prevent nutrient deficiencies or luxury consumption.
5. Split application of nitrogen fertilizers based on crop requirement.
6. Under stressed condition, supplement of 2% urea foliar application.

Modern Tools of Precision Nitrogen Management

It is very essential to have knowledge on economic and efficient use of nitrogenous fertilizers so that many adverse effects of excess N usage on living organisms may be avoided without compromising on yield. A large number of new technologies have evolved and are continuously being used in educating farmers on economic use of nitrogen fertilizers and some of these tools and techniques are discussed below for the benefits of farmers.

1. Chlorophyll meter: For grower, knowing the N requirement of plant enables the proper amount of N fertilizer supply to be managed. Some experiments shown that the chlorophyll meter (SPAD Meter) contributed to reductions in the use of N fertilizer by tens of per cents with no loss in yield. By optimizing the N fertilization efficiency in the field, proper N fertilizer management reduces the possibility of excessive supply of fertilizer, which can cause diseases in plants and environmental contamination. There is increasing awareness of the need for applying the proper amount of N fertilizer in respect to water contamination in both flowing streams and underground water due to nutrient leaching through the field's soil. The chlorophyll meter is playing a significant role in day to day development of N fertilizer application techniques.

2. Leaf Colour Chart (LCC): The LCC is usually a plastic, ruler-shaped strip containing four or more panels that range in colour from yellowish green to dark green. LCC was developed by IRRI (International Rice Research Institute) and also by FRRI (Philippines Rice Research Institute). In India these charts are provided by Nitrogen parameters which provide guidance to the farmers regarding improved Nitrogen (N) management. Nitrogen is applied by the farmers in rice plants at different growth stages, but the amount of N to be applied and the time of applications vary substantially. LCC helps to synchronize N application with the real time and quantity demand of the rice crop. Helps to prevent under or over usage of N in rice plants.

3. Green seeker: The Green Seeker handheld crop sensor is an affordable, easy-to-use measurement device that can be used to assess the health or vigor of a crop. Readings taken by the Green Seeker handheld can be used to make non-subjective decisions regarding the amount of fertilizer to be applied to a crop, resulting in a more efficient use of fertilizer - a benefit to both a farmer's bottom line and the environment. The strength of the detected light is a direct indicator of the plant's vigor.

The sensor displays the measured value in terms of an NDVI reading on its LCD display screen. NDVI readings can range from 0.00 to 0.99; the higher the reading, the healthier the plant.

NDVI = (NIRreflected– Redreflected)/(NIRreflected + Redreflected)

Green Seeker is an excellent indicator of biomass (amount of living plant tissue) and is used to accurately project yield potential.

4. Fertigation: Recent methods of application like fertigation would help in increasing the nutrient use efficiency along with reducing the losses. Fertigation is a method of fertilizer application in which fertilizer is incorporated within the irrigation water by the drip system. In this system fertilizer solution is distributed evenly in irrigation. The availability of nutrients is very high therefore the efficiency is more. In this method liquid fertilizer as well as water soluble fertilizers are used. By this method, fertilizer use efficiency is increased from 80 to 90 per cent. Practicing fertigation is beneficial to farmers in timely and site-specific application of nutrients. Application of exact quantity of fertilizers according to soil nutrient status based on soil tests will not only result in proper supply of deficient nutrient elements essential for profitable crop production but also saves cost by supply of precise amount of nutrients as per the nutrient supplying capacity of the soil.

5. Neem coated urea & slow releasing urea: By using neem coated urea, we can reduce the cost on urea input and also reduce the input cost of insecticides as neem is a natural insecticide. Hence, we can reduce the import of urea as it reduces the leaching of N in the soil and denitrification process. We can also use the synthetic polymers which reduces leaching as the water has to go through the small pores of polymer to reach the urea granules and also decreases the volatile nature of urea.

Conclusion

In long-term prospectus, the use of optical sensors may help in improving NUE and farmer profit only when precise data are collected from multiple sites considering soil, climate, and cultural practice variability and then a robust yield can be achieved. Sensor-based in nitrogen management combined with a soil testing approach at the beginning of crop planting, and a split application might be the answer to improve nitrogen use efficiency.

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Advance Seed Multiplication Techniques and Seed Standard for Sugarcane

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The Seed Act passed by the Indian Parliament in 1966 and subsequent orders/ amendments such as the Seeds (Control) Order, 1983, Seed Bill, 2004, etc are meant to regulate the quality of seeds for sale, import and export and to facilitate production and supply of quality seeds to farmers. Under the Seed Act the minimum seed certification standard, which are achievable by the seed producers and at the same time high enough to meet the needs of the cultivator, have been notified.

The minimum seed certification standards consist of two parts:
1. The general seed certification standards-requirement which are basic and applicable to all the crops under certification.
2. The specific certification standards requirement, which are applicable to only to a crop or group of crops.

Many sugarcane varieties have been notified under the Seed Act, but so far there is no certification of sugarcane seed by any agency probably due to the bulkiness and non-storability of seed cane which makes difficult to pack, seal, certify and transport. To formulate standards for seed cane, a task force was constituted in 1978 under the chairmanship of Dr. Kishan Singh, former Director of IISR, Lucknow. After several round of discussion, the draft was finalized and was adopted for the first time by the Indian Standard Institution (ISI) on December, 1966 and published as ISI: 3866-1966, “Specification for Sugarcane Seed Materials”. The draft was also published in 1990 by the IISR as “Standards for Sugarcane Seed Material” (see Technical Bulletin No 25). The field and seed standards for sugarcane planting material were reviewed by a committee constituted by the ICAR in 1999. The draft was approved by the Technical Committee of Central Seed Certification Board in October 2001 and later notified by the Central Seed Certification Board. The approved seed cane standards along with general seed certification standards as applicable for sugarcane are presented below. General seed cane certification standards.

Classes of Seeds

As followed in other crops, four generation systems of seed multiplication namely, nucleus seed, breeder seed, foundation seed and certified seed can be adopted for the conventional system of seed production in sugarcane using the stem cutting called ‘setts’.

1. Nucleus seed: It is the genetically puree seed of a variety, expected to have all the unique economic and diagnostic characteristic of a variety which distinguish it from other varieties. It is the basic seed produced and maintained by the breeder / research station which originally evolved the variety. The production of nucleus seeds of sugarcane should be done in cane-torow method of planting. In case of any variation with respect to any morphological attributes and incidence of pests and diseases, the whole row should be rejected and uprooted. Nucleus seed forms source for breeder seed.

2. Breeders seed: Breeder seed in sugarcane refer to the propagating materials i.e. setts produced from the nucleus seeds by a breeder who bred the variety or by a research station / university from where it was released. Production of breeder seed in research station is the best way of maintaining genetic purity over a longer period. Breeder seed is exempted from certification (Table). However, the breeder seed production plot is monitored at appropriate time by the breeder or by a team of experts. In case a sugarcane variety has spread to a larger area from the research station originally bred this variety, it would not be possible for the 2 station to produce and supply huge demand of the breeder seed. In that case, another breeder /research station can be designated at two or three locations in each States where the variety has spread. But the originating institute will have to assume the responsibility of maintaining the prototype and ensure supply of basic seed material to the sponsored breeders. The breeder seeds should confirm to the highest standard of 100% genetic purity so as to guarantee that in the subsequent generation of seed shall confirm to the prescribed standards. It is always better to produce breeder seed from the heat-treated seed materials at least once in 3-4 years. The planting of setts shall be done in 10-15 m long rows for controlled irrigation and leaving about 1.5 meters path after 5 rows for easy inspection and monitoring of the crop from time to time. Periodical inspection, say once in a month, and rouging of off types, if any, is an important operation in breeder seed production plot. Strict watch has to be kept for the occurrence of any pest and immediate control measures shall be initiated.

Table 1. Classes of seeds applicable for sugarcane seed production programme

*Commercial Production: Produced from certified seed at Farmers' field Certification Not always Replace the certified seeds after 3-4 cycles of crop with fresh lot of certified seed:

Classes of seeds	Seed Source	Place of production	Responsibility for maintaining purity	Certification	Remarks
Nucleus seed	Research station or breeder who developed it. Use heat treated seed	Research Centre	Concerned breeder or research Centre	Exempted	The explants for tissue culture derived plantlets are taken from nucleus seed
Breeder seed	Use heat treated seed, if not done at nucleus seed stage. The tissue culture derived planting material is designated as breeder seed.	Research Centre	Concerned breeder or research Centre	Exempted	Primary nursery is raised from breeder seed
Foundation seed	Produced from breeder seed or tissue culture derived planting material	Govt. Seed Farm, Sugar Factory Farm and progressive farmers' field	Research Centre / State Dept. Of Agriculture / State Cane Development Dept. / Sugar factories	Concerned breeder / Expert team / competent authority	
Certified seed	Produced from foundation seed or tissue culture derived planting material	Certified seed growers and progressive farmers	State Dept. Of Agriculture / State Cane Development Dept. / Sugar factories	State Seed Certification Agency	

Foundation Seed

This is the 3rd stage of sugarcane seed production chain. Foundation seed shall be produced from the breeder seed under the supervision of breeder (original / sponsored). The requirement of foundation seed of a variety would be high depending upon the spread of the variety. The facilities at research station may not permit such a large-scale production of foundation seed therefore; it is produced in Govt. seed farms or farms of sugar 3 mills or in progressive farmers' field. Periodical inspection and monitoring of crop by a competent and qualified person is essential to maintain varietal purity. Apart from maintaining varietal purity through regular rouging and so on, the seed crop shall be kept free of known seed borne diseases and pests. Heat therapy can be done, if it was not adopted at breeder seed stage. For foundation seed production planting may be done as in breeder seed but the path of 1.5 m may be left at every 10 rows. Foundation seeds can be harvested at 6-8-month age and supplied for certified seed cane production.

Certified Seed

The foundation seed so produced would be handed over to the state Department / sugar factories for organizing certified seed production in farmer's field. Regular inspection of seed production plots is necessary to ensure genetic purity and health of seed crop. The certified seed plot will be inspected and certified by the State Seed Certification Agencies. For commercial cultivation certified seed should be used. It is desirable to replace the certified seeds after 3-4 cycles of crop with another batch of certified seeds.

Certification procedures first sampling and field counts: here at least five counts may be taken up to an area of 5 acres and an additional count is taken for each additional 5 acres (Chowdhury, 2007). Number of plants observed in one count is 100. The procedure for taking counts in sugarcane and drawing seed samples for testing purity, moisture content and germination test are given below.

1. Enter the seed field at a randomly selected site from any side and determine the average number of plants per step. This process should be repeated at five random locations and average number of plants per step is calculated. Follow IISR, 1990. Standards for Sugarcane Seed Material. Technical Bulletin No. 25, Indian Institute of sugarcane Research, Lucknow and DBT. 2006. Sugarcane- Tissue Culture–(STC)-Standards. Available at http:// dbt guidelines at dbtncstcp.nic.in/downloads/Sugarecane.pdf

2. Sampling and field counts: Five counts may be taken up to an area of 5 acres and an additional count is taken for each additional 5 acres (Chowdhury, 2007). Number of plants observed in one count is 100. The procedure for taking counts in sugarcane and drawing seed samples for testing purity, moisture content and germination test are given below.

3. Enter the seed field at a randomly selected site from any side and determine the average number of plants per step. This process should be repeated at five random locations and average number of plants per step is calculated.

Determine the number of steps required including sufficient plants i.e. 100 per count, for 5 counts in 5 acres.

4. Walk through the field according to counting scheme given for wide spaced row crops, so that all the portion of the field are represented in the counts.

5. Select at random any row and any point in that row, start moving in the direction of the row take enough consecutive steps to include sufficient number of plants, say 20. Count the number of off-types, lodged cane and plants affected by designated diseases and pests within the say 20 plants. Simultaneously, the sample can be cut for seed testing.

6. Cross over the pre-determined number of rows (say 3 rows) and again start counting 20 consecutive plants from a point nearly parallel to the last plant counted in the previous rows. Count the factors mentioned above.

7. Repeat the process as many times as required to include the desired number of plants (say, 100). This completed one count. 7. Repeat the entire process until the number required for the field size is completed (say 5 counts / 5 acres).

Seed Inspection Report

The format of seed inspection report is given below:
Name of the Area / code:
Name & address of the farmers:
Survey number:
Date of Inspection:
Stage of seed:

	Particulars	Observations
1	Variety	
2	Source of breeder or Foundation Seed	
3	Planting date	
4	Planting distance (cm)	
5	Planting of (one /two/three) eye bud setts	
6	Tissue culture derived plantlets	
7	Area (ha)	
8	Previous crop, if any	
9	Plants affected by designated insect pests (Top borer, internode borer stalk borer, woolly aphid, scale insect, mealy bug, white fly	
10	Plants affected by designated diseases (Red rot, grassy shoot, Wilt, leaf Scald and Smut)	
11	Off type plants / stool (%)	
12	Lodging	
13	Bud sprouting (%)	
14	Crop vigour, deficiency symptoms, etc	
15	Instructions	
16	Remarks: Whether the plot meets the certification Standard or not	

*Absence of pest and disease at the time of seed inspection. Signature of Inspecting Officer(s)

Specific Standards for Seed Cane

The general seed cane certification standards are basic and together with the following specific standards constitute the standards for certification of sugarcane seed cane.

1. Age of the seed cane: The age of the crop harvested for seed purpose shall be 6 to 8 months for planting in tropical states and 8 to 10 months in subtropics. It shall not include any portion either the floral axis or three internodes below the highest node of a flowered cane and in the age of 12 months the lowest ½ portion may be rejected.

2. Appearance and physical purity: Physical purity of seed should be 98 per cent. Seed cane should be undamaged and reasonably clean. The crop should not have more than 10 per cent lodged canes. De-trashing is not recommended for seed crop. The maximum permissible limits for the striping of dry foliage shall be 2.0 %. Seed canes should not have aerial roots / nodal roots. In water-logged areas relaxation may be given up to a maximum of 5 per cent.

3. Sett moisture content: Moisture in seed cane should not be less than 65 per cent on wet weight basis. Moisture content of seed cane can be tested by following method. Using a sharp knife cut the middle-most internode of the stalk transversely into 4 cm thick pieces (sample). Place the sample inside a perforated paper bag and take the weight immediately (fresh weight). Ovens dry the paper bag containing samples at 80º C for 120 hrs. Remove the samples from oven and record its weight (dry weight) after keeping the samples in desiccators for 10 minutes at room temperature. The moisture content of the sample can be worked out as per the formula mentioned below.

$$\text{Moisture content (\%)} = \frac{\text{Fresh weight - Dry weight}}{\text{Fresh weight}} \times 100$$

Digital moisture meter can also be used for determining moisture content.

4. Genetic Purity: The seed material shall be of only one variety. No admixture is permitted. The genetic purity of seed cane should be 100 per cent. E. Germination: Germinability of buds should not be less than 85 per cent. Although the details on sample size and procedure for germination test have not yet notified, the procedure tested at AICRP (Sugarcane) Centres may be adopted as time being. The methodology for conducting germination test for seed certification has been standardized at Sugarcane breeding Institute, Coimbatore (Rajendra Prasad, 2005). It is presented below. General:

a. The standard seed germination for sugarcane setts shall be conducted using sterilized sand as the medium.

b. The test may be conducted either in the germination room under the controlled conditions either on sand beds or enamel/plastic trays (45 cm x 30 cm) filled with sand or in the seed germinator using enamel trays (45 cm x 30 cm) filled with sand for conducting germination test.

c. The germination room should maintain 30 O C temperatures and 90% relative humidity.

i. Germination test in sand bed Take 20 canes from the seed sample collected at random from seed plot. Prepare 200 single budded setts of equal size (leaving 1” of internode on either side of bud) taken from all the portions of the cane. Prepare sand beds of 6’ x 3’ size using pure, sterilized sand and divide the bed into 10 blocks each one to be a replicate. Allot 20 single budded setts to each block and do planting of the setts at a uniform depth of 1 cm from soil surface in horizontal position with bud facing upwards and cover them with 1” sand. Water the sand bed every day to maintain optimum soil moisture. Count the number of buds germinated giving rise to normal, healthy roots and shoots on 7 th and 10 th day. Do not count the abnormal seedlings that are damaged, deformed and decayed. Calculate the germination percent. Compare the final germination percent with the prescribed seed standard of 85 %.

ii. Germination in Enamel or Plastic trays Take 20 canes from the seed sample collected at random from seed plot. Prepare 200 single budded sets of equal size (leaving 1” of internode on either side of bud) taken from all the portions of the cane. Fill 10 Enamel or Plastic trays (45 cm x 30 cm) with pure, sterilized sand each one to be a replicate. Provide a small drainage hole at the bottom of each tray. Do planting of the setts @ 20 single budded setts/tray, at a uniform depth of 1 cm from soil surface in horizontal position with bud facing upwards and cover them with 1” sand. Water the trays every day to maintain optimum soil moisture. Count the number of buds germinated giving rise to normal, healthy roots and are shoots on 7th and 10th day. Do not count the abnormal seedlings that are damaged, deformed and decayed. Calculate the germination percent. Compare the final germination percent with the prescribed seed certification standard of 85 %.

5. Bud quality: Each node of a seed cane shall bear one viable bud. The number of nodes without sound buds shall not exceed 5 per cent (by number) of the total number of buds in a stalk. The number of buds which are swollen or have projected beyond 1 cm from the rind surface shall not exceed 5 per cent (by number) of total number of buds.

6. Seed Source: The certified classes will be produced from seed cane and/or many clones whose sources and identity may be assured and approved by the certification agency.

7. Land Requirements:

a. A seed crop of sugarcane shall not be eligible for certification if planted on land on which sugarcane was grown in the previous season.

b. Land/seed crop shall be kept free from sugarcane residues and drainage from other sugarcane fields.

I. Heat Treatments: Foundation stage shall be raised from heat-treated seed cane.

8. Field Inspection: A minimum of three inspections shall be made as under:

a. Stage-1: The first inspection shall be made at 45-60 days after planting to verify isolation and detect volunteer plants, designated diseases and pests and other relevant factors.

b. Stage-2: The second inspection shall be made at 120-130 days after planting to verify off-types, designated diseases and pests and other relevant factors.

c. Stage-3: The third inspection shall be made 15 days prior to the harvesting of seed canes to verify the age of cane, off-types, designated diseases and pests and other relevant factors.

Whenever, the off-types and diseased plants are noticed it should be rouged out along with roots and destroyed.

9. Field Standards:

a. General Requirements-Isolation: The sugarcane seed production fields shall be isolated from other fields with a minimum distance of 5 m to avoid mechanical mixture of other varieties.

b. Specific requirement:

		Stage of field inspection	Maximum permissible limit %	
			Foundation seed	Certified seed
1	Off-type	1,2 &3	None	None
2	Plants affected by designated diseases			
	a) Red rot: *Glomerella tucumanensis* Speg. Arx & Muller.	1,2 & 3	None	None
	b) Smut: *Ustilago scitaminea Sydow*	1 2 3	0.02* 0.01* None	0.10* 0.10* None
	c) Grassy shoot: Caused by MLO	2 3	0.05* None	0.05* None
	Leaf scald: *Xanthomonas albilineans*. (Ashby) Dowson	3	0.01*	0.01*
3	Plants affected by designated insect pests			
	a)Top borer: *Scirpophaga excerptalis* walker	2 & 3	5.0	5.0
	b) Internode borer: *Chilo sacchariphagus indicus* Kapur	3	10.0# None**	20.0 None**
	c)Stalk borer: *Chilo auricilius* Dudgeon	3	20.0+ None**	20.0 None**
	d)Plassey borer: *Chilo tumidicostalis* Hampson Gurudaspur borer: *Acigona steniellus* Hampson Scale insect: *Melanaspis glomerata* Green Mealy bug: *Sacchariphagus sacchari* Cockerell	3	5.0 None**	5.0 None**
Around 10% affected internodes. * Subject to immediate rouging of the whole clump + Around 0.5% affected internodes. ** In area where the presence of the pest has not been recorded.				

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Brinjal Shoot and Fruit Borer, *Leucinodes orbonalis* G.: A Serious Pest of Brinjal, *Solanum melongena* L.

Article ID: 31665

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Introduction

Brinjal or eggplant (*Solanum melongena* L.) is a common and popular vegetable crop grown in the subtropics and tropics (Sarker *et al*., 2006) and one the major vegetable crop in India. It is a native of India and is grown throughout the country. It can be grown in all the seasons having sufficient amount of moisture in the soil. It is being cultivated in an area of about 733 thousand hectares in India with a production of 13510 thousand MT (Anonymous, 2019). As this is the fruit vegetable, various major and minor insect pests viz. shoot and fruit borer (*Leucinodes orbonalis* G.), epilachna beetle (*Epilachna vigintioctopunctata*), jassids (*Amrasca biguttula biguttula*), leaf roller (*Eublemma olivacae*), aphids (*Aphis gossypii*), white fly (*Bemisia tabaci*) are found attacking on this crop. But among them, brinjal shoot and fruit borer (*L. orbonalis*) has been recorded as major and most destructive pest. Chemical control is widely used for controlling insect pests in brinjal which gives quick result. Repeated use of synthetic chemicals creates environmental contamination, Due to indiscriminate use of insecticides, Brinjal shoot and fruit borer has developed resistance to many insecticides. Hence, there is an urgent need to look for other and safer method to manage this pest.

Brinjal shoot and fruit borer, *Leucinodes orbonalis* G. is the most damaging insect pest of genus Pyralidae under order Lepidoptera. This pest is active throughout the year at places having moderate climate but it is adversely affected by severe cold. It is found throughout the tropics in Asia and Africa, where it can reduce yield by as much as 70%. It is a serious pest of brinjal throughout the India and Bangladesh (NBAIR, 2020). Yield losses reaching as high as 85-90% (Patnaik, 2000; Mishra 2008; Jagginavar *et al*., 2009). Hence, the farmers in the region rely exclusively on the application of chemical insecticides to combat shoot and fruit borer, which has resulted into a pesticides resistance, resurgence, secondary pest outbreak, environmental contamination, residual toxicity and toxicity to beneficial organisms in an attempt to produce damage-free marketable fruits. Despite intensive insecticide applications, the pest cannot be controlled due to its resistance to commonly used pesticides. The new generation of pesticides molecules have been claimed to be effective as well as safer for non- target organisms (Tonishi et al., 2005; Hall 2007; Sontakke et al., 2007; Mishra, 2008).

Life Cycle: This pest completes its life cycle with four different stages viz., the egg, the grub, the pupa and the adult.

The Eggs: The female adult moth lays 5 to 242 eggs singly or in batches on the lower leaf surface, stem, calyx and flowers. Eggs are oval or elongated in shape and creamy white in colour. The egg period is of about 1 week.

The Larva: The larva is creamy white to pinkish in colour. The full-grown larva (12 mm) is pinkish in colour with sparse hairs on the warts on the body and blackish head. The larva usually passes through five instars, sometimes six. The larval period is about 2 weeks.

The Pupa: The pupation takes place in the boat shaped silken cocoon on plant debris or on the soil surface. The pupal period varies from 7 to 10 days. The caterpillar hibernates in silken cocoon.

The Adult: The adult moth is medium sized (20 mm), white or dirty white with pale brown spots on the dorsum of thorax and abdomen. The head and thorax are blackish brown. Wings are white with brown and black patches on the forewings. The female moth tends to curl its abdomen upwards. The adult life span is 5-7 days.

In this way, *L. orbonalis* G. completes their 5 to 6 generations in a one year.

Fig. Life cycle of brinjal shoot and fruit borer

Nature of Damage

Newly hatched larvae enter the petiole/midrib of large leaves, young shoots, buds or fruits and there is no visible sign of entry. During the early vegetative phase larva feeds on the tender shoots due to which shoots bend down and withers. Later, entry into the fruit is made from underside of calyx. Larva plugged the entry hole with their excreta after boring. Thereafter, they feed on inner content and filled the feeded portion with their excreta. This results into the wilting of young shoots, drying and drop off. Plant growth also stunted. One larva damage about four to six fruits during larval period. Larval stage causes the damage varies from 30 to 90 per cent and vitamin C content.

	
Infested brinjal fruit	**Infested shoot of brinjal**

Integrated Pest Management

1. Adopt crop rotation to break the chain of pest.
2. Collect all the fallen infested fruits and destroy it.
3. Remove all infested branches and fruits showing boreholes as early as possible to prevent the infestation to healthy fruits and branches.
4. Grow the varieties with long and narrow fruits in endemic areas.
5. Grow resistant varieties viz., Pusa Purple Long, Pusa Purple Cluster, Pusa Purple Round, Aushey, Arka Kesav, Punjab Barsati, Punjab Chamkila and Doli-5.
6. Install pheromone traps @ 12 traps/ha during crop period.
7. Larvae of *L. orbonalis* G. commonly parasitized by *Trathala flavoorbitalis* Cameron (NBAIR, 2020).
8. Application of Neem cake (250 kg/ha) decreased the incidence of borer to 8 per cent and increased the yield of crop to nearly 68 per cent. (Sreenivasa Murthy et al., 2001).

9. Avoid use of synthetic pyrethroids.
10. Avoid using insecticides at the time of fruit maturation.
11. Application of Dipel 8L @ 0.2 per cent at 10 days interval reduce the shoot and fruit infestation. (Puranik et al., 2002)
12. Application of Cartap hydrochloride @ 0.1% are most effective for reducing this pest.
13. Basal application of Neem cake @ 20q/ha + foliar spray of Quinalphos 0.05 per cent reduces the fruit borer incidence.
14. In severe infestation, spray any one of the following pesticide:

Sr. No.	Pesticide	Recommended dose
1.	Azadirachtin 1.0% EC (1000 ppm)	3.0 ml/lit.
2.	Azadirachtin 0.03% WSP (300 ppm)	5.0 g/lit.
3.	Chlorpyrifos 20% EC	1.0 ml/lit.
4.	Dimethoate 30% EC	7.0 ml/10 lit.
5.	Emamectin benzoate 5% SG	4g/10lit.
6.	Phosalone 35% EC	1.5 ml/lit.
7.	Quinalphos 25% EC	1.5 ml/lit.
8.	Thiodicarb 75% WP	2.0 g/lit.
9.	Triazophos 40 % EC	2.5 ml/lit.
10.	Trichlorofon 50% EC	1.0 ml/lit.

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Non-Transformative Strategies for RNAi in Crop Protection

Article ID: 31666

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Summary

Since the earliest days of agriculture, farmers had a history of using agrochemicals to protect their crops. But, continuous and extensive use of pesticide resulted in the increasing resistance of crop pests to the established agrochemical classes. The scientists with their great intellectual energy have developed more recently gene silencing through RNAi (RNA interference) (Cagliari D et al., 2018). RNAi is a natural process present in eukaryotic cells for gene regulation and antiviral defence. But the transformative RNAi strategy should undergo regulatory rules and public acceptance and both are difficult. Therefore, a new way of non-transformative approaches might enable RNAi-based crop protection (Mitter et al., 2017). It does not allow plant to modify the DNA and will not introduce any heritable changes into the genome. Due to the instability of naked dsRNA into plant system and smaller protection window necessiated the development of bioclay. It is a combination of dsRNA loaded on layered double hydroxide nanosheets which can extend the virus protection window from 5 to at least 20 days. Hence bioclay proved to be an effective nontransformative strategy of RNAi in Crop protection.

Introduction

History of discovery of RNAi:

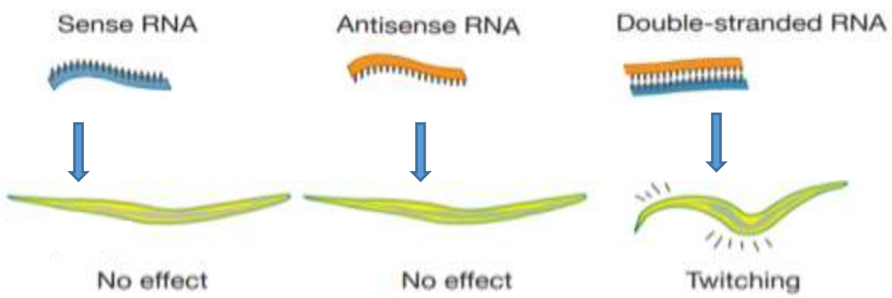


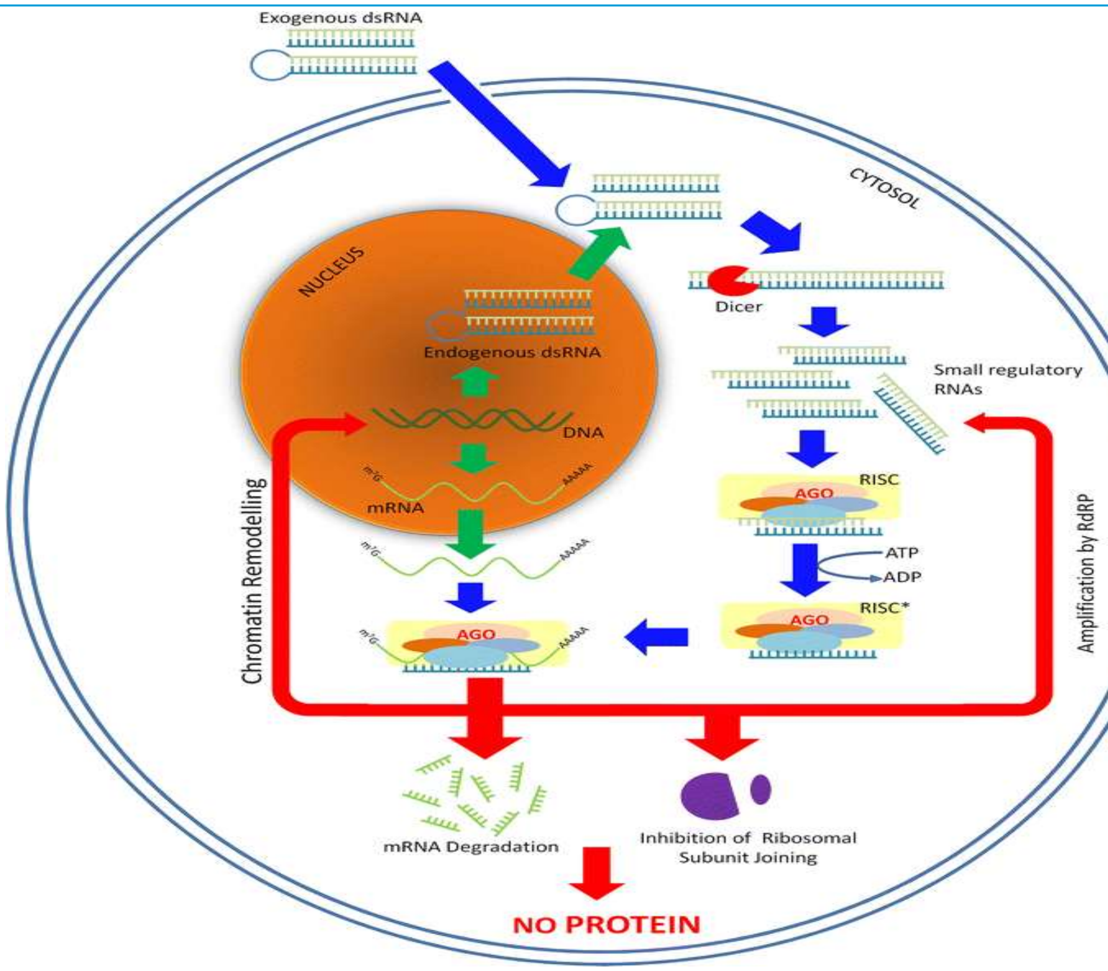
Fig.1. In 1998, Craig Mello and Andrew Fire during their experimentation with C. elegans discovered that double stranded RNA can be used to silence particular gene. They called it as RNA interference and they also received Nobel prize for their discovery in the year 2006.

RNA Interference Process

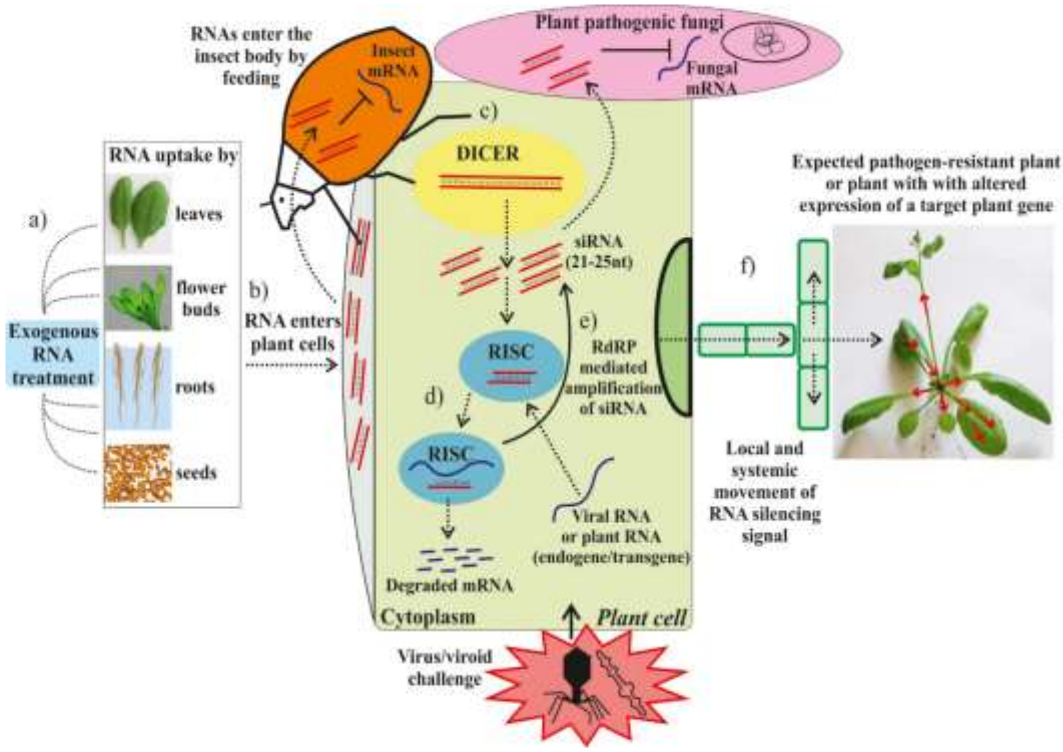
RNAi refers to double-stranded RNA (dsRNA)-mediated gene silencing that involves the blocking of the expression of specific target genes by destroying the corresponding mRNA molecules affecting only the translation process.

Fig.2. RNAi regulates the gene expression through small noncoding rnas (srnas). The dsRNA is processed into small interfering rnas (sirnas) by Dicer-2 which is ribonuclease III enzyme. Subsequently, an argonaute family protein (AGO), of the RNA-induced silencing complex (RISC), is incorporated, it cleaves the passenger (sense) strand and the guide (antisense) strand remains connected with the RISC.

With the help of RISC, the guide strand allows Watson-Crick base pairing to complementary target mRNA for cleavage of target mRNA by AGO2 protein. By this degradation of the target mRNA, specific post-transcriptional gene silencing occurs. (Saurabh et al., 2014).



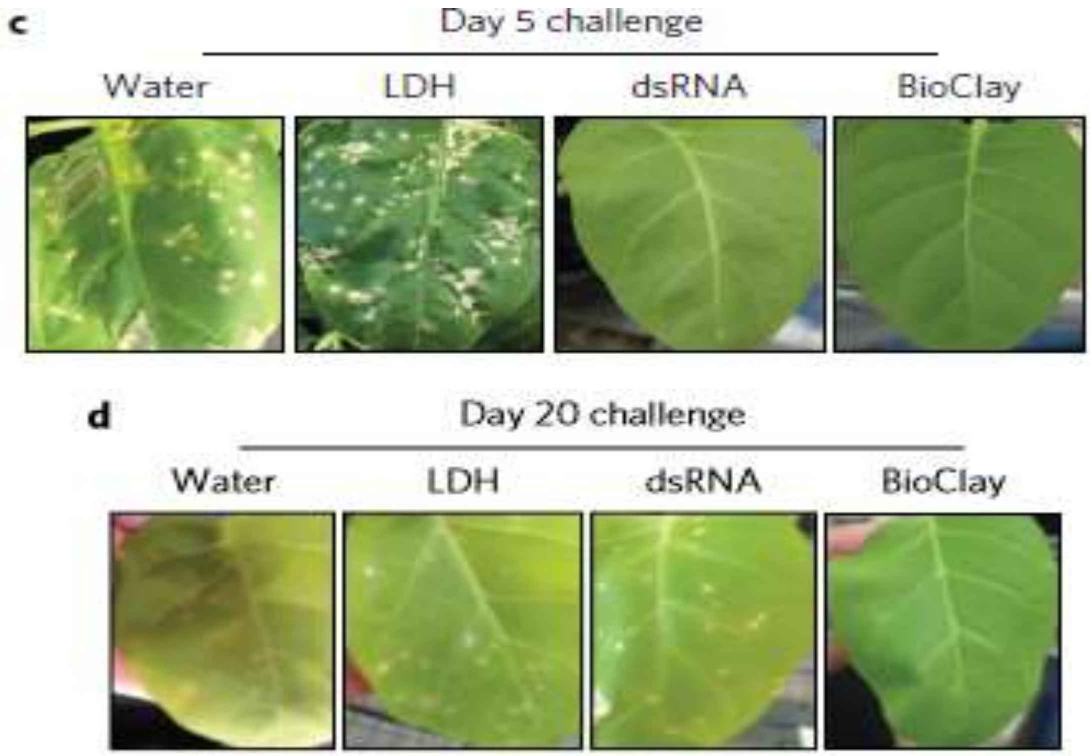
RNA Interference Process



This strategy does not allow plant to modify the DNA as in case of transformative RNA interference. The principle entails uptake of dsRNA from the environment and subsequent transport of the RNAi signal between cells and tissues in the plant body.

This (Fig 3) is the schematic representation of exogenous RNA applications for RNA interference (RNAi) induction and degradation of the target plant pathogen or endogenous plant mRNAs. (Dubrovina et al., 2019).

1. (a)Exogenous artificial RNA applied (b)It is transported into the cytoplasm (c) The dsRNA molecules are recognized by a ribonuclease, DICER-like (DICER), which cleaves the dsRNA into siRNAs. (d) they are incorporated in the RNA-induced silencing complex (RISC) (e) They are amplified into secondary siRNAs by the action of RNA-dependent RNA-polymerase (RdRP). (f) Movement of the RNA silencing signal between plant cells.



This Fig 4 c and d, depicts that when Nicotiana leaves which are treated with dsRNA and Bioclay targeting virus (Non-transformative) was inoculated with virus and naked dsRNA gave protection upto 5 days and bioclay protected upto 20 days. (Mitter et al., 2017).

Conclusion

1. GM free – no regulations, high consumer acceptance, easy topical delivery protects against virus
2. The effectiveness of the RNAi mechanism is mainly depending on the delivery, stability, and uptake of dsRNA by target species.
3. Sequence specificity helps in targeting a single gene which reduces the negative impact produced by broad-spectrum insecticides, and preserves the natural enemies and beneficial fauna in the crop area.

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Breeding for Fruit Quality Traits in Solanaceous Vegetables

Article ID: 31667

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Solanaceae family consists of 85 genera, which includes both tuberiferous and non-tuberiferous ones. Rich source of dietary vitamins, minerals, antioxidants and nutritional factors. Each crop has a specific with set of quality traits such as flavour; colour, firmness and nutritional value are becoming increasingly important in current plant breeding programmes. Quality attributes are essential components of economics yield as they determine the suitability of plant product for various uses and therefore, it is an integral part of plant breeding (Chakraborty et al., 2000).

Quality

Quality refers to the suitability or fitness of an economic plant product in relation to its end use.

Quality Traits

The various quality traits are classified into the following five broad groups:
1. Morphological traits: Shape, size, surface, color, thickness
2. Orgenoleptic traits: Taste, aroma, flavour, sweetness
3. Nutritional traits (Neutraceuticals): Beta carotene, ascorbic acid, TSS Protein , vitamins, minerals.
4. Undesirable traits: Solanine content, browning, prickliness.
5. Other traits: keeping quality, cooking quality.

Considerations in Breeding for Improved Quality

1. Improved quality should not be at the cost of yield.
2. Safeguard the economic interest of both consumers and farmers.
3. Break the negative association with lower yields.

Genetics of Quality Traits

The quality traits may be governed by:
1. Oligogenic inheritance: The inheritance is governed by one or few major genes, such gene is having a large and easily identifiable individual effect. It may be conditioned by either dominant or recessive allele of concerned genes.

2. Polygenic inheritance: When the inheritance is governed by several genes with small effect is referred to as polygenic inheritance. The characters are sensitive to environmental change and show low heritability.

3. Maternal effects: These are governed by cytoplasmic genes. Maternal effects have the same effect on the generic advance under selection as other environmental factors i.e. they confuse the correspondence between genotype and phenotype thus, reduce the progress under selection.

Inheritance Pattern of Quality Attributes

Attributes	Gene action	Crops	References
TSS	Non additive	Tomato	Hazra et al. (2017)
Acidity	Non additive	Tomato	Hazra et al. (2017)
Ascorbic acid	Non additive	Tomato	Shankar et al. (2013)
Dry matter content	Over dominance	Tomato	Shankar et al. (2013)
Carotenoids and lycopene	Over dominance	Tomato	Shankar et al. (2013)
Reducing sugar	Non additive	Tomato	Kalloo et al. (1986)
Vitamin A	Additive	Chilli	Zewdie et al. (2014)
Vitamin B	Additive and dominant	Chilli	Zewdie et al. (2014)
Capsaicin Content	Additive	Chilli	Zewdie et al. (2014)
Anthocyanin	Dominant	Brinjal	Chadha et al. (1988)

Sources of Quality Traits

1. Cultivated varieties.
2. Germplasm line.
3. Trans gene.
4. Mutants.
5. Wild relative.

CROPS	Quality traits
Tomato	Uniform and intense colour Lack of fruit cracking, Vitmin C High TSS (5.5B) or more, Low titrable acidity (0.4 -0.5), PH (4.5) Fruit flavour, texture, aroma & lycopene content Juice consistency, pericarp thickness & carotene content Fruit firmness (thick pericarp – 0.3cm and low locule number :2-3) and long shelf life/ storage.
Brinjal	Size and shape, fruit colour, fruit firmness and taste Anthocyanin & fruit phenolic contents Reduced browning and glycoalkoloids Low proportion of seeds
Chilli	Shape and appearance of fruits, flavour, thin flesh Pungency, pleasant aroma, dry matter High vitamin C Capsaicin
Potato	Low starch content Low polyphenol and alkaloid content

Breeding Approaches

1. Conventional:

a. Introduction.
b. Selection.
c. Hybridization.
d. Inter-specific hybridization.
e. Mutagenesis.

2. Non-conventional:
Biotechnological Approaches → Genetic engineering.

Advantages in Improvement of Quality Traits

1. Enables the grower to get good return.
2. More consumer acceptability.
3. Food and health security.
4. Makes the produce more suitable for processing.

Limitations in Improvement of Quality Traits

1. Takes longer period of time.
2. Negative association between yield and quality traits.
3. Low heritability & affected by environment.

Conclusion

Breeding for quality attributes in solanaceous is a continuous process for increasing and re-strengthening the germplasm collection. Development of F1 hybrids, varieties and induced mutants with higher nutritional values. Exploitation of molecular marker biology and cellular genetics for development of transgenic with high nutritional traits is needed. Incorporation of nutritional traits should be integrated with the normal breeding procedure for yield characteristics.

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Breeding for Colour Development in Vegetable Crops

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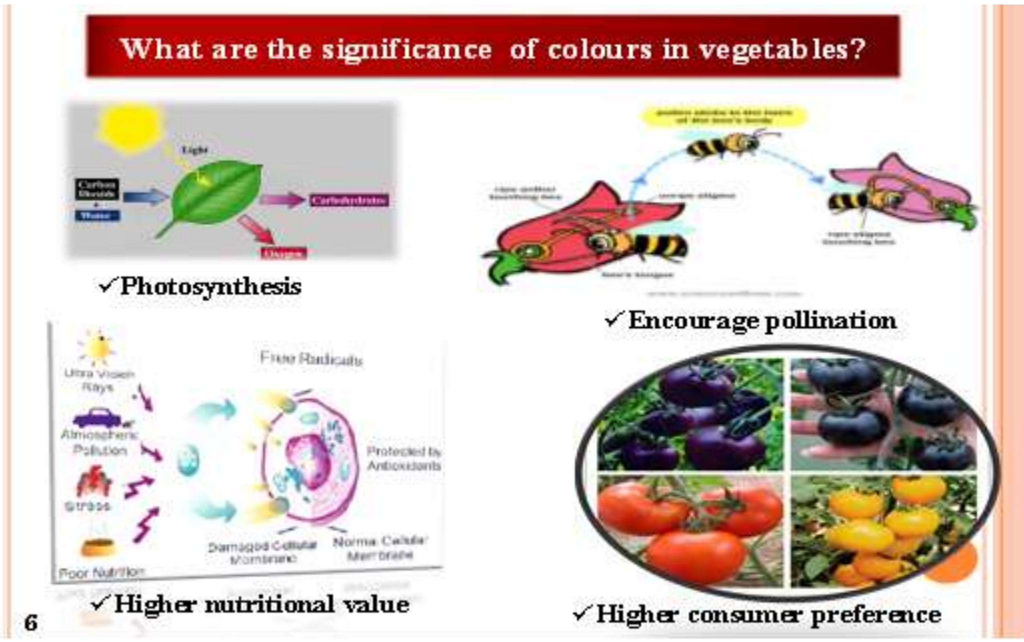
Fruits & vegetables are combinely known as "Protective foods" as they are rich in CHO, fat, proteins, vitamin and minerals, particularly vegetables richest and cheapest source of vitamins, minerals and crude fibre. CHO, fat and proteins are required in larger quantity as they supplies energy to our body but vitamins and minerals are required in smaller quantity as they do not supplies energy to our body but they required for physiological process and metabolic activities hence, Nutritionists of WHO-FAO suggested that vegetables are essential for balanced diet.

1. Vitamin A deficiency (VAD) is recognized as a serious public health problem in India.
2. It is estimated that 25% of the 15 million blind people globally are from India.
3. Colourful vegetables - have enormous amount of nutritional , aesthetic and medicinal value.

Pigments?

Pigments are natural organic compounds which gives characteristic to particular plant or plant parts. Different pigments present in leaves, flowers and other plant parts not only attracts inscets and animals for flower pollination and seed dispersal but also play critical role as follows.

1. In general, the visible colours are the emission of certain wavelengths of light.
2. Colours are ubiquitous in nature, particularly in living organisms ranging from bacteria and fungi to plants and animals. Many organisms have developed their own characteristic colours that vary by parts and developmental stage. These colours are not just visually decorative and attractive, but biologically essential in reproduction, co evolution, and ecosystem sustenance, (Chen et al., 2015). Breeding for colour improvement enhance not only colours also enrichment with nutrition which helps minimise the risk of cancer, obesity, cardiovascular disease diabetics etc.



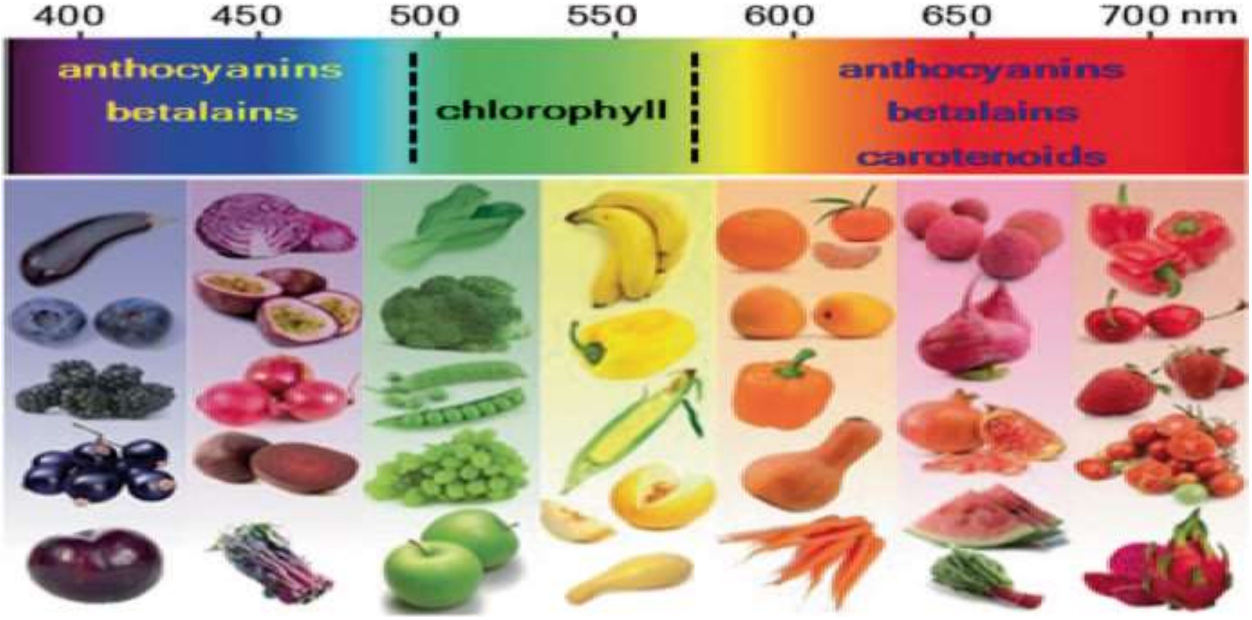
1. Photosynthesis: in the presence of Co2 and water green plants absorb the sunlight for their food production and release O2 and produced CHO are stored in starch as a reserved food material for future use.

2. Pollination: due to attractive colours in flowers pollinating agents attracts towards them and thereby encourage the pollination.

3. Nutritional value: Antioxidents which are enhanced by nutrition which neutralise the free radicals and other organic acids which are produced during heavy food metabolism.

4. Consumer preference: colour is the most important visual component to consumer preference as it fetches higher price and thereby increase in demand for export value.

Chlorophylls, with Examples of Pigment-Rich Fruits and Vegetables



Each pigment class was marked in the zones with the approximately corresponding wavelengths (400-700 nm) of visible light and the examples given in the columns below with the symbolic colours.

1. In above colour spectrum from 400-490 nm violet, indigo, blue colours are produced with anthocyanin and betalains pigments are developed.
2. From 490-575 nm green colour with chlorophyll pigment is produced.
3. From 575-700 nm yellow, orange and red colours are produced with again anthocyanin, carotenoids and betalain pigments are developed.

Carotenoids

1. Carotenoids are lipophilic, tetraterpenoids organic pigments (Li et al., 2017).
2. Carotenoids are natural isoprenoid pigments that provide leaves, fruits, Vegetables.
3. Flowers with distinctive yellow, orange and some reddish colours as well as several aromas in plants.

Flavonoids

1. Water-soluble polyphenolic compounds
2. Subgroups: Anthocyanins, Condensed tannins, Flavonols, Flavones, Flavondiols, isoflavonoids, chalcones, Aurones and Phlobaphenes (Jones et al., 2014).
3. Some flavonoids can function as antimicrobial or defensive agents against biotic and abiotic stresses, and others secretively act as signalling molecules for the plant– microbe interaction in rhizosphere.

Betalains

1. Betalains are a class of water-soluble pigments that are found only in the order Caryophyllales.
2. Betalains differ from anthocyanins in the chemical structures but share similarities to anthocyanins in the color spectra, biological functions.

3. For example, betalains contain nitrogen but anthocyanins do not. Similarly, betalains are also localized in vacuoles.

Breeding Approaches for Colour Improvement in Vegetable Crops

1. Selection.
2. Mutagenesis.
3. Hybridization.
4. Interspecific hybridization.
5. Somaclonal Variation.
6. Genetic engineering.

Conclusion

Now days coloured pigments play major role in human nutrition as well as attraction of consumer. There is lot of scope for natural colourants by pigment extraction. Colours are major visual component in export-oriented value. Now a day's molecular markers used in easy identification of colours at early stage and effective utilization of that particular quality aspects. Still the work is going on to breed varieties with resistant against particular biotic and abiotic factors along with colour improvement.

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Drone Revolutionizing Traditional Horticulture into Smart Horticulture / Horticulture 2.0

Article ID: 31669

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What is Drone?

Drones also referred to as Unmanned Aircraft Vehicles (UAV) is one of newer development which is applied in performing smart farming/horticulture. The drones are remote controlled aircraft with no human pilot on-board. This new technology has huge potential in horticulture sector in performing all sorts of field operations including spatial data collection.

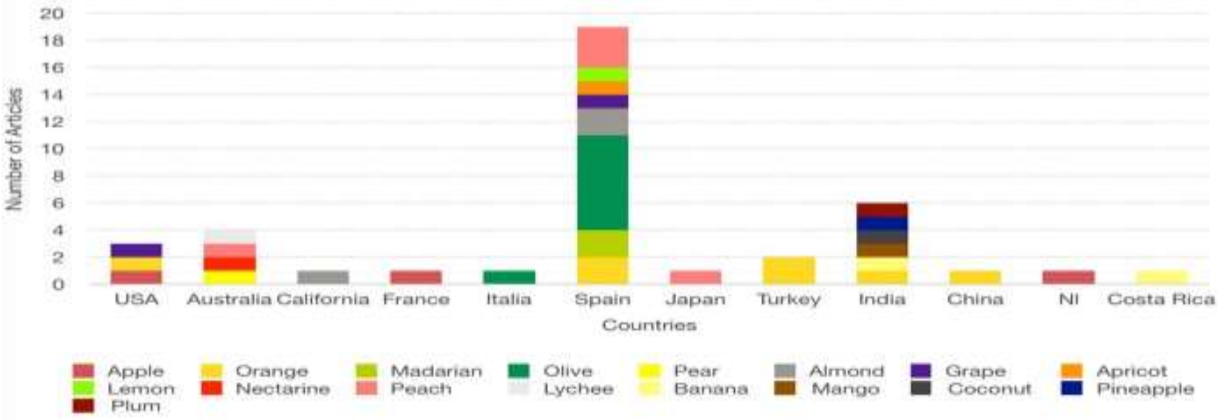

Fig1. Distribution of research locations and investigated fruits using drone

Principles of Working of Drone

To achieve controllable/autonomous flight, the drone mainly requires to complete attitude control, shooting/measuring, information storage/transmission, as well as environmental awareness (for anti-collision). A beginning point of the automatic control principle is the closed-loop feedback control, i.e. after the input adjustment is given, the change of the control amount is measured and feedback is adjusted to input till the control amount reaches the target value. Environmental awareness is the use of various sensors (optical cameras, ultrasound, etc.) to detect obstacles on the trajectory of the drone, such as buildings, bridges, etc., and to make manoeuvre circumvention.

The drone moves vertically and utilizes the rotor to advance and stop. The relative nature of force implies that when the rotor pushes the air, the air also pushes the rotor back. This is the basic principle that the drone can go up and down. Moreover, the faster the rotor rotates, the greater the lift, and vice versa. To turn the drone to the right, the angular velocity of the rotor1 needs to be reduced. Although the lesser thrust from the rotor1 can cause the drone to alter the motion's direction, the upward force is unequal to the downward gravity concurrently, so the drone drops.

The drone is symmetrical, it also applies to lateral movement. Each side of four-wheeled drone can be the front side, so how to move forward explains how to move backwards/the sides.

Drone Categories in India

1. Nano: Less than or equal to 250 grams (0.55 pounds).
2. Micro: From 250 grams (0.55 pounds) to 2kg (4.4 pounds).
3. Small: From 2kg (4.4 pounds) to 25kg (55 pounds).

4. Medium: From 25kg (55 pounds) to 150kg (330 pounds).
5. Large: Greater than 150kg (33 pounds).

Types of Drone

There are different kinds of drones can be categorized into the following groups:

1. Fixed wing: Vehicle is easy to control. It has some kind of a motionless wing and a propeller that facilitates forward movement. Due to its construction, it must always be moving relative to the air around it to stay aloft. Hence, wind has great impact on its operation. Another constraint is that larger drones require some kind of runway area that can be used for deployment as well as retrieval, while smaller ones can be hand launched and retrieved by landing on a smooth surface.

2. Tethered vehicle: It is a common drone tethered to a wire to abolish need for a remote controller. Drone movement is hence restricted according to the tether. Moreover, tethered drones have different kind of variations. They can range from a standard drone moved according to the tether to a drone tethered with a microfilament wire with an installed power system for limitless flight.

Fixed wing drone

Drone tethered with a wire

3. Rotary wing: The most common drone type. It looks like a small helicopter since it has multiple rotors (typically 4-8). Due to its rotary system, the drone has the ability to hover and can be vertically deployed and retrieved. The rotary wing vehicle has some advantages over the other types. It is small and easily transportable and less liable to mechanical failure. The main disadvantages, though, are its limitation in cargo it can carry, as well as its battery life, which is limited to allow only 15 minutes or less of flight.

4. Lighter-than-air (LTA): Vehicles include blimps and other typical helium-filled crafts tethered to some kind of wire. Their main disadvantages are the difficulty in transporting because of their size, and the fact that they cannot tolerate even moderate wind speeds. Therefore, LTA drones are used less in farming.

Rotary wing drone

Lighter-than-air (LTA) drone

Application of Drones in Horticulture

1. Soil and field analysis: After getting precise 3D maps for soil, planting can be planned and nutrient status can be analysed for further operations.

Drone flies over field and captures images of crop condition

2. Planting: UAS shoot seeds with nutrients in the soil with an average uptake of 75 percent, thus bringing down costs for planting.

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3. Crop spraying: Drones can scan the ground and spray the correct amount of liquid, modulating distance from the ground and spraying in real time for even coverage.

4. Crop monitoring: Time-series animations can show the precise development of a crop and reveal production inefficiencies, enabling better crop management.

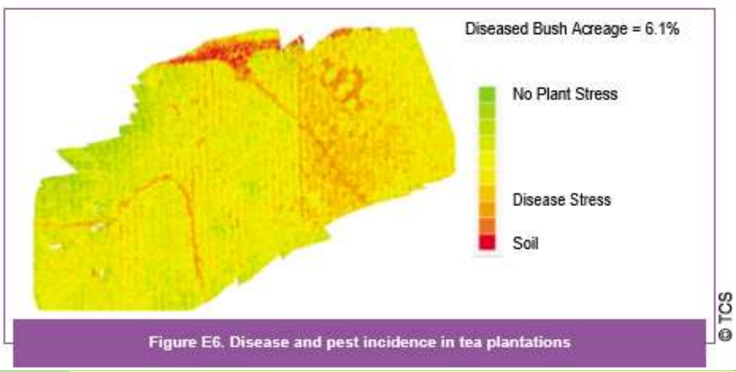
5. Irrigation: Drones with hyperspectral, multispectral, or thermal sensors can identify which parts of a field are dry or need improvements.

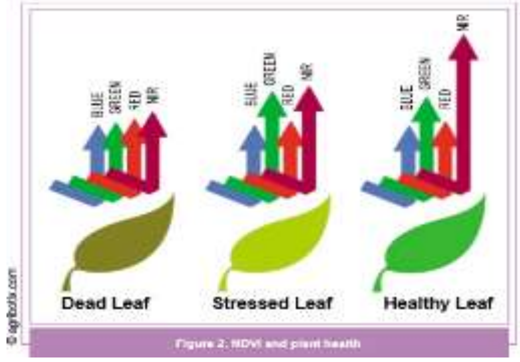
6. Health assessment: By scanning a crop using both visible and near-infrared light, drone-carried devices can identify which plants reflect different amounts of green light and NIR light. This information can produce multispectral images that track changes in plants and indicate their health.

Horticultural Attributes Measurement Using UMVs

Drones collect raw data and translate it with algorithms into useful information. Therefore, they can be used for various applications in farming, viz. the monitoring of following parameters:

1. Crop health; damage made by pests, color change due to pest infection
2. Vegetation indices; leaf area, anomaly detection, treatment efficacy, phenology, yield
3. Plant height; plant height and density
4. Plant scouting; plant size, plot statistics, stand number, compromised plots, planter skips
5. Water needs; water-stressed parts of the field/orchard in need of watering
6. Soil analysis; nutrient availability for plant nutrient management.





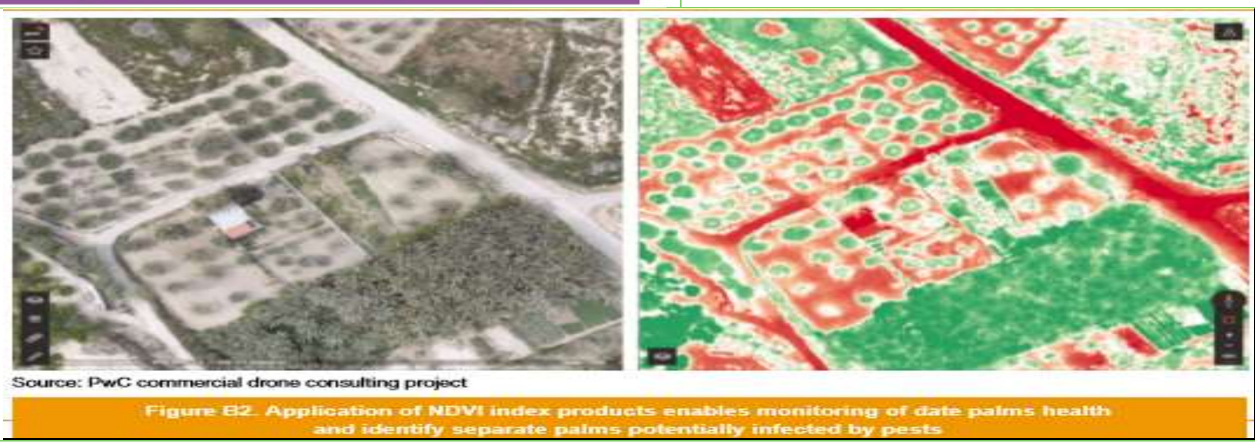


Fig 2. Horticultural attribute measurement using drone/UAV

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General Rules for Flying a Drone in India

1. All drones must be registered and issued a Unique Identification Number (UIN) [except falling in Nano category.
2. A permit is needed for commercial drone operations (except for Nano category flown below 50 feet and those in the Micro category flown below 200 feet).
3. Drone pilots must maintain a direct visual line of sight at all times during flight.
4. Drones cannot be flown more than 400 feet vertically.
5. Drones cannot be flown in areas specified as "No Fly Zones", which include areas near airports, international borders, Vijay Chowk in Delhi, State Secretariat Complex in State Capitals, strategic locations, and military installations.
6. Permission to fly in controlled airspace can be obtained by filing a flight plan and obtaining a unique Air Defense Clearance (ADC)/Flight Information Center (FIC) number.

Required Drone Equipment in India

India has peculiar requirements regarding the types of features a drone must have to be flown in India (excluding those in the Nano category). These mandatory requirements include:

1. GPS.
2. Return-to-home (RTH).
3. A flight controller with flight data logging capability.
4. Anti-collision light.
5. RF ID and SIM/No Permission No Takeoff (NPNT).
6. ID plate.

Constraints of Using Drone in Horticulture

1. Quality software – Software plays a key role in the applicability of this technology right from flight path planning to processing of the final image.
2. Legal aspects – Different nations have their own regulatory regimes to use UAVs in agriculture.
3. Acceptability on farmer front – Technological unawareness may be a limit in its penetration.
4. Flight time and flight range – Most drones have short flight ranges thus limiting the acreage that they can cover. The drones with the longer flight ranges are comparitively expensive.
5. Initial cost of purchase – Drones with features that suits for use in agriculture are quite costly.
6. Interference with airspace – Drones share the same airspace with manually manned aircraft.
7. Connectivity – Mostly farmlands may not have good connectivity, thus either the farmer has to invest in connectivity or buy a drone capable of capturing data locally for later processing.
8. Weather dependency – Drones operations are heavily dependent on weather, thus limiting usage.

Figure J4. Diagram of the UAV-WSN system

Conclusion

The introduction of drone has revolutionized the horticulture sector in fighting the problems of labour shortage and mental stress of farmers. By using this technology, farmers can save time, money, wear ant tears of data collection as the drone's work with more preciseness compared to other data collecting sources. Farmer education is very important for smooth operation of this technology and conversion of traditional horticulture into smart horticulture or Horticulture 2.0.

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Seed Priming Memory in Inducing Abiotic Stress Resistance in Plants

Article ID: 31670

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Summary
India being an agricultural country urges the need of simple, effective and manageable technology to enhance establishment of crops under all environmental conditions. Seed priming is the simple technique to synchronise seed germination, increase emergence and establishment in the farm. It facilitates the transition of quiescent dry seeds into germinating state and lead to improved germination potential. Also, priming imposes abiotic stress on seeds that represses radicle protrusion but stimulates stress responses. This irreversible transition towards radicle protrusion initiated during priming and the cross-tolerance activated by abiotic stresses generated by priming constitutes "Priming Memory" (Chen and Arora et al., 2013). Priming treatment can constitute stress potentially at two levels: first, moderate abiotic stresses during priming itself. and second, the post-priming drying. Imprints could be formed by accumulation of proteins or transcription factors or by epigenetic changes. By Priming, both enzymatic and non-enzymatic antioxidants and other cell protectants will be developed and they act as stress imprint which help to combat different abiotic stresses.

Introduction
1. Priming and its types: Priming is an approach that involves treating seeds with different organic or inorganic chemicals and or with high or low temperatures [Kamithi et al., 2016].

2. Types:

a. Hydro-priming: Hydro-priming is a technique which uses water to soak seeds, drying it for dehydrating and then sowing the next day.

b. Halo-priming: Halo-priming is a technique which involves submerging seeds in solutions of inorganic salts viz. sodium chloride, calcium chloride etc.

c. Osmo-priming: Osmo-priming involves soaking seeds in solution of osmotic priming material for a certain period followed by air drying before sowing. e.g. polyethylene glycol (PEG), glycerol, mannitol, sorbitol.

Seed Priming Memory in Seeds Represents
1. An irreversible transition towards radicle protrusion initiated during priming.
2. The cross-tolerance activated by abiotic stresses generated by priming.

Primed Seeds Show Advancement in Development (Chen et al., 2013)
1. It can be studied by Protein profiling and is used visualize the advanced state transition during priming.

2. Primed seeds possess greater energy to complete germination: more efficient ATP production as a result of increased number of mitochondria.

3. Priming initiates cell cycle and cell elongation: Primed seed lots show advanced phase I and II of germination (higher 4C/2C DNA ratio than unprimed ones) and advances cell cycle from G1 to G2 phase. (Varier et al., 2010).

4. Priming influence hormonal regulation: Priming gradually increases GA/ABA ratio (El-Araby et al., 2006), which, in turn, facilitates germination.

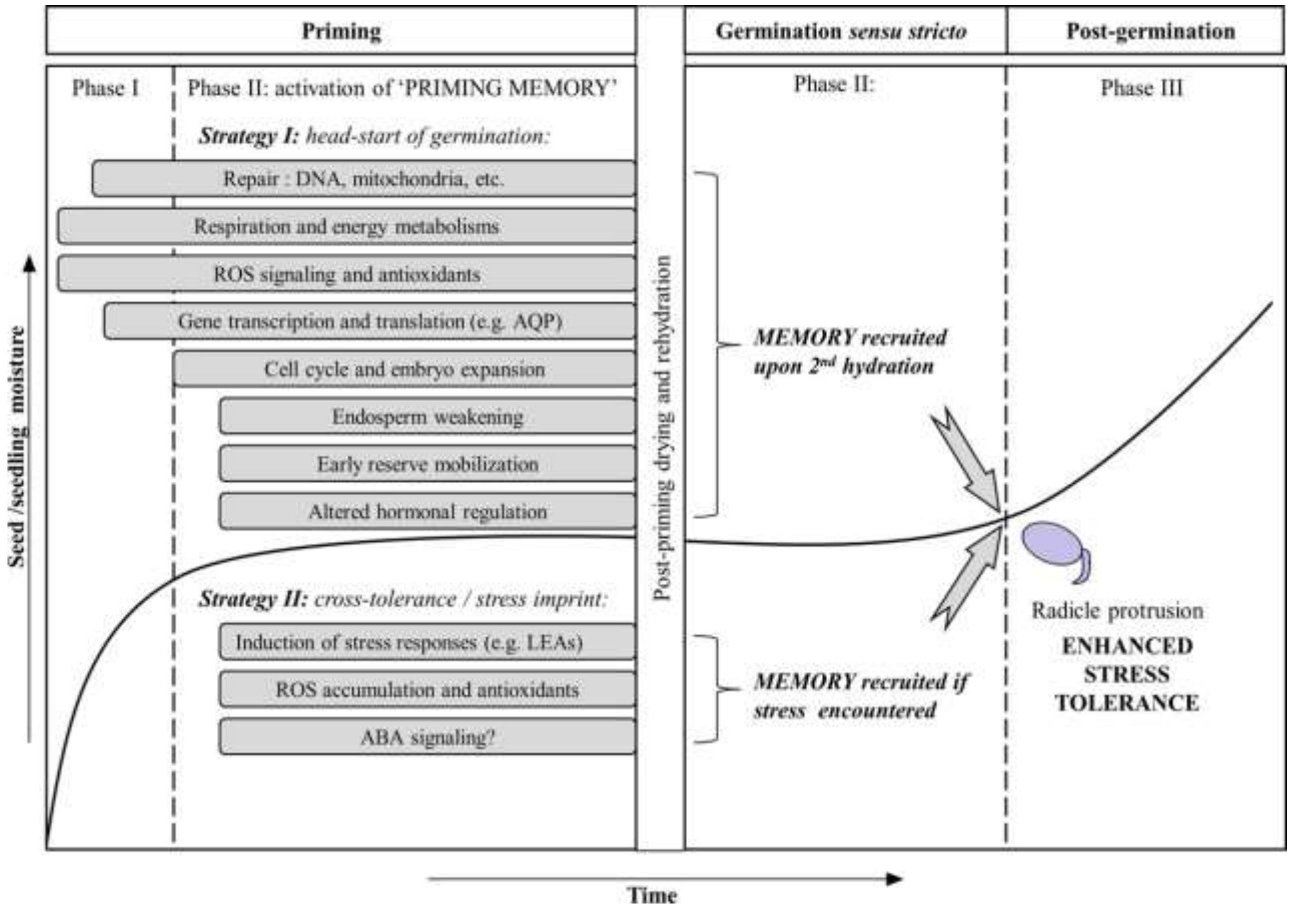

Fig 1. Model for the establishment of 'priming memory'. It relates to stress-tolerance of germinating seeds. Primed seeds are hydrated twice: (1) by priming, and (2) during subsequent germination. (Nonogaki et al., (2018)). It induces better stress tolerance.

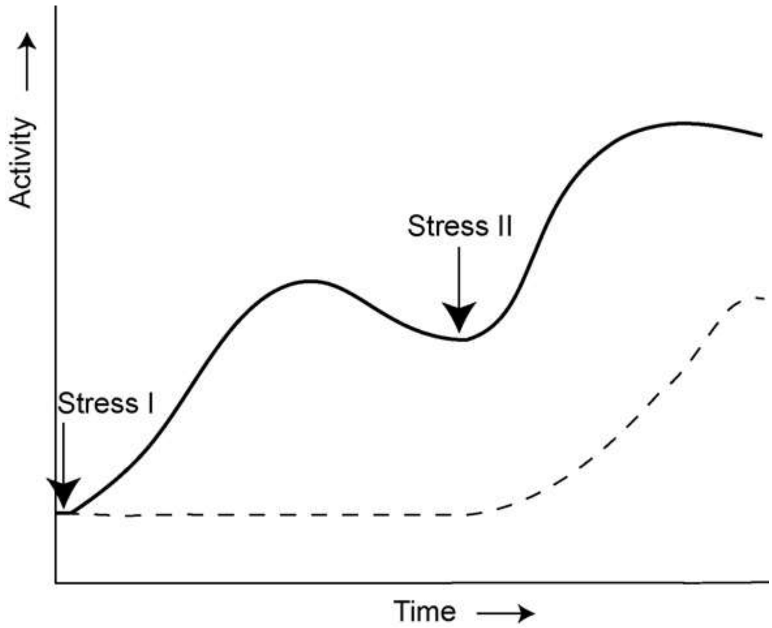

Fig. 2. Model to show Comparison of the activity of a stress-responsive gene in a primed plant (–) (Higher) and an unprimed plant (- -). (Bruce et al., 2007).

Priming Induces Cross Tolerance (Stress Imprint)

1. Priming itself is a stress, because priming restricts radicle protrusion in imbibed seeds. Thus, the primary source of stress could be the priming strategy itself

2. Priming induces stress responses: LEAs, HSPs get accumulated.

All the above effects of priming remain as such in seeds as a memory even after drying the seeds and helps in germination advancement.

Possible Reason for Stress Imprint

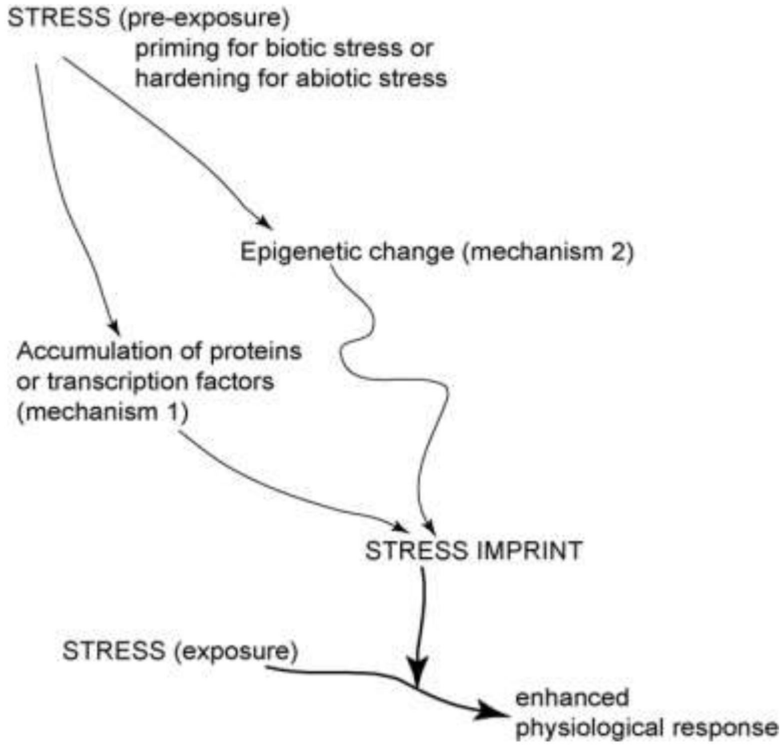

Fig.3 The stress imprint leads to an enhanced physiological response when the plant is exposed again. Imprints could be formed by accumulation of proteins or transcription factors (mechanism 1) or by epigenetic change (mechanism 2) or indeed by both mechanisms. (Bruce et al., 2007)

Conclusion

1. Priming the seed ameliorate the adverse effects of stress on seedlings by scavenging the ROS by the action of enhanced enzymatic antioxidants and non-enzymatic antioxidants, reducing the damaging effects of ROS on the membrane of plant cells.
2. This enhanced tolerance is due to the" priming memory "that is developed in the seed during initial exposure to stresses during priming and during the process of drying.

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Creating A Sustainable Food Future

Article ID: 31671

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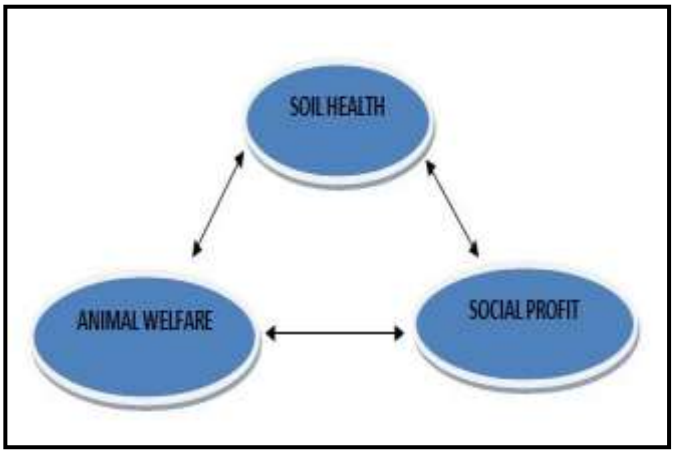
Introduction

About one-third of the world's topsoil is already acutely degraded, and it is estimated that a complete degradation would follow within 60 years, if current practices tends to continue. Agriculture is one of the major sectors in contributing to CO2 emissions and the greenhouse gases (GHGs) are most responsible for the climatic changes that we are witnessing today. Agriculture needs to close an 11-gigaton greenhouse gas (GHG) gap between expected emissions in 2050 and those needed to hold global warming below 2oC. It is vital to create a safe, sustainable future without carbon pollution where we can provide our booming world population with fresh, healthy food grown in a sustainable soil ecosystem. Thus, regenerative agriculture claiming a triple win situation: climate change mitigation, increased profit for farmers and greater resilience to a changing climate is the need of the hour. The practices grouped as regenerative agriculture can improve soil health and yield some valuable environmental benefits.

Soil health is intrinsically linked to the total health of the food system. Soil health affects everything from plant health to human wellbeing and the future of our planet. Regenerative agriculture prioritizes soil health while simultaneously encompassing high standards for animal welfare and worker fairness. "Beyond sustainable" regenerative agricultural methodologies seek to soil addition through a self-nourishing ecological system that benefits the environment in the process.

What is Regenerative Agriculture?

Regenerative agriculture refers to a systems-based approach of agriculture with the aim to maintain abundant and diverse biological activity in the soil leading to increased soil carbon, increased humates and increased ability of the soil to absorb and hold water, acting like a sponge where the microbial activity works to feed nutrients in the soil to the plant roots. A year-round ground cover allows the plants to create a healthy environment for diverse microorganisms, while capturing carbon above and below the soil thereby protecting the soil from drying out. Regenerative agriculture, as compared to the current industrial agriculture, has considerably lower annual chemical inputs of pesticides and synthetic fertilizers, with the substantial reduction of associated expenses for purchase and application. Pastured animals are a significant component of the system, turning vegetation into much-needed natural fertilizers.



Three pillars of regenerative agriculture

'Healthier the Soil, Healthier the Crop' Concept

The regenerative farming approach focuses on soil restoration that have been degraded by both industrial as well as agricultural system. It promotes a healthier ecosystem by rebuilding soil organic matter through holistic farming and grazing techniques. In short, regenerative agriculture practitioners let nature do the work. Soil organic matter is plant or animal tissue in the process of decay. While most soils are only 2% to 10% soil organic matter, this plays a vital role in soil health. Each one-percent increase in soil organic matter helps soil hold more water. And heightened water holding capacity means crops are more resilient through times of drought or heavy rain. By maintaining surface residues, roots and soil structure with better aggregation and pores, soil organic matter reduces nutrient runoff and erosion, as well When plants have the nutrients and roots systems they need to thrive, they build compounds to help protect against external factors like insects and diseases. There is also growing evidence that a healthy soil microbiome consisting of abundant population of bacteria, fungi and nematodes is more likely to produce nutrient-dense food that helps in promoting better human health.

"Regenerative prioritizes soil health while simultaneously encompassing high standards for animal welfare and worker fairness. The idea is to create farm systems that work in harmony with nature to improve quality of life for every creature involved". The main difference is the systems-based approach.

Need for Regenerative Agriculture

The loss of fertile soil and biodiversity, along with the loss of indigenous seeds and knowledge is posing a mortal threat to our future survival. According to soil scientists, if the current rates of soil destruction (i.e. decarbonization, erosion, desertification, chemical pollution) persists, then within 50 years there will be serious damage to public health due to a qualitatively degraded food supply characterized by diminished nutrition and loss of important trace minerals and also enough arable topsoil will no longer be available to feed ourselves.

Principle and Practices

The key to regenerative agriculture is to improve the land using technologies that can regenerate and revitalize both the soil and environment. Regenerative agriculture leads to healthy soil, capable of producing high quality, nutrient dense food while simultaneously improving the quality of land and ultimately leading to productive farms and healthy communities and economies. It is a dynamic and holistic approach, incorporating permaculture and organic farming practices, including conservation tillage, cover crops, crop rotation, composting, mobile animal shelters and pasture cropping to increase food production, farmers' income and soil health.

Regenerative farming practices boost soil health by following a variety of techniques:

1. Cover crops: One of the key principles of regenerative agriculture is to keep the soil covered at round the years. This can be achieved both through plant residues and cover crops, which protect the soil from wind and water erosion, lower the temperature of the soil, and feed the microorganisms within it.

2. Integrating livestock: As animals graze, they break up the soil, compacting inedible plants and allowing nutrients and sunlight to new plants- essentially speeding up the building of soil organic matter, with crushed leaves and stalks creating a natural mulch. This better equips the soil for germinating seeds. And the livestock's excrement adds nutrients to the ground, further improving water retention and nutrient status.

3. No-till: One spoonful of healthy soil has more living organisms than there are people on Earth- vitally important building structure and overall soil health. Mechanical, physical, and chemical (synthetic fertilizer, herbicide, pesticide, and fungicide) disturbances all have a negative on the soil microbiome, putting soil nutrient cycling and environmental resilience at risk. Limiting the disturbance of the soil maintains the soil structure and prevents erosion.

4. Crop diversity: “Nature is more collaborative than competitive,” regenerative agriculture focuses on ecosystem diversification, whether through plant or animal species that helps in evolving healthier and more resilient soil.

A Shift to Regenerative Agriculture Can

1. Reduce GHG emissions: The new food system could be a key driver of solutions to climate change.
2. Mitigate climate change: Emission reduction alone is simply inadequate, so reversing climate change can be made possible by increasing soil carbon stocks.
3. Upgrade yields: Yields on farms can be assured significantly higher than conventional farms.
4. Create drought-resistant soil: The addition of organic matter to the soil increases the water holding capacity of the soil. Regenerative organic agriculture builds soil organic matter.
5. Revitalize local economies: Family farming represents an opportunity to boost local economies.
6. Preserve traditional knowledge: Understanding indigenous farming systems reveals important ecological clues for the development of regenerative organic agricultural systems.
7. Nurture biodiversity: Biodiversity is fundamental to agricultural production and food security, as well as a valuable ingredient of environmental conservation.
8. Restore grasslands: One third of the earth's surface is grasslands, 70% of which have been degraded and can restored by using holistic planned grazing.
9. Enhance nutrition: More diverse agro-ecosystems can ensure a more diversified nutrient output of the farming systems.

Conclusion

Sustainable agriculture seeks to meet society's present production needs without compromising the ability for current or future generations to meet their needs on the other hand, regenerative practices recognize the natural systems that are currently impacted and applies management techniques to restore the system to improve productivity. Regenerative and sustainable actions essentially use the same practices, the difference lies in the application and the management of those practices.

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Unbelievable Ride Towards Weight Loss: Sirtfood Diet

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"What you eat IN PRIVATE eventually is what you wear IN PUBLIC. EAT CLEAN, LOOK CLEAN"

Background

A diet that allows you to indulge in red wine and dark chocolate would grab your attention immediately, right? Well, that's precisely what the sirtfood diet does, and still promises to help you burn fat and lose weight. This is also the diet that Grammy-winning singer Adele reportedly used to lose weight recently, and it has become globally popular ever since. This diet, which first hit the scene in 2016, experienced a surge in popularity when news broke that Adele, Pippa Middleton, and other celebrities purportedly follow the plan to lose weight and boost energy with foods like kale, red wine, dark chocolate, and matcha—and it's only been gaining steam. In fact, Google just announced that the Sirtfood Diet was the seventh-most searched for diet in 2019. Here's everything you need to know about this trendy new diet.

What is the Sirtfood Diet?

The Sirtfood Diet was developed by U.K.-based nutritionists Aidan Goggins and Glen Matten, both of whom hold master's degrees in nutritional medicine. Their book, The Sirtfood Diet, was published in the U.S. in 2017 and features a plan to help you "lose seven pounds in seven days while experiencing lasting energy and enjoying the foods you love including chocolate, red wine, strawberries, and more."

According to the diet's founders, these special foods work by activating specific proteins in the body called sirtuins. Sirtuins are believed to protect cells in the body from dying when they are under stress and are thought to regulate inflammation, metabolism and the aging process. It's thought that sirtuins influence the body's ability to burn fat and boost metabolism, resulting in a seven-pound weight loss a week while maintaining muscle. However, some experts believe this is unlikely to be solely fat loss, but will instead reflect changes in glycogen stores from skeletal muscle and the liver.

What Foods are Considered "Sirtfoods"?

Sirtfoods are any food that is rich is the sirtuin protein, which is type of plant-based protein that has shown some promise in clinical studies to improve metabolic health. Sirtfoods include: red wine, dark chocolate, olive oil, walnuts, blueberry, strawberry, coffee, parsley, soy, kale, buckwheat, green tea and turmeric. All of these foods contain specific polyphenol compounds (quercetin, resveratrol, kaempferol, etc.) that have, in fact, been found in scientific studies to increase sirtuin activity. So, in this regard, the diet is at least somewhat based on science.

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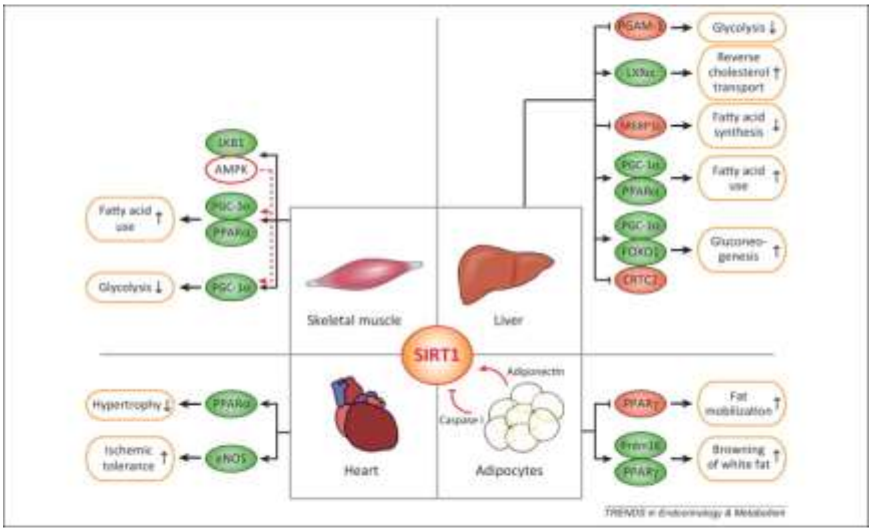
Sirtuins Pathway

Figure 1. SIRT1 mediates metabolic benefits in various tissues. Major metabolic tissues, such as liver, heart, white adipose tissue (WAT), and skeletal muscle are depicted to illustrate SIRT1 functions. In the liver, SIRT1 supports gluconeogenesis via peroxisome proliferator-activated receptor (PPAR)γ coactivator 1α (PGC-1α) and forkhead box O1 (FOXO1), and facilitates CREB-regulated transcription coactivator 2 (CRTC2) degradation upon prolonged fasting. SIRT1 inhibits glycolysis by repressing glycolytic enzyme phosphoglycerate mutase-1 (PGAM-1). In the liver, SIRT1 responds to fasting and promotes fatty acid oxidation by activating peroxisome proliferator-activated receptor α (PPARα) and inhibits fatty acid synthesis by targeting sterol regulatory element binding protein 1c (SREBP1c) for degradation. SIRT1 is a positive regulator of liver X receptor (LXR) and thus regulates whole-body cholesterol homeostasis. In the skeletal muscle, SIRT1 exerts similar actions on increasing fatty acid utilization, and reduces glycolysis as described above. Here, SIRT1 and AMP-activated protein kinase (AMPK) comprise a reciprocal positive regulating loop. AMPK activates SIRT1 by upregulating the gene encoding the NAD+ synthetic enzyme nicotinamide phosphoribosyl transferase (NAMPT). Reciprocally, SIRT1 activates AMPK by deacetylating liver kinase B1 (LKB1). In WAT, SIRT1 mobilizes fat from WAT via PPARγ to drive lipid utilization in liver and muscle [83]. In addition, by deacetylating PPARγ to facilitate PR domain containing 16 (Prdm16) binding, SIRT1 drives white fat browning to enhance energy expenditure. SIRT1 protein is degraded post high-fat diet challenge by activated caspase I and can be upregulated by adiponectin. SIRT1 also benefits the heart by increasing ischemic tolerance via an activation of endothelial nitric oxide synthase (eNOS). SIRT1 additionally protects against cardiac hypertrophy through PPARα activation. Targets that are directly activated by SIRT1 are shown in green. Those repressed or inhibited by SIRT1 are shown in pink.



What are the Phases of the Sirtfood Diet?

The diet claims to help in “sustained weight loss, incredible energy and glowing skin”. It’s not just about eating sirtuin-producing foods to lose weight though; you also to have to cut your calories. The Sirtfood Diet is broken down into two basic phases:

1. Phase One lasts for seven days. For the first three days, the diet calls for consuming three sirtfood green juices and one meal rich in sirtfoods—for a total of 1,000 calories per day. Days four through seven each consist of two green juices and two meals—for a total of 1,500 calories per day. This is the part of the plan in which Goggins and Matten claim you can "lose seven pounds in seven days."

2. Phase Two is a 14-day maintenance phase meant to "help you lose weight steadily." You can have three sirtfood-rich meals plus one green juice per day.

Do Dietitians Recommend the Sirtfood Diet?

When the foods seem healthy enough, and you can pretty much dine out on Sirtfood Diet, is it a good call?

The pros: "From a nutritional density view, foods containing high levels of sirtuins also provide good levels of nutrients which are overall linked to improved health."

The cons: "Keeping this up long term can prove very difficult and often requires big shifts," she adds. "Life changes and restrictions which may not all be positive. Also, the impact on our mood with weight regain post-diet has been identified as a major drive in returning to comfort eating and less healthy eating habits."

Indian context: "I am not sure if it is feasible in India as many of the sirtfoods are either not available in our country or are very expensive. The limited food options offered by it can be boring after a point."

Who Shouldn't Try the Sirtfood Diet?

Dietician said that they wouldn't recommend anyone with diabetes try the diet. Plus, adds it may be hard going if you're highly active. If you do go ahead, they warn to expect side effects like headaches or light-headedness in the first stage of this plan as your body adapts to the lower calorie intake.

Sirtfood Recipes

If you're thinking of trying the Sirtfood Diet, here is to give you a helping hand, with some tasty recipes from The Sirtfood Diet book by Aidan Goggins and Glen Matten. Contained within the book is a seven-day plan to lose an average of 7lb, although adding in Sirtfood recipes to your diet can help too, if you'd rather take a more relaxed approach.

1. Sirt Muesli (serves 1): If you want to make this in bulk or prepare it the night before, simply combine the dry ingredients and store it in an airtight container. All you need to do the next day is add the strawberries and yoghurt and it's good to go.

a. Ingredients:

20g buckwheat flakes.
10g buckwheat puffs.
15g coconut flakes or desiccated coconut.
40g Medjool dates, pitted and chopped.
15g walnuts, chopped.
10g cocoa nibs.
100g strawberries, hulled and chopped.
100g plain Greek yoghurt (or vegan alternative, such as soya or coconut yoghurt).

b. Instructions: Mix all of the above ingredients together (leave out the strawberries and yoghurt if not serving straight away).

2. Turmeric tea:

a. Ingredients:

3 heaped tsp ground turmeric.

1 tbsp fresh grated ginger.
1 small orange, zest pared.
honey or agave and lemon slices, to serve.

b. Instructions:

i. Boil 500ml water in the kettle. Put the turmeric, ginger and orange zest in to a teapot or jug. Pour over the boiling water and allow to infuse for around 5 mins.

ii. Strain through a sieve or tea strainer into two cups, add a slice of lemon and sweeten with honey or agave, if you like.

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Conservation Agriculture Associated Machinery to Avoid Stubble Burning

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Introduction

In India, there is a large variability in the availability of crop residues and their use depending on the cropping intensity, productivity and crops grown in different states. Burning of crop residues produce soot particles and smoke causing human health problems, loss of plant nutrients such as N, P, K and S, adverse impacts on soil properties and wastage of valuable organic carbon and energy rich residues. There are several options which can be practiced those may enhance the soil health to avoid burning of crop residues such as composting, conversion to energy, production of bio-fuel and recycling in soil to manage the residues in a productive manner.

Conservation agriculture adoption has great potential for improving depleted soils with nutrients. Conservation agriculture is defined as a way of achieving sustainable and profitable farming using three core principles namely minimal soil disturbance, permanent soil cover and crop rotations. Conservation agriculture helps to conserve moisture, maintain or improve organic matter and reduce soil erosion. In India, dissemination of conservation based agricultural technologies have been underway for decades that made significant progress. The technologies of conservation agriculture provide opportunities to reduce the cost of production, save water and nutrients, increase yields, increase crop diversification, improve efficient use of resources, and benefit the environment. However, there are lot of constraints for promotion of conservation agriculture technologies, such as lack of appropriate seeders especially for small and medium scale farmers, competition of crop residues between conservation agriculture use and livestock feeding, burning of crop residues, availability of skilled and scientific manpower and overcoming the bias or mindset about tillage.

Effects of Paddy Stubble Burning

An acre of paddy field produces around 2.5 tonnes of stubble which, on burning, releases 7.5 kg of particulate matter, 150 kg of carbon monoxide, 3,650 kg of carbon dioxide, 498 kg of ash and 5 kg of sulphur dioxide. These gases and aerosols consisting of carbonaceous matter contribute to global climate change. For sowing wheat on-time the burning of rice residue decreases the soil fertility and is harmful for human beings, animals and environment. It is estimated that burning of 1 tonne of stubble or paddy straw accounts for loss of 5.5 kg N, 2.3 kg P, 25 kg K and 1.2 kg S, besides organic carbon. Rice husk is unusually high in ash, which contain 92-95% silica, highly porous and light in weight, with a very high surface area. Its absorbent and insulating properties are useful in many industrial applications, such as acting as strengthening agent in building materials. Husk is also produced as fuel for processing paddy, production through direct combustion or gasification. It is also used as cattle feed.

Technological Interventions to Avoid Stubble Burning

Some of the machines available for countering stubble burning and promoting conservation agriculture are:
1. Zero till drill.
2. Happy seeder.
3. Paddy straw chopper.
4. Straw reaper.

5. Straw mulcher.
6. Hay rake.
7. Baler.
8. Super straw management system.

Zero Till Drill

Zero till drill is used for sowing wheat without tillage or disturbing the soil in paddy/other crop harvested fields. It mainly comprises of hoppers to fill seed and fertilizer, metering mechanisms to meter seed and fertilizer, inverted T-type furrow opener to make a narrow slit in soil for dropping of seed and fertilizer.

Advantages

1. Reduces labour, saves time.
2. Saves fuel.
3. Reduces machinery wear.
4. Improves soil tilth.
5. Increases organic matter.
6. Traps soil moisture.
7. Reduces soil erosion.
8. Improves water quality.
9. Improves air quality.

Happy Seeder

The approach of happy seeder is attach seed drill immediately behind a modified forage harvester (straw management unit). The straw management unit cuts, lifts and throws the standing stubble and loose straw onto the sown area behind the seed drill, which sows into bare soil. Happy Seeder combines the straw management and sowing units into a single, light, compact machine.

Advantages

1. Reduces air pollution as it avoids stubble burning.
2. Reduces soil disturbance, enabling it to retain more nutrients, moisture and organic content.
3. Saves money as less time is needed on carrying out field operations.

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Cisgenesis: A Novel Way of Crop Improvement

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Introduction

Hybridization and mutation are the two ways for crop improvement. However, crops can also be improved using genetic engineering techniques; but, the existing GM (genetically modified) crops are highly regulated and depend on risk assessments with the source of transgenes which are usually from sexually incompatible species. Recently due to sequencing of genomes of many crop species, gene sequence information of plants is available which aids the cloning of cisgenes from sexually compatible species or plants themselves. Transformation of crop plants with cisgenes to improve crop while restricted within the gene pool of the classical breeder. Cisgenesis is an advancement of a one-step gene transfer from sexually compatible species by avoiding linkage drag, whereas conventional breeding suffers multiple steps of gene transfer as well as linkage drag. The similar genes used in cisgenesis compared with conventional breeding may be convincing to consider cisgenic plants as conventionally bred plants. This provides another argument to treat cisgenic plants as classically bred plants, by exempting cisgenesis of plants from the GM legislations. The advancement of the new biotechnology tool assists in increasing the effectiveness of work. The genome sequencing information of many of genotypes and the mined allelic variation in most important crops, landraces and wild relatives permit the cloning of desired genes and their transformation into selected varieties. The cisgenesis/intragenesis that makes the most of the resemblance with gene transfer by hybridization. The cisgenesis/intragenesis undertake few concerns for the application in agriculture and under review globally to consider the likely elimination from the current genetically modified plant regulation systems.

Trangenesis

Transgenic crop is a recipient plant inserted with one or more genes from donor plant that is sexually compatible or incompatible with the recipient plant or any nonplant organism and is called as Genetically Modified (GM) crop or transgenic crop. Introduction of foreign genetic material into the food crops is the major concern among the public leading to worldwide objections to transgenic crops.

In view of public concerns of safety issues about transgenic crops and at the same time make sure an environmentally sound plant production, the two concepts of transformation as cisgenesis and intragenesis were developed as options to transgenic crop improvement. The two concepts depend on the restricted use of gene pool from the same species or sexually compatible species the same as for hybridization. This is dissimilar to transgenesis where DNA sequences can be transformed between any species or maybe beyond genus. The genetic variation exploited by cisgenesis and intragenesis is equal to the genetic variation accessible for conventional breeding. Additionally, foreign DNA sequences such as vector-backbone genes and selection marker genes should be avoided for the intragenic/cisgenic transformants.

Cisgenesis

The cisgenesis is the transformation of a recipient plant with one or more genes cloned from a sexually compatible donor plant species. That gene is called as cisgene. The cisgene is an identical copy of the endogenous gene of the plants in which introns and its native promoter, exons and the terminator are present in the normal sense orientation. While cisgenes shared a familiar gene pool accessible for conventional breeding and final cisgenic plant not contain any foreign DNA viz., vector-backbone sequences and selection markers. Therefore, cisgenesis limits any modification in the original gene.

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Intragenesis

Cloning of particular genetic elements or genes from a plant and permit in vitro modifications of these genetic elements or genes and transformation of the resulting cassettes into a sexually compatible plant. The transformed genetic material can be a novel combination of different DNA fragments from the same species or species from sexual compatibility. Here Plant transfer DNA (P-DNA) borders used as an alternative to T-DNA borders used in Agrobacterium-mediated transformation. Therefore, the DNA sequence of one gene (with or without introns) can be combined with promoters and terminator of dissimilar genes belongs to the sexually compatible species. While using Agrobacterium-mediated transformation, the sequences of the T-DNA border should belong to a sexually compatible DNA pool (P-DNA borders).

Advantages of Cisgenesis Over Conventional Breeding

1. The transformation of genes among sexually compatible plants can be done faster. Gene transfer by hybridization methods may require up to 15-20 generations.

2. Linkage drag is avoided. Genetic material encoding for undesired traits may be tightly linked to the desired gene of interest may transfer through conventional breeding methods. The cisgenesisis precise to avoid such transfer of unwanted genetic material.

3. The original genetic makeup of plant variety is remaining preserved. Cisgenesis efficient method for cross-fertilizing heterozygous plants that propagate vegetative, such as banana, apple, and potato. In conventional breeding permits mixing up the combination of alleles in the existing heterozygous elite recipient genotype with genes from wild germplasm.

4. The higher expression level of a specific trait can be acquired by retransforming the gene encoding trait with native promoter and terminator or with a promoter and terminator from the sexually compatible gene pool.

The Requisites for Developing Cisgenic and Intragenic Plants

1. Availability of the gene of interest and gene elements within the sexually compatible species.
2. The development of plants lack of the foreign DNA sequence from marker genes and vector-backbone sequences.

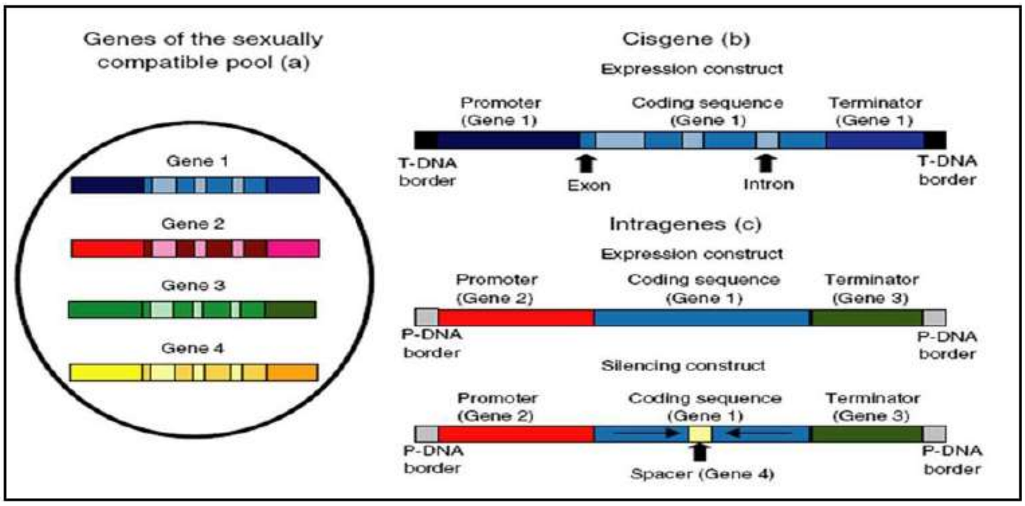

Fig 1: Cisgene and intragene constructs as defined by Rommens in 2004 and Schouten and coworkers in 2006, respectively. [Holme et al., (2013)].

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Effect of Primary Macronutrients on Insect-Pest of Field Crops

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Plant nutrition is the study that deals with plant's need for certain chemical elements including their specific and interactive effects on all aspects of plant growth and development, their availability, absorption, transport, and utilization. These chemical elements are referred to as plant nutrients. A plant nutrient is a chemical element that is essential for plant growth and reproduction. Essential element is a term often used to identify a plant nutrient. Plant nutrients can be classified on the basis of mineral composition, nutrients concentration and on the basis of their physiological functions. Besides carbon, hydrogen and oxygen, which plants obtain from carbon dioxide and water, 14 nutrients are recognized as essential viz., primary macronutrients (nitrogen, phosphorus and potassium), secondary macronutrients (calcium, magnesium and sulphur) and micronutrients (iron, manganese, zinc, copper, boron, molybdenum, chlorine and nickel) for growth of plants. The relative availability of various nutrients affects the growth and fitness of herbivores, whose biomass generally contains much greater concentrations of elements as compared to plants (Boswell et. al., 2008). Qualitative nutritional requirements of insects include carbohydrates, proteins, amino acids, fatty acids, minerals and vitamins. Insects get their nutrients from plants through feeding and the term insect nutrition is defined as the science that interprets the interaction of nutrients and other substances in food in relation to maintenance, growth, reproduction, health and disease of an organism. It includes food intake, absorption, assimilation, biosynthesis, catabolism and excretion

Effect of Nitrogen

Nitrogen has been found to affect the reproduction, longevity and overall fitness of certain pests. Synthetic fertilizer application, especially nitrogen fertilizer resulted in more serious insect herbivores occurrence and crop damage from these insects by reducing plant resistance. Ahmed et. al., (2007) found that high rate of nitrogen resulted in highest mean population/leaf of jassids, whiteflies. High levels of nitrogen fertilization also appear to promote cotton aphid reproduction and the build-up of high populations. Bi et. al., (2003) in another study observed a positive response between nitrogen application rates and the numbers of adult and immature whiteflies appearing during population peaks. According to Singh et. al., (1995) an increase in the level of nitrogen application resulted in an increase in the infestation by *Lipaphis erysimi* on mustard. Nitrogen is taken up by plants in two different forms, nitrate or ammonium. The amino acid compositions were different among plants with different nitrogen treatments, and amino acid content and carbohydrate-to-amino acid ratios were linked to changes in aphid development. Coulibaly (1990) has reported that increasing application of nitrogen fertilizer reduced the fibre content in sugarcane and resulted in increased damage by the stem borer. The application of nitrogen fertilizer in plants can normally increase herbivore feeding preference, food consumption, survival, growth, reproduction, and population density. Plant nutritional quality and plant defenses that directly act on herbivores are altered by nitrogen fertilization and herbivorous insects can distinguish between plants receiving different nitrogen applications (Chen and Ruberson, 2008).

Effect of Phosphorus

Higher phosphorous levels are associated with higher insect population. Jansson and Ekbom (2002) found that as phosphorous fertilizer levels are increased, the development time of aphid *(Macrosiphum euphorbiae)* got shortened, while the lifespan of adult and its number of offspring increased. Some reports showed that the application of phosphorus reduced the population densities and damage of pod sucking bugs (Pitan et. al., 2000) and *Empoasca dolichi* (Shri Ram et. al., 1990) and not much is known of its effects on other insect pests. Many scientists have also concluded that phosphorous either does not influence sucking insects (about 48%) or influences them in a positive way (approximately 38%).

Effect of Potassium

Potassium has been considered a key component of plant nutrition that significantly influences crop growth and insect-pests infestation. Amtmann et. al., (2008) suggested that potassium ion from soil supply may affect a number of physiological, metabolic and hormonal processes in plant tissues. These processes are likely to be crucial for plants susceptibility or resistance to pathogens and insects. Potassium fertilizer is negatively associated with occurrence of *Aphis glycines*, leafhoppers and mites (Myers and Gratton, 2006). Potassium nutrition has a profound effect on the profile and distribution of primary metabolites in plant tissues, which in turn could affect the attractiveness of plant for insects and pathogens as well as their subsequent growth and development. Amtmann et. al., (2008) gave a potential mechanism to explain the relationship between potassium deficiency and increased insect attack. Potassium deficiency results in reduced synthesis of proteins, starch, and cellulose, and increased accumulation of lower molecular weight compounds such as amino acids, nitrate, soluble sugars, and organic acids. These lower weight molecular compounds are more easily utilized as nutrient sources by sucking insects. Thus, in other words, potassium deficiency on its own may not correlate with higher insect attack, but the subsequent impact of potassium deficiency on plants, makes plants more readily attacked by sucking insects. This was better explained by (Walter and DiFonzo, 2007) who reported that low potassium fertility was associated with high foliar levels of the amino acid serine and higher aphid infestations. Increase potassium level also leads to accumulation of more phenols which had a profound effect on insect-host interactions and probably contributes in increasing insect resistance in some rice cultivars.

Conclusion

Nutrient enrichment from agricultural and atmospheric sources has the potential to alter plant–insect interactions via changes in plant growth and defense. Optimized management of chemical fertilizers will be essential for achieving sustainability of intensive farming. Thus, a greater understanding of relationships among soil characteristics, fertilization practices, plant nutrient content and the ability of pests to reduce yield or crop quality will be required.

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Performance of Quinoa as Leafy Vegetable

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Non-traditional vegetables are underutilized which are often neglected because their nutritional content is not fully known although some are quite rich in nutrients compared to traditional vegetables. Leafy green quinoa is one such example of a non-traditional vegetable. Quinoa (*Chenopodium quinoa*) belongs to the family Amaranthaceae. *Chenopodium quinoa* is an annual herbaceous plant, measuring 2 to 3 m in height, depending on environmental conditions and genotype. The leaves show pronounced polymorphism: rhomboid, deltoid or triangular. It has a racemose infloresence. The fruit occurs in an indehiscent achene, protected by the perigonium. The seeds are 1 to 2.6 mm and are white, yellow, red, purple, brown or black.

The benefits of quinoa are due to its high nutritional value. Quinoa leaves contain a high amount of ash (3.3%), fiber (1.9%), nitrates (0.4%), vitamin E (2.9 mg a-TE/100 g) and Na (289 mg/100 g), vitamin C (1.2–2.3g/kg) and 27–30g/kg of proteins (Bhargava *et al*., 2006). The total amount of phenolic acids varied from 16.8 to 59.7 mg/100 g and the proportion of soluble phenolic acids varied from 7% to 61%; which was low compared with cereals like wheat and rye, but was similar to levels found in oat, barley, corn and rice (Repo Carrasco *et al*., 2010). Quinoa leaves are considered nutritious vegetables and based on their dry weight; they present a better profile than grains. The protein content in their fresh leaves is greater than that in spinach (2.86%), chard (1.82%) and broccoli (2.98%). The nutritional properties of quinoa leaves are due to their high mineral and vitamin contents, in100 grams of leaves possessing 410 mg of magnesium. This content meets the recommended quantity for men (400–420 mg) and surpasses the amount recommended for adult women (310–320 mg),that is why quinoa should be a key part of the diet (Nutri-Facts, 2014). Because of its large agricultural and nutritional potential, interest in quinoa has increased in recent years it is considered as a “star” product in the world because of its nutritional and medicinal properties. Quinoa includes a variety of species, and its seed is different from cereals because it has all of the required amino acids; it is also the only vegetable-derived food that can replace animal protein. In this sense, the increases in production and exportation are largely due these qualities (Ayala, 2013).

This needs to bring a greater awareness of its nutritional value among the people. Prospects for improving propagation and cultivation techniques are fairly encouraging. Agro industrial processing is a decisive factor for the present and future development of the crop. It enables quality and use to be optimized and aggregate value increased and it makes marketing easier, thus encouraging growers not only to improve productivity but also to increase the area sown.

Cultivation Details

The soil is to be prepared well by ploughing to get fine tilth and incorporate FYM in the soil. Seeds to be sown at a depth of 1-2cm with proper spacing. Before sowing, just like in Amaranthus crop, quinoa seed should be mixed with fine sand in the ratio of 1:2 for proper distribution of seed. After sowing, cover the seed properly with soil and leveled gently. Irrigation is given immediately after sowing and then at regular intervals. Gap filling should be done after sowing, thinning should be done to remove excess plants to reduce the competition for moisture, nutrients etc., and removed seedlings are used for gap filling.

Fertilizers to be applied in the form of urea, single super phosphate and murate of potash at required doses i.e. 50:50:50 kg NPK/ha. Apply urea at 50 kg/ha in 3 dose after first, second and third cuttings respectively. Phosphorous and potassium are applied initially at the time of sowing. Weeding should be done 30 DAS to keep the crop free from weeds. Harvesting starts at 30DAS after sowing and subsequent cuttings can be done at 15days interval.

Arpitha (2017) conducted an experiment on quinoa spacing and leaf quality at Hyderabad, Telangana. The data related to the effect of crop geometries on leaf length and width of quinoa is presented in Table 1. The data revealed that with increase in spacing there was increase in leaf length and width. The data related to the leaf quality (Table 2) revealed that with increase in the age of crop, the crude fiber, crude protein and carotenoids increased significantly but not much variation in vitamin-C.

Table 1: Effect of crop geometries on leaf length and width of quinoa

Treatments	Leaf length (cm)			Leaf Width (cm)		
Crop geometry	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS
S1 (15x10 cm)	3.07	3.71	4.20	2.56	3.30	3.66
S2(25x10 cm)	3.29	3.94	4.84	2.93	3.72	4.02
S3(13x10 cm)	3.50	4.27	5.53	3.17	3.94	4.52
S4(45x10 cm)	3.96	4.83	5.95	4.10	4.20	4.65
Mean	3.46	4.19	5.13	3.19	3.79	4.21
S.Em+_	0.05	0.09	0.1	0/09	0.09	0.08
C.D at 5%	0.16	0.29	0.32	0.30	0.28	0.26
CV%	3.52	5.05	4.57	6.98	5.39	4.53

(Arpitha, 2017)

Table 2: Comparative Nutritional Values

Quinoa nutritional parameters		
Nutrition values	30 DAS	60 DAS
Crude fiber (%)	8.6	11.66
Crude Protein (%)	12.20	21.10
Carotenoids (mg/kg)	632.84	680.38
Vit-'C' (mg/kg)	88.44	87.97

(Arpitha, 2017)

Conclusion

The leaves harvested form the quinoa crop at closer spacing and early harvest (30 DAS) are tenderer with less fiber content. Fresh quinoa leaves were incorporated into various products viz dosa batter, potato curry, chat with chana and sweet corn and all are accepted in sensory evaluation when compared with bathua leaves (aprpitha,2017). The addition of quinoa leaves not only improves the nutritional value of the product but adds variety to the diet.

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Mechanization of Orchard Management Practices

Article ID: 31677

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Introduction

Higher labour inputs and prolonged field operations increase the cost of cultivation in fruit orchards. The use of robotic or automated machines in orchard operations is associated primarily with insufficient labour availability and rapidly increasing labour costs in tree fruit production and is critical for improving the yield of high-quality fruit with minimal dependence on seasonal human labour. With the use of improved machines not only the cost of cultivation gets reduced but the profitability is also improved. There are machines, which perform two-three operations at a time with precision. Another advantage of using improved machines lies in increasing the input use efficiency, which is crucial in agriculture. For increasing the input use efficiency, adoption of mechanization is essential.

The Importance of Mechanization in Orchard Management

The orchard management practices like pruning, thinning, spraying and harvesting are possible to carry by machines. The machines are often designed to spray pollen suspended in a liquid or dust medium to target canopy areas.

1. Robotic Pruning: Pruning involves cutting away the tree branches to make the balance between the vegetative and reproductive growth of the plant, manipulate the canopy resulting in good fruit quality, size and yield, and set the optimal crop load for the next season. Pruning is one of the most important tree fruit production activities, which is highly dependent on human labour. Skilled labour is in short supply, and the increasing cost of labour is becoming a big issue for the tree fruit industry. Growers are motivated to seek mechanical or robotic solutions for reducing the amount of hand labour required for pruning. Identifying tree branches/canopies with sensors as well as automated operating pruning activity is the important components in the automated pruning system. Tree architecture is very critical for adopting automated orchard operations such as pruning and harvesting. Intensive tree orchard with narrow tree canopy or even 2D planar fruiting wall would be suitable for fully autonomous pruning system in the future. To develop robotic pruning, simple and quantified pruning rules are the essential of practical pruning strategies. Many studies have focused on the tree branch identification and reconstruction; however, the accuracy and efficiency still need to be improved for practical pruning operation (Long He and James Schupp, 2018).

2. Artificial pollination by robots: Other than the application of agro chemicals, artificial pollen application (also called mechanical pollination) is another important application of spraying technology in producing fruit, berry, nut and vegetable crops. Artificial pollination using ground robots/vehicles is very like agro chemical applications using electrostatic sprayers. The machines are often designed to spray pollen suspended in a liquid or dust medium to target canopy areas. Different types of sprayers have been tested to optimize the type and size of nozzles, operating pressure, flow rate, carrier medium and distance to bloom so that the desired density of pollen could be sprayed to targeted canopy areas. So, the fruit set percentage will be increased by artificial application of pollen grains.

3. Robotic Thinning: Fruit trees produce many more flowers than are required for a commercial crop with desired yield, fruit size and fruit quality. Thinning of flowers is performed to regulate the number of fruits that will set, and as a result, influences fruit size and quality. Thinning is also required to offset the tendency of some varieties of fruit crops towards alternate year bearing. The current practice is to thin the crop with chemicals, or manually. The small size of the target, the flowers, relative to the large size of the canopy poses some challenges for implementing robotics and automation solutions to this orchard task. Robotic and automated thinning has so far focused on flower thinning: including introducing elements of autonomy to mass removal systems such as string thinners with the development of robotic thinning arms and end-effectors. There also has been work on detecting flowers in colour or multispectral images for two purposes: precise flower estimates as inputs to thinning models and three-dimensional estimation of canopy and flowers for robotic thinning.

4. Robotic Spraying: Spraying agro chemicals on orchard crops is one of the most important field operations to protect crops from various types of pests and diseases and to provide desired nutrients and other inputs such as plant growth regulators. Precise application of chemicals (i.e. right amount of spraying at right location and at right time, sometimes referred to as 3R) is essential to make sure inputs are applied effectively to achieve desired efficacy. The ground spray systems discussed so far lack the capability to spray input materials to specific targets such at fruit or individual flowers. There have been some efforts at developing robotic solutions to spray targeted canopy objects or specific parts. One system targeted herbicide application to grapevine suckers, which grow at the base of grapevine trunks (Kang et al., 2012). The system included a camera system to detect trunks and suckers of grape vines and a set of nozzles to spray chemicals to only targeted areas of the trunks to control sucker plants and insects, such as cutworm. The system was tested in wine grapes in Washington State showing a chemical saving up to 92% compared to a band broadcasting of chemicals with a regular sprayer.

5. Robotic Harvesting: Harvesting is a labour intensive and time sensitive operation in orchard crops. Scientists and engineers have been investigating robotic systems for harvesting various types of crops. A robotic harvesting system for orchard crops consists generally of a vision system to detect and locate target fruit (and obstacles when needed), a manipulation system to reach the target fruit, an end- effector to detach fruit from branches and collect them onto a conveyance system, and a conveyance system to bring harvested fruit onto a container/bin (some of the components are depicted in developed at Washington State University by a team led by Manoj Karkee and Qin Zhang Fig.3). Robotic tree fruit harvesting is a difficult challenge, but there exists a clear need for the technology in today's economy.

Fig: 1 Mechanical pruning system for apple trees with saw-tooth cutter driven by a tractor

Fig: 2 precision spraying system on Grape vine

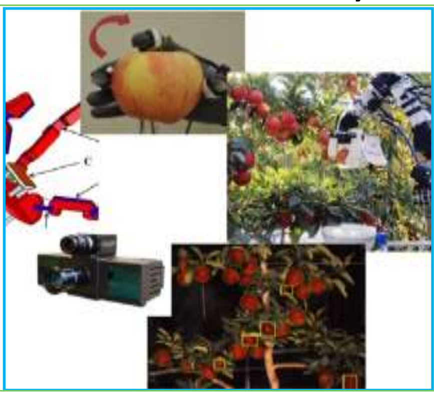

Fig: 3 robotic harvesting system developed at Washington State University	Fig: 4 Artificial pollination by electrostatic sprayer

Constrains in Mechanization

1. High cost: Farm mechanisation, due to the numerous machines involved usually expensive to operate.
2. Un-organized farm sector.
3. Farmers mostly depends on traditional harvesting methods, lack of knowledge on mechanized harvesting, pruning etc.
4. Poor infrastructure set up mechanization options for orchard management practices in India.
5. Small and fragmented holdings.
6. Poor resource base of farmers.
7. Non-availability of loans from cooperative and commercial banks for purchase and hiring of improved implements.
8. On-existing of small units for manufacturing prototypes and repairs of farm machinery.
9. Lack of effective consumer protection in rural areas for redressel of cases of product problems, and poor after-sales- services, etc.

Conclusion

In Horticulture, field operations are time-bound. Timeliness of operations is crucial to success in farming. Reduction in cost of cultivation is of paramount importance in horticulture. Higher labour inputs and prolonged field operations increase the cost of cultivation. With the use of improved machines not only the cost of cultivation gets reduced but the profitability is also improved. There are machines, which perform two-three operations at a time with precision. Another advantage of using improved machines lies in increasing the input use efficiency, which is crucial in agriculture. The demand for sustainable mechanization and services will continue to rise naturally with a growing. The demand for sustainable mechanization and services will continue to rise naturally with a growing population's demand for food, feed and biological industrial raw materials from agriculture and horticulture.

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Role of Agriculture in Economic Development of India

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Role of Agriculture in Economic Development

1. Agricultural sector plays a strategic role in the process of economic development of a country. It has already made a significant contribution to the economic prosperity of advanced countries and its role in the economic development of less developed countries of vital importance.

2. For a long time, economists have debated on the relative importance of agriculture and industry in economic development of a country. Accordingly, different priorities have been assigned to these two key sectors of the economy in developmental planning. But the real issue is now whether agriculture should be accorded maximum priority in planning or industrial development.

3. Economic development is a complex process and it is influenced by both economic and non-economic factors. In economic factors, development process in any country depends on the available capital stock, capital output ratio in various sectors, agricultural surplus, conditions in foreign trade and economic system. In addition, some non-economic factors such as size and quality of human resources, political freedom, social organization, general education etc. are also important factors for development.

The Important Roles of Agriculture for the Development of Indian Economy is Given Below

The agriculture sector is the backbone of an economy which provides the basic ingredients to mankind and now raw material for industrialization.

1. Contribution to National Income.
2. Source of Food Supply.
3. Source of Livelihood.
4. Pre-Requisite for Raw Material.
5. Provision of Surplus.
6. Shift of Manpower.
7. Creation of Infrastructure.
8. Relief from Shortage of Capital.
9. Helpful to Reduce Inequality.
10. Based on Democratic Notions.
11. Create Effective Demand.
12. Helpful in Phasing out Economic Depression.
13. Source of Foreign Exchange for the Country.
14. Contribution to Capital Formation.
15. Employment Opportunities for Rural People.
16. Improving Rural Welfare.
17. Extension of Market for Industrial Output.
18. Commercial Importance.
19. Source of Government Revenue.
20. Role of Agriculture in Economic Planning.
21. International Trade.
22. International Ranking.

Agriculture Makes its Contribution to Economic Development in Several Ways, Viz

1. By providing food and raw material to non-agricultural sectors of the economy.
2. By creating demand for goods produced in non-agricultural sectors, by the rural people on the strength of the purchasing power, earned by them on selling the marketable surplus.
3. By providing investable surplus in the form of savings and taxes to be invested in non-agricultural sector.
4. By earning valuable foreign exchange through the export of agricultural products.
5. By providing employment to a vast army of uneducated, backward and unskilled labour.

As a matter of fact, if the process of economic development is to be initiated and made self-sustaining, it must begin for agricultural sector.

An Increasing Marketable Surplus of Agricultural Output is Very Much Essential in India for

1. Increasing supply of food and raw materials at non-inflationary prices.
2. Widening the domestic market for industrial products through higher purchasing capacities in the rural sector.
3. Facilitating inter-sectoral transfers of capital needed for industrial development along-with infra-structural development.
4. Increasing foreign exchange earnings through increasing volume of agricultural exports.

Agriculture Sector Provides Funds for Capital Formation in Many Ways as

1. Agricultural taxation.
2. Export of agricultural products.
3. Collection of agricultural products at low prices by the government and selling it at higher prices.
4. Labour in disguised unemployment, largely confined to agriculture, is viewed as a source of investible surplus.
5. Transfer of labour and capital from farm to non-farm activities etc.

Contribution of Agriculture to Economic Growth

The four possible types of contribution that the agricultural sector is capable of making for overall economic development. These are:

1. Product contribution i.e., making available food and raw materials.
2. Market contribution i.e., providing the market for producer goods and consumer goods produced in the non-agricultural sector.
3. Factor contribution i.e., making available labour and capital to the non-agricultural sector.
4. Foreign Exchange contribution.

Conclusion

From the above cited explanation, we conclude that agricultural development is a must for the economic development of a country. Even developed countries lay emphasis on agricultural development. Agricultural progress is essential to provide food for growing non-agricultural labour force, raw materials for industrial production and saving and tax revenue to support development of the rest of the economy, to earn foreign exchange and to provide a growing market for domestic manufactures.

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Applications of Pulsed Electric Field in Food Processing

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Introduction

Non-thermal technologies represent a novel area of food processing and are currently being explored on a global scale due to the increasing demand for foods with a high nutritional value and fresh-like characteristics, representing an alternative to conventional thermal treatments. Pulsed electric field (PEF) processing is one of the most promising non-thermal methods of food preservation that involves the application of pulses of high voltage to liquid or semi-solid foods placed between two electrodes. PEF is a continuous processing method, which is not suitable for solid food products that are not pumpable and restricted to food products with no air bubbles and low electrical conductivity. The maximum particle size in the liquid must be smaller than the gap of the treatment region in the chamber to ensure proper treatment.

The main objective of PEF processing is to inactivate microorganisms present in the foods while minimizing the changes in the physical, sensory, and nutritional properties. It aims to offer consumers high-quality foods and is considered superior to traditional thermal processing methods because it greatly reduces or detrimental changes in the sensory and physical properties of foods (Quass, 1997). PEF technology is designed to eliminate the use of elevated temperature during processing and to avoid the adverse effects of heat on the flavor, color, appearance, and nutritive value of foods (Barbosa-Canovas et al., 2000).

Principle of Pulsed Electric Field

The basic principle of the PEF technology is the application of very short pulses of high electric fields with duration of micro to milliseconds and intensities in the range of 10-80 kV/cm, usually at room temperature. The processing time is calculated by multiplying the number of pulses with effective pulse duration. The process is based on pulsed electrical currents delivered to a product place between a set of electrodes.

Applications of PEF in Different Foods

Application of PEF technology has been successfully demonstrated for the pasteurization of foods such as milk and milk products, liquid egg products, tomato juice (Mohamed and Eissa, 2012). It has also been successful in a variety of fruit juices with low viscosity and electrical conductivity such as orange, apple, and cranberry juice (Evrendilek *et al.*, 2000). The PEF treatment was shown to be very effective for inactivation of microorganisms, increasing the pressing efficiency and enhancing the juice extraction and for intensification of food dehydration and drying (Vorobiev *et al.,* 2005; Bajgai and Hashinaga, 2001; Bazhal *et al*., 2001 and Taiwo *et al*., 2002).

The various applications of PEF processing in different food products were given as follow:

1. Milk: Dunn and Pearlman (1987) conducted a shelf-life study on homogenized milk inoculated with *Salmonella dublin* and treated with PEF at 36.7 kV/cm and 40 pulses for 25 minutes. They reported that the *Salmonella dublin* was not detected in the PEF treated homogenized milk stored at 7-9ºC for 8 days.

Miranda (1998) studied the effect of PEF treatment on inactivation of *Listeria innocua* suspended in skim milk and its subsequent sensitization to nisin. The microbial population of *L. innocua* was reduced by 2.5 logs after PEF treatment at 30, 40, and 50 kV/cm.

Fernandez-Molina *et al.,* (1999) studied the shelf-life of raw skim milk treated with PEF at 30 kV/cm and 40 kV/cm with 30 pulses and treatment time of 2µs using exponential decaying pulses and reported that the shelf-life of milk increased up to 22 days and 14 days respectively.

2. Apple juice: Simpson *et al*., (1995) reported that apple juice from concentrate treated with PEF at 50 kV/cm with 10 pulses and treatment time of 2µs and maximum processing temperature of 45ºC had a shelf-life of 28 days compared to a shelf-life of 21 days of fresh apple juice.

Vega-Mercado *et al*., (1997) reported that PEF processing at 22-25ºC extended the shelf-life of fresh apple juice and apple juice from concentrate to more than 56 days and 32 days, respectively.

3. Orange juice: Zhang *et al*., (1997) studied the effectiveness of different pulse waves on processing conditions and shelf-life of reconstituted orange juice treated with PEF and reported that the square wave is the most effective pulse shape.

Yeom *et al.* (2000) in their study on PEF treated orange juice stored at 4ºC for 112 days reported that the PEF treated orange juice showed less browning than the thermally pasteurized juice.

4. Grape juice: Grimi *et al*., (2009) studied the juice extraction efficiency from Chardonnay white grapes using a pulsed electric field with two pressure conditions, and a treatment of 400 V/cm was applied. The study reported that the PEF treatment increased the juice yield by 67-75% compared to the control sample without any treatment.

5. Green pea soup: Vega-Mercado *et al*., (1996) treated the pea soup with PEF at 35 kV/cm with 16 pulses in temperature beyond 55ºC and reported that the shelf-life of PEF treated pea soup stored at refrigerated temperature exceeded 4 weeks.

6. Eggs: Dunn and Pearlman (1987) conducted a study in liquid egg products in a static parallel electrode treatment chamber with a 2 cm gap using 25 exponentially decaying pulses with peak voltages of around 36 kV. The study showed that the importance of the hurdle approach in the shelf-life extension of liquid egg products.

Qin *et al*., (1995) conducted studies on liquid whole eggs treated with PEF and showed that the PEF treatment decreased the viscosity but increased the colour of liquid whole eggs compared to fresh eggs.

7. Meat: PEF causes a significant microstructural change in the meat tissue as compared to freezing. A combination of freezing-thawing and PEF results in improved tenderness and significantly increases the purge loss but not cooking loss. Freezing with or without PEF greatly affects the volatile profile of the meat (Faridnia *et al*., 2015).

8. Beer: Ulmer *et al.,* (2002) studied the inactivation and sub-lethal injury of the beer spoilage microorganism, *Lactobacillus plantarum* using different pulse electric field strengths (10-19 kV/cm) and total energy inputs (13-42 kJ/kg). The study concluded that the cells were inactivated only above critical values of 13kV/cm and 64kJ/kg below these values cell damage was reversible.

Conclusion

Pulsed electric field processing is an emerging method of non-thermal food preservation that uses short bursts of electricity to retain food quality attributes. PEF can inactivate microorganisms in the food, reduce enzymatic activity, and extend the shelf-life with negligible or no changes in the quality parameters. Considering the effectiveness of PEF treatment on liquid products such as milk, fruit juices, liquid egg products, and other pumpable food products, extensive research has to be done to implement the process at an industrial level.

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Methods of Sensory Evaluation of Foods Substances

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Summary

In today's world people have started to demand change and innovation in food. Their tastes are no longer the same and they keep on changing very frequently. So to provide consumers with the food they like it is important to know the taste trends and consumer impressions of a product before launching it. Sensory evaluation is used to study the sensory characteristics of a food substance and analyse the same based on sensory attributes. This helps the producer to know that how well the product will be perceived by the consumers when it is launched and the producer can also know what all the aspects which have to be improved are and what are all the aspects which are subjected to change. Sensory evaluation is carried out in Sensory analysis laboratories where it is done by an expert panel with at most perfection. Sensory evaluation has to be carried out very perfectly as even minor errors will lead to significant losses. There are various methods to carry out sensory evaluation and every method is used for different purposes.

Introduction

Sensory evaluation of food is characterizing food substance based on various sensory attributes like Aroma, colour , flavour, texture , shape and size. Sensory evaluation has been defined as a scientific method used to evoke, measure, analyse and interpret those responses to products as perceived through the senses of sight, smell, touch, taste, and hearing (Stone and Sidel, 1993). Sensory evaluation has been a very important factor in food industry in determining the overall quality of the food, and in eliminating the uncertainties related to the Quality of food. We can see the outcome of sensory testing as a way to reduce risk and uncertainly in decision making (Dzung, N. H., Dzuan, L., & Tu, H. D ,2003.). Sensory evaluation can be used to learn about the difference among food substances in terms of sensory characteristics and the extent of difference in the sensory characteristics and only if the consumer likes the product the research and production of a product will be successful. Sensory evaluation gives us the eating quality of the food and an overall impression of the consumer while eating the food substance. Sensory evaluation often gives quick results than other Non-sensory methods and even the minute difference can be identified using sensory evaluation methods.

Sensory Testing

Sensory evaluation is supposed to be a precise method of analysis of sensory attributes and the testing should be highly sensitive in order to detect even the slightest difference in sensory attributes. Generally, an expert and unbiased panel conduct the sensory evaluation. The testing has to be conducted in a clean and controlled environment which is free from external distraction like external noise or fragrance which could deviate the panellists. The testing is mostly carried out in individual booths so that panellists do not get to interact with other fellow panellists and change their opinion. The order in which panellists are going to test the samples should also vary from one panellist to another panellist. The testing booths should have both normal lighting and red lighting to determine the colour differences in food samples. A typical tray which is used in sensory evaluation contains food samples of definite and equal volume in separate containers , A cup of water, Tissue papers, utensils (if required), plate cleansers like unsalted crackers for cleaning the palate and A sensory analysis Questionnaire with a pen. It should take care that sufficient volumes of food sample must be given but at the same time given volume of food sample should not make the panellist fatigue. The containers of food samples are labelled with a unique 3-digit number to keep the samples anonymous. This tray setup is then passed to the panellists via doors which connects their booth. It should be taken care that all the samples remain in the same temperature as temperature difference between the samples could also cause differences in the results. After testing the samples, the Questionnaires are collected from the panellists and statistics is being applied to the responses to get the results of sensory evaluation.

Sensory Evaluation Methods

There are 3 different methods of sensory analysis which are listed below:
1. Discriminative tests.
2. Descriptive tests.
3. Affective tests.

Discriminative Tests

Discriminative tests are used to identify the presence of differences between the samples. This is generally performed when a new batch of food substance is produced, this is to confirm that there is no difference s between both the batches of food.

There are 3 types of discriminative tests:

1. Triangle test: In this test 3 samples will be given out of which 2 are same and the panellists will be asked to identify the 2 same samples out of the 3 samples. The order of testing will also be mentioned in the Questionnaire.

2. Duo trio test: In this test 3 samples will be given out of which 1 will be treated as reference sample and among the 2 sample which are left out the panellist will have to identify which one is same as the reference sample. Reference sample contains twice the volume of the samples to be tested.

3. Paired Comparison test: In this test only 2 samples are used and the panellist is asked to pick the sample which is more of the desired character.

Descriptive Tests

Descriptive tests are used to identify the basis and extent of difference among the food substances.
There are 3 descriptive tests:

1. Line Scale/Unstructured scale: In this type of descriptive tests a 15cm line is drawn with 2 anchor points at 1.5 cm and 13.5 cm. The two anchor points will be described with the help of Points and words. The panellists will have indicated their marking by drawing a vertical line at the point in the scale. For every characteristic there are different lines on which the marking will be done.

2. Category scaling: In this type of descriptive test a 6- or 10-point scale is used where each point is described with words starting from least likely to most likely. The panellist will have to choose the point which describes their opinion on analysing the food substance. For every attribute there is a separate category scale.

3. Ratio Scaling: In this type of descriptive testing three samples are given to the panellist and they'll have to rate the first sample and they'll have to rate the other 2 samples in relation to the first sample. The samples used for this testing differs in only the attribute which is to be tested.

Affective Tests

Affective tests are used to identify consumer acceptability and liking of the food substance.
Again, there are 3 most commonly used Affective tests.

1. Paired Comparison Preference test: In this test panellist are given 2 samples and based on one given characteristic the panellists are asked to choose their preferred sample.

2. Hedonic Scaling: In Hedonic scaling a scale is given for every attribute with a series of statements describing each line and the panellist will have to choose the statement which describes the food substance.

3. Ranking Test: In this test the panellists are given with 3 samples and they are asked to rank the samples according to given characteristic as per their preference.

Conclusion

Sensory evaluation solves many problems related food quality assessing and consumer perception prediction thus ensuring that the food substance is well liked by the consumer and it is better than other methods as sensory evaluation is rapid, highly sensitive precise and reliable. Sensory evaluation thus enhances the process of food quality assessing by giving accurate results.

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Impact of Lockdown on Indian Farmers

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Introduction

Due to COVID-19, the whole farming community at the national level has been badly impacted. The agricultural production system activities including grain production, milk, meat, fisheries, vegetables, horticultural produce can't wait indefinitely. It is also a common knowledge that agriculture and allied sectors support directly or indirectly approximately 60% of the Indian population. Consequently, the whole lot is going to be affected by the onslaught of the dreaded virus impact. All the crops are affected due to the impact of COVID -19, yet the most affected is sugarcane, vegetable & horticultural crops, cotton & fresh-flower production. Because sugarcane is a labor-intensive crop right from sowing till harvesting. Crops other than rice and wheat are also labor-intensive. On the other hand, the incentivized crop diversification program will receive a huge jolt. Under such a situation the farmers will be forced to leave their land unsown, at least a part of it, which will affect the total productivity of the states and nation as well. The ongoing situation will be a fall out on vegetable & fruit production system which is labor-intensive activity. Vegetables and horticultural crops require manual laborers from day one to the consumption point. Most of the vegetables and fruit crops are perishable and have a very short shelf-life; hence are required to be reached to the consumer in a time-bound manner. If manual labour is not timely available it brings a huge loss to the growers which directly impacts remuneration of the growers, and ultimately the consumer has to pay more price owing to demand-supply principle. Timely transportation of these commodities is another issue that spurts the prices of these commodities for the consumers of far-flung areas. Similarly, the quality of the commodities is badly affected due to such issues. The next affected agri-activity is the fresh- flower growing industry which has fallen flat owing to the non-availability of the labour force as well as its demand in the local and international markets.

Conclusion

Due to the pandemic of COVID-19, most of the farmers could not harvest their crop in the past month and those who did harvest reported a yield loss because of lockdown-related issues such as low market price or inability to access their land due to travel restrictions. Farmers are storing their crops instead of selling them due to the lockdown and some were still trying to sell their crops. Lockdown has impacted the farmer's ability to prepare for the upcoming sowing season.

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Covid-19: Problem and Planning for Agriculture

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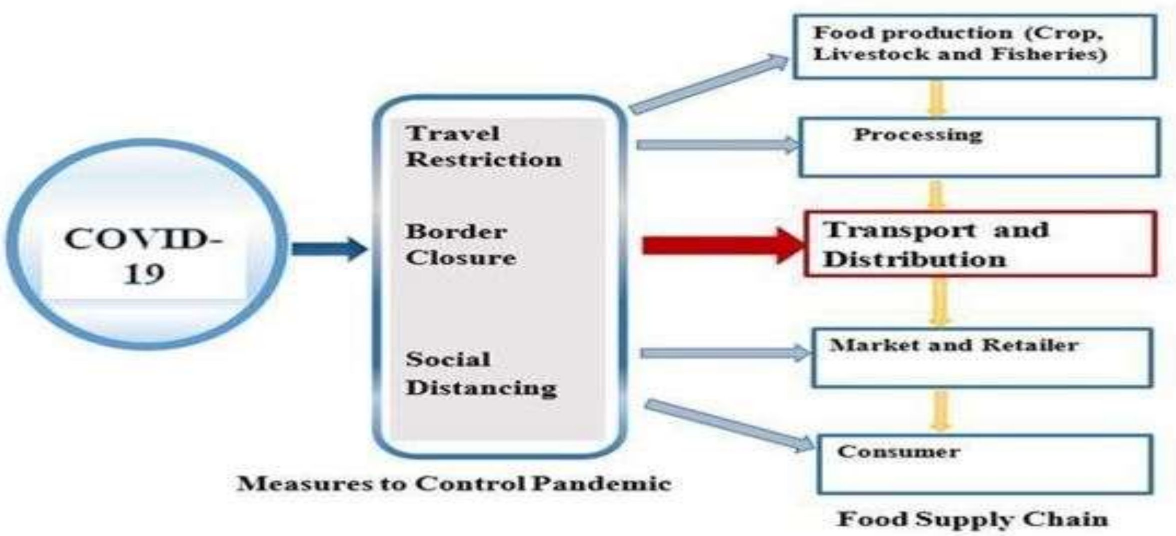
Covid-19

The corona virus disease (COVID -19) is caused by severe acute respiratory syndrome corona virus 2 (SARS – CoV - 2), which is also known as the COVID - 19 virus. In January 2020, the WHO declared the outbreak a Public Health Emergency of International Concern, and by March 2020, the WHO characterized the outbreak as a global pandemic. The COVID-19 virus has zoonotic importance, which means it is transmitted from animals to humans and has since spread between humans. It is primarily spread through saliva droplets or discharge from the nose. Corona virus (SARS-CoV-2), which causes COVID-19, the genetic material is only RNA. Once the virus, goes inside cell, the virus uses its genetic material — RNA to grow and multiply inside the cells. The COVID-19 that has swept through countries and continents has caused untold human suffering, social upheaval and economic damage. But, while the spread of the current crisis is unprecedented, the new corona virus follows a number of diseases that have emerged in recent decades, such as Ebola, AIDS, SARS, avian influenza and swine flu. All originated in animals and there is increasing evidence that humanity's over exploitation of nature is one of the factors behind the spread of new diseases (Galaverni et. al., 2020).

Indian Agriculture Condition During Covid-19 Pandemic



(Source: [Burning Issue] COVID-19 and its Impact on Agriculture – Civilsdaily)

Agriculture holds a share of about 14% in GDP of India and employees about 43% of population of India. The substantial decline of growth in this sector may leave the biggest impact of covid-19 in this world. Agriculture has emerged as a sector of hope and support. India could ensure food safety and security because the agriculturist produced enough food-grains and we had a workable mechanism to ensure food distribution. India's agriculture economy is estimated US$ 400 Billion- the second largest in the world. We are amongst the top five producers in most of the commodities. Our burgeoning population with ever increasing middle class provides a ready market for our agricultural products within the country. Globally, India is one of the most sought-after consumption destinations for agricultural produce. Our agricultural import bill is second only to petroleum products. We have a great opportunity to substitute imports of agricultural produce by competitively growing our products.

1. Crop production and availability of seeds: For crop production, the largest part of the seeding process will be almost unaffected between now and the summer. So, there would be no impact as such on seeds availability for now. But if the same scenario continues till year end, then surely seed availability can be an issue.

2. Fertilizers shortage: Due to global trade disturbance, farmers are facing the shortage of agricultural inputs like fertilizer and pesticides. In a shorter span, there is little shortage to be expected. In the longer term, the delivery of fertilizer via international markets may become a problem since some of the production plants in China have been shut down.

3. On food production and distribution: Most of the countries have taken measures such as home confinement, travel bans and business closure to control the rate of infection. Agriculture produce is mostly perishable in nature, so farmers are compelled to hold their unsold produce for a longer period of time. This has led to a reduction in food quality as well as an increase in the cost of production.

4. On livestock: Different agricultural sector such as livestock and fishery have been hit hard by the pandemic. In India, COVID-19 has caused a higher impact on livestock farming due to limited access to animal feed and a shortage of labour. For example, the travel ban has affected the delivery of breeding stock of poultry.

5. On workers: Agricultural workers in low and middle-income countries lack proper health services and social protection and due to little saving or no saving. Many informal workers in agriculture are obligate to work for their sustenance despite the self-isolation protocol during COVID-19 pandemic.

6. Impact on food demand and food security: The demand for food has affected due to reduction in income and purchasing capacity. Panicked Consumers are stock piling the foods which in turn has affected the food availability and price. Due to the decline in international trade, disturbance in food supply chain and food production, food insecurity may arise.

Agriculture and Food Supply Chain in India

In India, the Covid-19 lockdown disrupted some important agricultural activities and supply chains. Preliminary reports have been shown that due to the non-availability of laborers, the harvesting activities of wheat and pulses are severely interrupted in most of the states. Particularly in north-western states (Punjab, Haryana, and Himanchal Pradesh), for the harvesting of the crop is completely dependent on migrant laborers (Ananth, 2020; Ramakumar, 2020). Due to transportation and other issues, the supply chains of agricultural produce are also severely affected. Prices of cereals, vegetables, milk, and other crops have been declined, though consumers are paying more in some areas (Carberry and Padhee, 2020). Closer to hotels, restaurants, fast-food corners, and sweet shops during lockdown is also affecting harshly to milk and dairy industries. Meanwhile, the red meat industries including poultry farming have been badly hit by various humor, particularly on different social media platforms that the chicken could be a carrier for the coronavirus. In India, a large section of the population is under the below poverty line (BPL), who is directly dependent on different government and NGOs initiatives for food and nutrition, employment, health and education of children. For example, Mid-day meal in Anganwadi Kendra and school, MNREGA for employment to poor peoples. Covid-19 lockdown disrupts all these initiatives which may lead to serious food crisis and unemployment for poor people (Ramakumar, 2020; Swaminathan, 2020). Hence, to minimize the impact of this crisis and for the smooth running of agricultural activities and food supply chains, some initiatives have been taken by the government, including.

Here are some measures are required to keep the agricultural sector and supply chains working smoothly:
1. The government has correctly issued lockdown guidelines that exempt farm operations and supply chains. But implementation problems leading to labor shortages and falling prices should be rectified.

2. Keeping supply chains functioning well is crucial to food security. It should be noted that 2 to 3 million deaths in the Bengal famine of 1943 were due to food supply disruptions—not a lack of food availability.

3. Farm populations must be protected from the coronavirus to the extent possible by testing and practicing social distancing.

4. Farmers must have continued access to markets. This can be a mix of private markets and government procurement.

5. Small poultry and dairy farmers need more targeted help, as their pandemic-related input supply and market-access problems are urgent.

6. Farmers and agricultural workers should be included in the government's assistance package and any social protection programs addressing the crisis.

7. As lockdown measures have increased, demand has risen for home delivery of groceries and E-commerce. This trend should be encouraged and promoted.

8. The government should promote trade by avoiding export bans and import restrictions.

Government Announcements

1. Rs 1 lakh crore Agri Infrastructure Fund for farm-gate infrastructure for farmers.
2. Rs 10,000 crore scheme for formalisation of Micro Food Enterprises (MFE).
3. Rs 20,000 crore for Fishermen through Pradhan Mantri Matsya Sampada Yojana (PMMSY).
4. National Animal Disease Control Programme.
5. Setting up of Animal Husbandry Infrastructure Development Fund- Rs. 15,000 crores.
6. Promotion of Herbal Cultivation : outlay of Rs 4,000 crore.
7. Beekeeping initiatives –Rs 500 crore.
8. From 'TOP' to TOTAL – Rs 500 crore.

Mitigation Measures

1. Agricultural Produce Market committees (APMCs) should allow farmers to sell their goods beyond designed mandis to earn more income and lessen monetary burden (ICRISAT).

2. Agri-inputs and implements such as seeds, fertilizer, PGR's, pesticides should be made easily available to farmers.

3. Investment in key logistic should be enhanced to sustain the demand of agricultural commodities, start-up needs to be encouraged and promoted.

4. The micro small and medium enterprises (MSMEs), which requires raw materials from agriculture and allied sector, needs special attention to prevent collapsing of the rural economy and low interest or interest free loans should be offered to the industry.

5. Government should allow functioning of all trades and manufacturing units related with agri-inputs to ease the collapse of agri-input ecosystem (THE HINDU).

6. Minimum amount of Rs 3,000 per months for the next three months should be transferred to unemployed and migrant workers who are most vulnerable due to nCoV pandemic.

7. Dependency on inputs i.e., chemical fertilizers and pesticides should to restricted to cut the input cost and meet the demand of food production organically in sustainable way.

8. Erratic weather conditions can cause more loss to farmers so prior to sowing and harvesting of crops proper advisory needs to take. Government should promote trade by avoiding ban on export and import restrictions.

9. Post COVID situation might be tough for farmers and researchers, so productive investment on research and development would be helpful for them from the agricultural point of view.

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Importance of Mycorrhiza Fungi in Agriculture

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Introduction

The microorganism was used from the very beginning of the civilization in the agriculture and industrial processes even before their existence was well known. Production of fermented beverages, bread and vinegar are traditional processers practiced from the time of early civilization. The primary functions of filamentous fungi in the soil are to degrade organic matter and help in soil aggregation. Besides this property, bound species of *Alternaria, genus Aspergillus, Cladosporium, Dematium, Gliocladium, Humicola* and *Metarhizium* manufacture substance like organic compounds in soil and therefore could also be necessary for the maintenance of soil organic matter. Plant growth regulators and chemical fertilizers have been used to increase crop production. Application of chemical fertilizers to crop plants negatively affects human health and environments. Recent studies have focused on identification of alternative methods to enhance plant productivity and protect the soil.

Mycorrhiza is one of the major components of the agricultural natural resource microbes and they are members of the Kingdom: Fungi; Phylum: Glomeromycota. Soil-borne plant pathogens such as fungi, bacteria and nematodes incurred a great economic loss to the agricultural productivity. For management of these problems, an extensive use of chemicals for control of diseases pose a serious threat to the present-day sustainable crop production systems. The use of beneficial microorganisms is one of the alternative management strategies to have protective measures against soilborne pathogens (Mukerji *et al.,* 2002). Therefore, many researchers are trying to use alternate approaches based on either manipulating or incorporating microorganisms to strengthen plant.

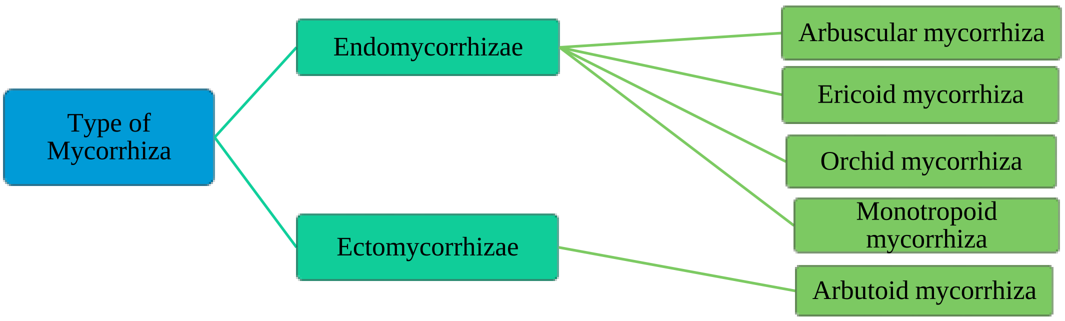
Soil is a primary source of fungal growth, and is associated with the roots of all plant species. Fungi produce a wide range of bioactive metabolites, which can improve plant growth. In addition, fungi supply inorganic nutrients to plants, such as ammonium, nitrate, and phosphate and they are used as biofertilizers. Rhizosphere microorganisms can overcome competition with other soil factors and survive under variable environmental conditions (Ferrara *et al.,* 2012). Mycorrhizae form a network of filaments that associate with plant roots and draw nutrients from the soil that the root system would not be able to access otherwise. This fungus-plant alliance stimulates plant growth and accelerates root development. One kilometre of hypae (fine filaments) may be associated with a plant growing in a one-litre pot and it can access water and nutrients in the smallest pores in the soil. It also makes the plant less susceptible to soil-borne pathogens and to other environmental stresses such as drought and salinity. In return the plant provides carbohydrates and other nutrients to the fungi. They utilize these carbohydrates for their growth and to synthesize and excrete molecules like glomalin (glycoprotein). The release of glomalin in the soil environment results in better soil structure and higher organic matter content.

Mycorrhiza Working Mechanism

The mycorrhizal symbiosis is the oldest symbiosis known to science. Fossil evidence suggests plants first colonized land with the help of AM fungi. That means this intimate relationship has been evolving for over 400 million years. It is a biologically complex relationship that we don't fully understand yet. Mycorrhizal spores germinate when in contact with plant roots and form filaments (hyphae), which create a symbiotic relationship increasing the plants ability to uptake fixed nutrients and water, improving plant performance. Mycorrhizal fungi increase the surface absorbing area of roots 100 to 1,000 times, thereby greatly improving the ability of the plant to access soil resources. Mycorrhizal fungi increase nutrient uptake not only by increasing the surface absorbing area of the roots, but also release powerful enzymes into the soil that dissolve hard-to-capture nutrients, such as organic nitrogen, phosphorus, iron and other "tightly bound" soil nutrients.

It begins when a seed germinates. The young plant produces hormones called strigolactones that attract AM fungi to it. The plant wants to be colonized. In fact, it prepares channels for the AM fungi that run between the cells in its roots. The fungi penetrate plant roots with filament called a hypha, and grow through these channels. Along the way it occasionally penetrates individual cells where it produces a structure called an arbuscule. The plant grows a special membrane to surround the arbuscule. The interface between these structures is where nutrients and minerals are exchanged between plant and AM fungi. Once colonization has occurred, the fungus sends its hyphae into the soil. They are _ner than the smallest roots and can penetrate pores in the soil that roots are too large to access, collecting water and nutrients which would otherwise be unavailable to the plant. Because the hyphae grow out from the plant's roots, extending beyond them into the soil, they also extend the total volume of soil available to the plant for nutrient uptake.

Two Groups of Mycorrhiza



1. Endomycorrhizae: Endomycorrhizae forms symbiotic relationship with about 85% of plants, they penetrate into the root cortexs and form nutrient exchange structures within the root cells. Among the types of endomycorrhizal fungi, arbuscular mycorrhizal fungi (AMF) are the most prevalent in soils. Endo-mycorrhizae represent a group of fungi that are associated with most agricultural crops and provide biological protection against soil-borne diseases. They occur in most ecosystems of the world and are found in many important crop species (wheat, maize, rice, grape, soybean and cotton) and horticultural species roses, petunias and lilies). AMF are obligatory biotrophs feeding on the products of their live plant host and those fungi are not specialized to their potential hosts. The host plant receives mineral nutrients from outside the root's depletion zone via the extraradical fungal mycelium, while the AMF obtains photo-synthetically produced carbon compound from the host.

2. Ecto-mycorrhizae: Ecto-mycorrhizal fungi do not penetrate into the root cell walls; they form a sheath around the root known as a fungal mantle as nutrient exchange network. Ectomycorrhizal fungi are mainly in forests ecosystems. Ecto-mycorrhizal (ECM) fungus forms a thick mantle structure within the intercellular spaces of root cortex and a sheath around the feeder root acting as an interface for channelling of nutrients from the plant to the fungus and vice versa. Ectomycorrhizal fungi do not penetrate living cells in host roots, but can only surround them. The extensive mycelium produced by ectomycorrhizal may function in transferring nutrients directly from the decaying leaves.

Benefits of Mycorrhizae

Mycorrhizal fungi allow plants to draw more nutrients and water from the soil. They also increase plant tolerance to different environmental stresses. Moreover, these fungi play a major role in soil aggregation process and stimulate microbial activity. According to the plant species and to the growing practices and conditions, mycorrhizae provide different benefits to the agriculture and to the environment:

1. Produce more vigorous and healthy plants.
2. Increase plant establishment and survival at seeding or transplanting.
3. Increase yields and crop quality.
4. Improve drought tolerance, allowing watering reduction.
5. Enhance flowering and fruiting.
6. Optimize fertilizers use, especially phosphorus.
7. Increase tolerance to soil salinity.
8. Reduce disease occurrence.
9. Contribute to maintain soil quality and nutrient cycling.
10. Contribute to control soil erosion.
11. The fungi selectively exclude the passive uptake of toxic elements limiting the partner plant's exposure to heavy metals, such as lead and cadmium.

Table 1: Direct and indirect effects of mycorrhizal fungi on crop productivity in organic farming systems:

Direct effects on crops	Indirect effects
Stimulation of plant productivity of various crops	Weed suppression
Nutrient acquisition (P, N, Cu, Fe, Zn)	Stimulation of nitrogen fixation by legumes (green manure)
Enhanced seedling establishment	Stimulation of soil aggregation and soil structure
Drought resistance	Suppression of some soil pathogens
Heavy metal resistance	Stimulation of soil biological activity
Enhance soil activity	Increased soil carbon storage
Increase production	Reduction of nutrient leaching

Conclusion

It is the substitute to reduce chemical fertilizer requirement, mycorrhizal fungi can directly and indirectly contribute to plant productivity in organic farming systems. Mycorrhizal effects include enhanced nutrient uptake, enhanced seedling establishment and stimulation of soil structure. Additional work in area of research is needed to develop farming systems that optimize the use of natural resources such as mycorrhizal fungi for sustainable agricultural production. AM fungi can act as support systems for seedling establishment, provide resistance against drought and some pathogens, and AM fungi can enhance biological diversity in grassland.

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Marker Assisted Selection: Importance and its Application in Crop Improvement

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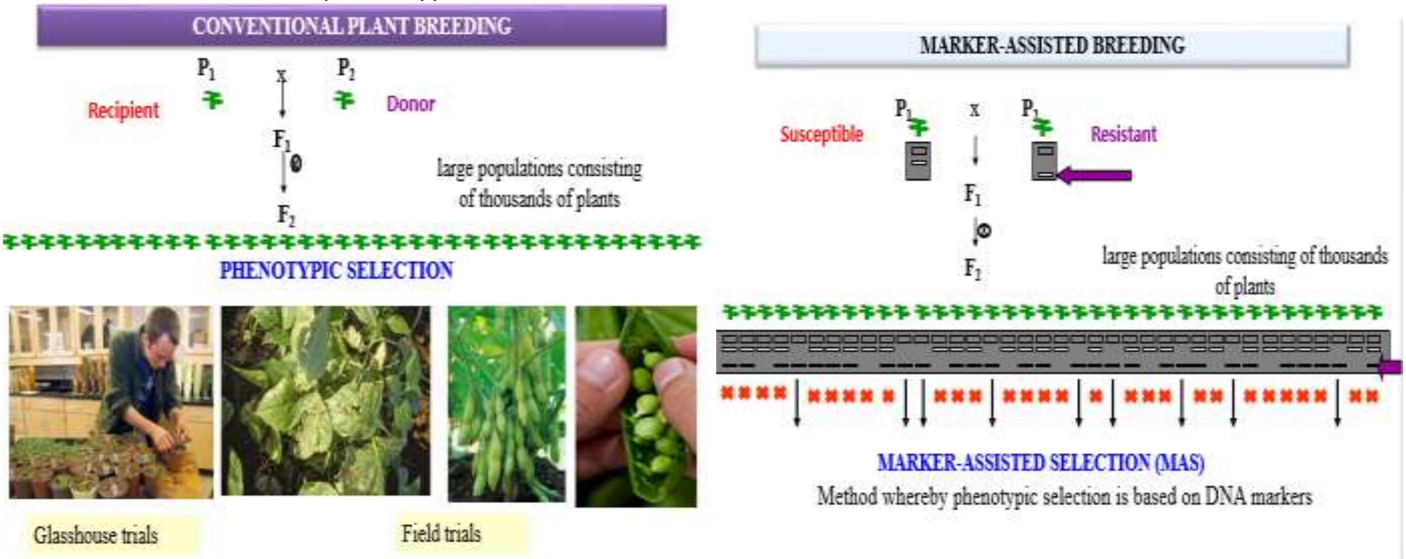
Marker assisted selection (MAS) can be defined as selection for a trait based on genotype using associated markers rather than the phenotype of the trait.



Advantages of Marker Assisted Selection

Gene stacking for a single trait: MAS allows breeders to identify the presence of multiple genes/alleles related to a single trait, when the alleles do not exert individually detectable effects on the expression of the trait. E.g: when one gene confers resistance to a specific disease, breeders would be unable to use traditional phenotypic screening to add another gene to the same cultivar in order to increase the durability of resistance. In such cases, MAS would be the only feasible option, provided markers are available for such genes.

Early detection: MAS allows alleles for desirable traits to be detected early i.e in the seedling stage itself well before the trait is expressed phenotypically. This benefit can be particularly important in slow growing and long duration crops.

Recessive genes: MAS allows breeders to identify heterozygous plants that carry a recessive allele of interest whose presence cannot be detected phenotypically. In traditional breeding approaches, an extra step of selfing is required to detect phenotypes associated with recessive genes.

Heritability of traits: MAS is mainly useful in selection for traits with low heritability up to a point, gains from MAS increase with decreasing heritability.

Seasonal considerations: MAS offers potential savings compared with conventional selection when it is necessary to screen for traits whose expression depends on seasonal parameters. Using molecular markers, at any time of the year, breeders can screen for the presence of an allele (or alleles) associated with traits that are expressed only during certain growing seasons.

Multiple genes, multiple traits: MAS offers potential savings when there is a need to select for multiple traits simultaneously. With conventional methods, it is often necessary to conduct separate trials to screen for individual traits.

Differences b/w Conventional and Molecular Breeding

Particulars	Conventional Breeding	Molecular breeding
Type of markers used	Morphological markers	DNA markers
Laboratory required	Simple laboratory	Sophesticated laboratory
Effect of environment	Very high effect of environment on conventional markers	No effect of environment on identification of DNA markers
Accuracy of method	Medium to high	Very high
Time required to develop a new variety	10-15years	3-5 years
Cost involved	Low to medium	Very high
Health hazards	Only in mutation breeding	With technique involving radio active labelling
Effect of gene interaction	Very high	No effect
Mapping of QTL	Not possible	Possible
Screening at seedling stage for economic traits	Not possible	Possible

Main Considerations of Marker Assisted Selection

1. Reliability: Molecular markers should co-segregate or tightly linked to traits of interest, preferably less than 5 cM genetic distance. The use of flanking markers will greatly increase the reliability of the markers to predict phenotype.

2. DNA quantity and quality: Some marker techniques require large amounts and high-quality DNA, which may sometimes be difficult to obtain in practice, and this adds to the cost of the procedures.

3. Technical procedure: Molecular markers should have high reproducibility across laboratories and transferability between researchers. The level of simplicity and time required for the technique are critical considerations. High-throughput simple and quick methods are highly desirable.

4. Level of polymorphism: Ideally, the marker should be highly polymorphic in breeding material and it should be co-dominant for differentiation of homozygous and heterozygous individuals in segregating progenies.

5. Cost: Molecular markers should be user-friendly, cheap and easy to use for efficient screening of large populations. The marker assay must be cost-effective in order for MAS to be feasible.

Procedure of Marker Assisted Selection

1. Selection of Parents:

a. The parents should be such that, we can get usable level of polymorphism.(Variation).

b. Parents with contrasting characters or divergent origin should be chosen – easy identification of DNA and also their segments in F_2 generations in various recombinations.

c. The parents that used for MAS should be pure (Homozygous).

2. Development of Breeding populations

a. The selected parents are crossed to obtain F_1 plants.

b. Generally 50-100 F_2 plants are sufficient for study of segregation of markers.

3. Isolation of DNA:

a. DNA can be isolated even from the Seedlings.

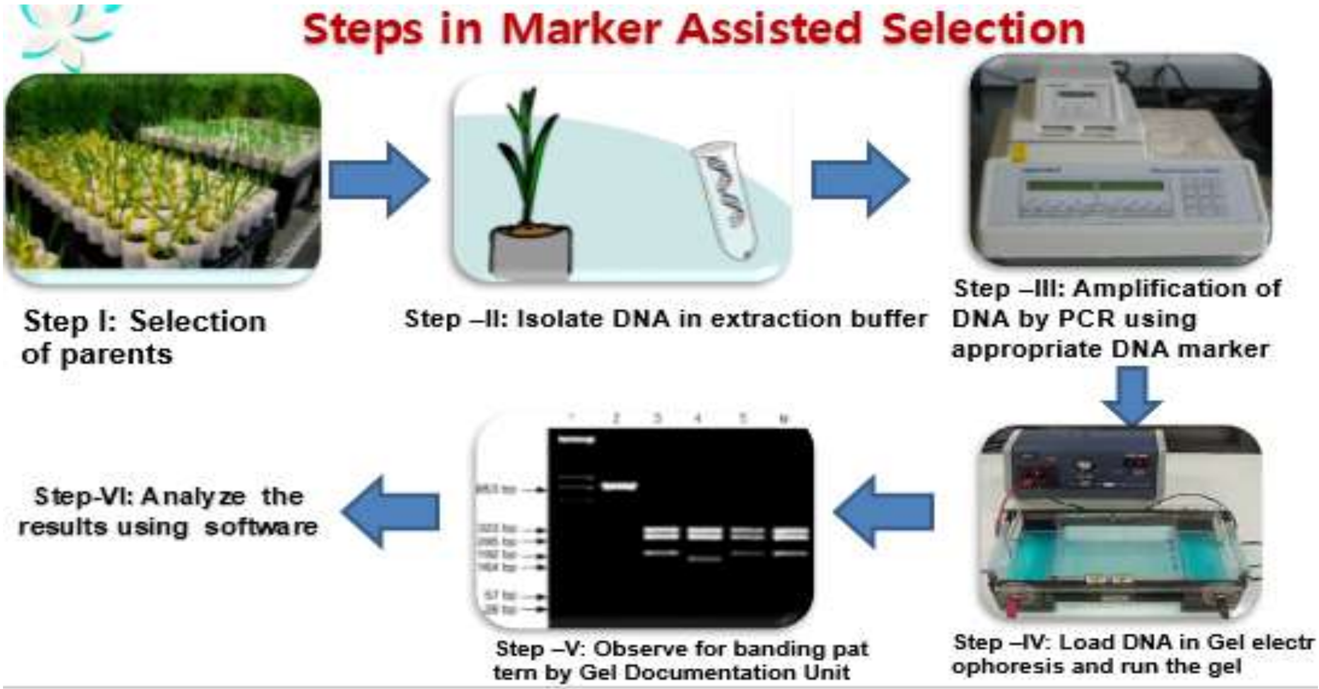
b. DNA is isolated from each F_2 plant.

4. Scoring markers:

a. The polymorphism between the parents and their involvement in the recombinants in F_2 population is determined by using markers(primers)

b. The markers are used to find out the fragments having similarity and amplify only with those segments which are complementary in nature.

5. Correlation with morphological traits: If, the DNA markers are correlated with morphological markers, MAS can be effectively used for genetic improvement of various traits.



MAS Breeding Schemes

1. Early generation selection.
2. Marker-assisted backcrossing.
3. Marker-assisted recurrent selection.
4. Marker-assisted Pyramiding.
5. 'Combined' approaches.

Disadvantages of MAS

1. Extraction of DNA is one of the bottlenecks for MAS.
2. MAS is more expensive than conventional techniques- especially for start-up expenses and labour costs.
3. Recombination between the marker and the gene of interest may occur-leading to false positive.

Software and Statistical Packages in MAS

1. Joinmap 3.0.
2. MAPMAKER or EXP ver 3.0.
3. LOD.
4. Chi square.

Conclusion

Marker assisted selection can be performed in early segregating populations and at early stages of plant development for pyramiding the resistance genes, with the ultimate goal of producing varieties with durable or multiple disease resistance in vegetable crops. Thus, with MAS it is now possible for the breeder to conduct many rounds of selection in a year.

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The Blue Economy: A Framework for Sustainable Development

Article ID: 31685

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Introduction

During these tragic times of the pandemic 'COVID-19', a scroll down the news feed only tells more depressing stories such as the downfall of the world economy, multinational companies going bankrupt, a considerable amount of the working-class population getting unemployed. Suddenly in all those, headlines pop, "INDIA RISES AMID COVID-19", digging deeper into it, the news was for the 0.16% increment in the export of seafood.

A report by The Marine Product Export Development Authority (MPEDA) stated that India had shipped 12,89,651 million tonnes of seafood worth 46,662.85 crores of rupees from 2019 through 2020. For many, this must be a piece of mere daily news but looking in the different perspective, here lies an opportunity of the blue economy which can help in uplifting the downfall with adequate measures towards the sustainable development.

The blue economy is the economic activity that directly or indirectly takes place in the ocean and seas, using outputs, goods and services into the ocean and land-based activities". Gunter Pauli first articulated the idea of the blue economy in 2010. Blue economy has incredible potential for boosting the financial development, business and food of economy.

It bolsters food security, overseeing and ensuring the sea condition, the formation of high worth employments and broadening to address new assets for vitality, it is a source of many new medications and necessary synthetics, protein food, remote ocean minerals. The Indian Ocean has a full cluster of biodiversity and environment assets from mangroves, coral reefs and ocean grass beds to deep seas, gives monetary worth items and administrations, for example, exceptionally nutritious food and job.

India has a coastline of over 7,500 km, spanning into nine maritime States and 2 Union Territories (UTs) in the mainland, and two island UTs with 12 major and 187 non-major ports, which plays a crucial role in sustaining the growth of trade and commerce. With Exclusive Economic Zone (EEZ) extending to 2.02 million sq km and the continental shelf area to 0.18 million sq km.

The Indian coast supports about 30% of 1.25 billion Indian population and various activities in inland waterways and port-based activities. The economic activity in the ocean is rapidly expanding due to ocean industries combined with large industries like maritime and coastal tourism, offshore oil and gas, shipbuilding and maritime equipment.

There is great potential for marine aquaculture, capture fisheries, fish processing, offshore wind, and port-based activities to provide employment, especially in marine aquaculture, fish processing, offshore wind etc. With a sustainable and monitored approach, this sector can act as the boon for the economic, social and environmental stability.

Taxonomy of Blue Economy Sectors and Activities

As we know, the earth is covered with 70% of water, a single most tremendous natural asset on the planet which represents some 99% of the earth's living volume and delivers numerous benefits to humanity. If the ocean were a country, it would have several trillion dollars per year of economic activity and would rank 7th on the list of largest nations by GDP. What generates all this are various sectors and activities listed below:

1. Fishing: Capture fishery, Aquaculture, seafood processing.

2. Marine Biotechnology: Pharmaceuticals, chemicals, seaweed harvesting, seaweed products, marine-derived bio-products.

3. Minerals: Oil and gas, deep-sea mining (exploration of rare-earth metals, hydrocarbon).

4. Marine Renewable Energy: Offshore wind energy production, wave energy production, tidal energy production.

5. Marine manufacturing: Boat manufacturing & repair, sail making, net manufacturing, marine instrumentation, aquaculture technology, water construction, marine industrial engineering.

6. Shipping, Port & Maritime Logistics: Shipbuilding and repairing, ship owners and operators, shipping agents and brokers, ship management, liner and port agents, port companies, ship suppliers, container shipping services, stevedores, roll-on roll-off operators, custom clearance, freight forwarders, safety and training.

7. Marine Tourism & Leisure: Sea angling from boats, sea angling from the shore, sailing at sea, boating at sea, water skiing, jet skiing, surfing, sailboarding, sea kayaking, scuba diving, swimming in the sea, bird watching in coastal areas, whale/dolphin watching, visiting coastal nature reserves, trips to the beach, seaside and islands.

8. Marine Construction: Marine construction and engineering.

9. Marine Commerce: Marine financial services, marine legal services, marine insurance, ship finance & related services, charterers, media & publishing.

10. Marine ICT: Marine engineering consultancy, meteorological consultancy, environmental consultancy, hydro-survey consultancy, project management consultancy, ICT solutions, geo-informatics services, yacht design, submarine telecom.

11. Education and research: Education and training, R&D.

Challenges and Opportunities

Our forefathers have been utilising all these resources from decades now, with the greed of human civilisation lies the exploitation of the resources. These exploitations have not only created loss but has also triggered the environmental degradation.

Many issues and challenges faced are: Approximately 20% of the world's coral reefs have been lost, mangroves have been reduced to 30-50%, rise in sea level and change in ecosystem status, increment in the pollution of oceans with marine debris. But with challenges lies new opportunities. Blue Economy offers a suite of opportunities for sustainable, clean, equitable blue growth in both traditional and emerging sectors.

The blue economy and sustainable depends on understanding the role of oceans and economic activities affecting the ocean, integration of economic, social and environmental aspects and coherent policies and management. Prime Minister Narendra Modi has stated it as a tool for India's development, emphasising on the protection of shared marine spaces for 'Security and Growth for All in the Region'.

Some of the initiatives taken by our government are as follow:
1. The Sagarmala project- extensive use of IT-enabled services for modernisation of ports.
2. O-SMART a scheme which aims at regulated use of oceans, marine resources for sustainable development.
3. ICZM (Integrated Coastal Zone Management) focuses on conservation of coastal and marine resources.
4. Development of Coastal Economic Zones (CEZ), wherein industries and townships that depend on the sea will contribute to global trade.
5. India has a National Fisheries Policy for promoting 'Blue Growth Initiative', which focuses on sustainable utilisation of fisheries wealth from the marine and other aquatic resources.

Conclusion

It is fair to say that in our quest for modernity, we have demonstrated considerable ignorance concerning the impact of our inventions. The blue economy is the emerging concept that encourages better use and protection of the blue resources while improving the human well-being and social equity. It can play a vital role in upbringing the economic status and social stability but proposing a controlled manner. The blue resources account for the 44 times of employment generation per a ton of fish and also the source for the 30% of oil and gas resources. A step forward can be initiated with innovative technologies, new products and services, and demand for 'green' infrastructure and processes for reshaping the traditional ocean economy. Achieving the blue economy goals would require extensive cooperation between the community of coastal states and a range of other stakeholders that include the private sector, non-governmental organisations, scientific and local communities. Further, we can improvise to meet broader goals of growth, employment generation, equity and protection of the environment. A must focus on marine ICTs, transport and communication services and Indian ocean security strategies, to prevent disasters.

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Novel Growth Regulators for Crop Productivity

Article ID: 31686

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Introduction

Plant growth regulators (PGR's) are considered as a new generation agro chemical after fertilizers, pesticides and herbicides which are responsible to signal, regulate and control the growth of plants. In general, Auxines, Gibrellins, Cytokinins and Ethylene are considered as growth regulators. There are some newer molecules of recent times also recognized as novel growth regulator such as Salicylic Acid, Brassinolides, Jasmonic acid and Growth Retardants. They enhance the source-sink relationship either by increase or reduce source-sink size and increase the translocation of photo assimilates thereby they enhance the activity of anti-oxidative enzymes, helping in better retention of flowers and fruits and even out the membrane activity under stress condition.

Salicylic Acid

In recent times, salicylic acid has been acknowledged as a potential PGR. It improves longevity of flowers, inhibits ethylene biosynthesis, reverses the effects of Abscisic acid (ABA), boosts environmental stress tolerance, important role in signal transduction and improves systemic acquired resistance. Salicylic acid nullifies effect of chilling injury under winter season by increasing the surface temperature.

Brassinolides

Brassinolides are plant hormones that regulate cell division, cell expansion, reproductive and vascular development, retard leaf abscission and enhance resistance to stress. It enhances the nutrient and water uptake. Brassinolide (0.5 ppm) increase the photosynthetic efficiency, translocation of organic material from source to sink. It regulates membrane stability under stress abiotic condition.

Jasmonic Acid

Jasmonic acid (JA) can regulate plant resistance to insects and pathogens, root growth, tendril coiling, viable pollen production and modulate the aspects of fruit ripening. Jasmonic acid levels increase precipitously in reaction to insect pest damage and stimulate the production of plant defences proteins. JA induces transcription genes involved in plant defence, genes encoding vegetative storage proteins but represses some genes responsible for proteins of photosynthesis.

Growth Retardants

There are compounds which prevent the gibberellins activity in plants such as cell enlargement or stem elongation. So, they are called as anti-gibberellins or growth retardants such as Cycocel, Mepiquat Chloride, Phosphon D, AMO – 1618, Morphactins, Maleic Hydrazide, Daminozide.

Role of Growth Retardants

1. Growth retardants reduce stem elongation and increase green colour.
2. Reduce cell division in sub apical meristem of shoot and show little effect on production of leaves or roots growth.
3. Reduce Internodes elongation without reduction in number of internodes and leaves.
4. The green colour of the leaves intensified and the leaf thickness and epicuticular wax may enhance.

5. Growth retardants reduce water consumption, retard senescence and improve resistance to environmental stresses.
6. Improves stem stability, Fruit colour development, fruit set in grapes, fibre quality in cotton, Induction of flower bud formation and controlling tree sizes.

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Organizational Climate: The Unique Identity of an Organization

Article ID: 31687

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Introduction

Organizations in the 21st century are facing more challenges than ever before. These challenges are not unique to any specific organization or industry, but affect all organizations, regardless of their structure and size. An organizational climate in a particular organization is constantly challenged by the increasing number of changes impacting on organizations today. The concept of organizational climate was formally introduced by the human relationists in the late 1940s. Now it has become a very useful metaphor for thinking about and describing the social system.

Basically, the organizational climate reflects a person's perception of the organization to which he/she belongs. It is a set of unique characteristics and features that are perceived by the employees about their organizations which serves as a major force in influencing their behaviour. Thus, organizational climate in a broad sense can be understood as the social setting of the organization.

Meaning of Organizational Climate

Organizational climate is made up of the two different terminologies i.e. organization and climate. Climate in natural sense is referred to as the average course or condition of the weather at a place over a period of years as exhibited by temperature, wind, velocity and precipitation. However, it is quite difficult to define organizational climate incorporating the characteristics of natural climate. This is so because the most frustrating feature of an attempt to deal with situational variables in a model of management performance is the enormous complexity of the management itself.

Organizational climate can be understood as the set of characteristics that describe an organization, distinguish it from other organizations and are relatively enduring over time and influence the behaviour of people in it. We can also say organizational climate as set of the attributes specific to a particular organization that may be induced from the way that organization deals with its members and its environment.

In more simple words, we can say that organizational climate is a relatively enduring quality of the internal environment that is experienced by its members, influences their behaviour and can be described in terms of the value of a particular set of characteristics of the organization. It may be possible to have as many climates as there are people in the organization when considered collectively, the actions of the individuals become more meaningful for viewing the total impact upon the climate and determining the stability of the work environment.

Characteristics of Organizational Climate

1. Multi-Dimensional Concept: Organizational climate is a multi-dimensional concept. The various dimensions of the organizational climate are individual autonomy, authority structure, leadership style, pattern of communication, degree of conflicts and cooperation etc.

2. General Perception: Organizational climate is a general expression of what the organization is. It is the summary perception which people have about the organization. It conveys the impressions people have of the organizational internal environment within which they work.

3. Unique and District Identity: Organizational climate gives a distinct identity to the organization. It explains how one organization is different from other organizations.

4. Abstract and Intangible Concept: Organizational climate is a qualitative concept. It is very difficult to explain the components of organizational climate in quantitative or measurable units.

5. Enduring Quality: Organizational climate built up over a period of time. It represents a relatively enduring quality of the internal environment that is experienced by the organizational members.

Factors Affecting Organizational Climate

Some researchers have given various factors affecting on organizational climate as below:

1. Lawrence James and Allan Jones have classified the five factors that influence organizational climate:

- **a. Organizational Context:** Mission, goals and objectives, function etc.
- **b. Organizational Structure:** Size, degree of centralization and operating procedures.
- **c. Leadership Process:** Leadership styles, communication, decision making and related processes.
- **d. Physical Environment:** Employee safety, environmental stresses and physical space characteristics.
- **e. Organizational Values and Norms:** Conformity, loyalty, impersonality and reciprocity.

2. Richard M. Hodgetts has given two major factors that influence organizational climate: He has classified organizational climate into two major categories. He has given an analogy with an iceberg where there is a part of the iceberg that can be seen from the surface and another part that is under the water and cannot be seen. The factors in the visible part that can be observed and measured are called overt factors and the factors that are not visible and quantifiable are called covert factors.

- **a. Overt factors:** Hierarchy, financial resource, goals of organization, skills and abilities of personnel, technological state, performance standards, efficient management.
- **b. Covert factors:** Attitude, feelings, values, norms, interaction, supportiveness, satisfaction.

Conclusion

On the basis of the above-mentioned information, one can understand the exact meaning of the organizational climate. Employees who work in any organization can compare the characteristics of their organization with the above-mentioned characteristics. Future researchers will more clearly understand the concept of the organizational climate on the basis of above-mentioned characteristics for their research work. Managers can manage their organization more effectively on the basis of the above-mentioned factors affecting the organization.

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Establishment of Lawn

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Introduction

A lawn can be defined as the green carpet for a landscape. It is a basic feature for home ground development and an essential feature for any other type of garden. In a home garden a lawn improves the appearance of the house, enhances its beauty, increases conveniences and usefulness thus adding monetary value to the real estate. The lawn provides a perfect setting for a flower bed, a border, a shrubbery or a specimen tree or a shrub. Besides, the material value, a lawn has its spiritual value, too.

The Site

The best situation will be the southern side and the next-best is the south-east and south-west of the building. Most of the grasses also do not grow well under the drip of large trees. Moreover, the dried leaves fall over the grass and make the lawn dirty. Therefore, it is desirable that no big tree should be planted at the site. Soil moisture capacity and drainage are also two important points which should be kept in mind. In a poorly-drained soil the grass will perish.

Soil

In India, the common lawn grass, *Cynodon ductlon (Doub)*, is very hardy and can be grown in any type of soil. But to obtain a most luxuriant lawn, it is desirable to have a fertile, loamy soil containing enough human. The soil should retain enough moisture and at the same time the drainage should also be adequate. A lawn soil should preferably be a little, but not highly, acidic, the pH range being 5.5 to 6.0. One reason for a poor-quality lawn is the insufficient depth of soil. A least a depth of 25-30 cm of good soil is required for obtaining a good lawn.

Drainage

Grasses are shallow-rooted herbs and, therefore, no deep drainage is necessary, but no water should stagnate in the rooting zone. In clayey soils, some kind of drainage must be provided. This may be done by drainage pipes or by putting a layer of broken pieces of bricks and rubbish 90 cm below the surface. Ordinary drainage work can be carried out in conjunction with grading or levelling.

Digging

Rough surface levelling by eye estimation should be done prior to digging. If during rough levelling a lot of shifting and filling of soil is necessitated, the surface soil should first be taken out and kept separately, which should be laid on the top after final levelling. After rough levelling is completed the digging work will commence. Thorough preparation of the ground is most essential in the success of a lawn. The digging operation should be done by the trenching method, otherwise the gardener may fail to dig to the desired depth. To ensure this a trench of 60 cm deep and 45 cm width is dug at one end of the site along its entire length and the soil is kept outside the lawn area. The rest of the area is dug at the same depth in widths of 45 cm at a time, the earth removed from the freshly dug trench going into the trench dug preceding this.

In most parts of India, digging is done during the hot months of April and May. After the trenching is completed the soil is left to dry in the scorching sun for a period of 7-15 days to kill the weeds or insects and for sterilizing the soil. The soil should be turned up subsequently 2-3 times at weekly intervals, each time the clods of earth, if any, are broken and roots of weeds removed.

Manuring and Grading

After the digging is over, the soil is to be manured and graded levelled. If the soil was originally fertile it is better not to apply any organic manure, as organic manure contains weed seeds which may contaminate the lawn with weeds which are difficult to remove. But poor soils will need dressing with organic manure. Night soil manure, FYM or old stable manure is used for this purpose. The manure is sieved finely and spread over the surface at the rate of 500 kg per 100 square metres of soil. The amount can be reduced depending on soil fertility level. This is then worked up in the soil to a depth of 15-20 cm.

Methods of Planting

If irrigation facilities exist, a lawn can be laid out any time during the year. Under Indian climatic conditions it is better to sow after one or two monsoon showers, while the grass root is planted at the beginning of the monsoon. The different methods for starting a lawn are by (a) seed sowing (b) dibbling, (c) turfing, and (d) turf-plastering.

1. From Seed: If grass-cuttings or roots are not easily available, one should go for the seeds. It is important to secure good quality seeds free from weed seeds. Doob grass seed is very light and fine and proper care should be taken during sowing. Prior to sowing, the surface, when relatively dried up, is scratched to a depth of 2.5 cm with the help of a garden rake.

The total area should then be divided into equal plots of 200 to 300 square meters to ensure even sowing of seeds. The sowing should be preferably undertaken on a windless day. The seed is divided at the rate of 500 g per 200 square meters and mixed with double the quantity of finely sifted soil and broadcast by hand. After sowing is completed the rake is drawn lightly twice in opposite directions to mix up the seed. The ground should then be rolled with a very light roller.

It will be advisable to cover the seeds with a thin layer of finely sifted soil. The plot should be watered at regular intervals with a water can having a fine rose. Watering can also be done with a hose-pipe with a fine rose. Sometimes, ants carry away the seeds and to prevent this the soil should be treated with B.H.C. or heptachlor. There is a belief that seeds sown within two days of full moon gives best germination and stronger growth, whereas sowing during new moon is the worst. However, there is no experimental evidence to prove this. The seed germinate in about 3 to 5 weeks from sowing. When the grass is about 5 cm tall it is clipped with a pair of garden shears. Initially the lawn mower is not used as this will uproot the grass. If the germination is patchy, resowing will be needed to cover such areas.

2. Dibbling: After the land is ready, well-matured unrooted (or rooted) doob grass cutting is obtained from a close-cut lawn or nursery or from a lawn-scraping. Grass, growing in shades and having nodes far apart, is not suitable for planting. If grass with short internodes is not available it will be desirable to plant the underground stems. The roots or grass thus obtained are dibbled (planted) in the ground when it is slightly moist at 7-10 cm apart. The soil is kept moist by frequent watering till the grass sprouts. Roots of doob grass sprout easily and the cuttings or off-shoots root readily under moist condition and within 5-7 weeks the grass will be ready for first cutting. By this method a lawn will be ready in about four months.

3. Turfing: The quickest method of developing a lawn is by turfing, but the cost is prohibitive. Turf is a piece of earth of about 5 cm thickness with grass thickly grown over it. The pieces may be of small squares or in rolls small width (30 cm or so). The turf must be free from weed and consist of the required lawn grass. These should be laid closely to each other in a bonded alternate pattern, like bricks in a wall, in the already prepared ground. Any unevenness in thickness can be corrected by under packing or removing some of the soil before putting in position. Along the joints sandy soil should be filled as packing. Bone-meal is dusted in the prepared ground a few days prior to turfing. The turf thus laid is made firm by a wooden beater made out of heavy block of wood and fitted with a handle. The grass is immediately watered copiously. By this method a lawn will be ready for use in a very short time.

4. By turf plastering: A paste is prepared by mixing garden soil, fresh cowdung, and water. Bits of chopped-up fresh roots and stem or rhizomes of doob grass are mixed with this paste and the paste is spread evenly on the surface of the prepared ground after moistening the soil. The paste is then covered by spreading 2 cm of dry soil and watered at regular intervals. This method is not very suitable especially in a dry and variable climate.

Conclusion

A lawn is the source of charm and pride and also reduces tension of the mind after a day's hard work in the materialistic world. But unfortunately, in India the growing of lawn is neglected from its construction stage to its maintenance. A garden lover should do well to remember that 75 per cent of the beauty of a garden depends on a properly maintained lawn. Hence one needs to know about the establishment of lawn before it's establishment.

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Phage Therapy - A Potential Bio- Control Technology

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Most of the plant disease causing pathogens are of fungus than bacteria. Even though less in number bacterial plant pathogens are responsible for severe economic losses in agriculture. Controlling of bacterial diseases is usually challenging due to lack of efficient bactericides, increased pathogen variability, increasing population of pathogen under favourable conditions, high transformation rates resulting in pesticide resistance development, high mutation rates also led to bacteria overcoming plant genetic resistance.

Why Bacteriophage as Biocontrol Agent?

From earlier days antibiotics and copper compounds are the regular means for managing bacterial plant diseases. Due to the continual use of copper fungicides, copper resistant bacterial strains were formed and which reduced the control efficacy. Continuous copper use is responsible for environmental hazards due to build-up to toxic levels in soils. Antibiotics usage paved the way to resistant strains led to loss of control of many pathogen systems. This initiated the accomplishment of eco-friendly alternatives, like plant activators and biocontrol agents.

Bacteriophages

Bacteriophage (phage) is a virus that infects and replicates with in bacteria and archaea. Bacteriophages are among the most common and diverse entities in the biosphere. Bacteriophages are omnipresent, found wherever specific bacteria (host) exist. Bacteriophages infect and lyse host bacteria. Interest in the capability of phages to control bacterial growth has spread wings from medical applications into agriculture.

Biocontrol of Plant Pathogen by Bacteriophage

The use of phages for disease control is a rapidly mounting area of plant disease control with immense potential to replace most of the present chemical control measures. Bacteriophages can be used successfully in integrated disease management strategies. The relative ease of preparing phage treatments make them good candidates for extensive use in developing countries as well. However, the effectiveness of phages depends significantly on prevailing environmental factors as well as on vulnerability of the pathogen as in many biological control agents. At most care is essential during development, production and application of phage treatments. Additionally, regular monitoring for the emergence of resistant bacterial strains is necessary.

Phage Therapy

Bacteriophages were first reported in association with plant pathogenic bacteria in 1924 against “cabbage-rot” caused by *Xanthomonas campestris* pv. *campestris*. Subsequently phages were effectively used to control potato tuber rot caused by *Erwinia carotovora* subsp. *atroseptica* and Stewart’s wilt of corn, caused by *Pantoea stewartii*. There after many bacterial diseases of crop plants were biologically controlled by phage therapy (Table 1).

Table 1. Successful usage of phage therapy against different plant disease:

Host	Disease	Pathogen
Cabbage	Black rot	*Xanthomonas campestris pv. campestris*
Citrus	Citrus canker	*Xanthomonas citri subsp. citri*
Citrus	Citrus bacterial spot	*Xanthomonas fuscans* subsp. *citrumelonis*
Mungbean	Bacterial leaf spot	*Xanthomonas axonopodis pv. vignaeradiatae*

Mushroom	Bacterial blotch	*Pseudomonas tolaasii*
Onion	*Xanthomonas* leaf blight	*Xanthomonas axonopodis pv. allii*
Pepper	Bacterial spot	*Xanthomonas campestris pv. vesicatoria*
Pomegranate	Fireblight	*Erwinia amylovora*
Potato	Potato scab	*Streptomyces scabies* [
Tomato	Bacterial spot	*Xanthomonas campestris pv. vesicatoria*
Tomato	Crown gall	*Agrobacterium tumefaciens*
Tomato, potato, brinjal	Bacterial wilt	*Ralstonia solanacearum*
Tomato, potato	Soft rot	*Erwinia amylovora*

Phage Therapy - Advantages

1. Less chance for host to regain viability: Once infected by an obligatory lytic phage, bacteria will not regain their viability.

2. Self-sustenance: Phages are self- sustainable, self- replicating and self- limiting. Bacteriophage live and replicate as long as the host bacterium is present in the environment and degrade quickly in the absence of its host.

3. Host specificity: Phages are host specific and do not harm other beneficial bacteria or eukaryotes.

4. Less chance for inducing resistance: Phage resistance occurs in a small population size as they have a very narrow host range. Mutations of the bacteria leading to resistance to the phages frequently results in loosing of virulence.

Phage Therapy - Challenges

1. Narrow host range: Phages host range is very narrow. Cannot infect different pathogenic bacteria species or even races

2. Skill needs for production: Continuous study and improvisation of the phage formulations are needed from time to time.

3. Horizontal gene transfer: The temperate phages can induce susceptible bacteria to a virulent one by horizontal gene transfer (HGT).

4. Environmental dependency: Highly depend on environmental condition for infection and proliferation.

Continuous studies on improvisation of phage therapy, phage formulation development, method of application and managing favourable environmental condition for phage activity may result in commercialization of phage therapy for controlling bacterial plant diseases in near future.

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Green Super Rice: The Next generation Rice

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Introduction

Rice *(Oryza species)* belonging to Poaceae family is the staple food crop for over half of the world's population and occupies 11% of the Earth's cultivated land area and ranks next to wheat (Khush, 2005). About 90 % of the world's rice is produced and consumed in Asia.

The rice yield is currently increasing at the rate of 1.0 % per year whereas number of rice consumer is increasing at the rate of 1.5 % per year. India has the largest rice cultivable area but in production, it ranks second next to China. It is mainly due to numerous biotic and abiotic stresses. To overcome these yield barriers, there is a need to develop stable high yielding resistant varieties.

Sustainable rice production is the key to food security and poverty alleviation of many Asian and African countries. Developing a Stable variety under this tremendous climate change condition is the greatest challenge to the breeders. The new emerging concept "Green Super Rice" (GSR) has been came and help breeders to develop a sustainable variety for mitigate the climate change.

Green Super Rice

GSR defined as the rice cultivars that can produce high and stable yield with less input (Zhang, 2007). This concept has now also been extended to promote high resource use efficiency in rice production, to support more efficient, environmental-friendly crop management technologies and ecological crop production systems along with mechanization and improved adaptability to avoid the impeding climate change.

Green Super Rice Project

Decrease hunger and increase the food and income security is the main moto of the GSR project. Breeding resource-use efficient and resistant to multiple abiotic and biotic stresses and dissemination of rice cultivars into five target countries of South Asia (India, Bangladesh), Eastern and Southern Africa (Tanzania, Uganda), and West Africa (Nigeria) small hold rice farmers is the major aim of the project.

In addition, smallholder farmers in eleven additional target countries of Asia (Philippines, Indonesia, Vietnam, Pakistan, Laos and Sri Lanka), and six SSA countries (Mozambique, Ethiopia, Rwanda, Mali and Senegal) plus four western provinces (Sichuan, Guangxi, Yunnan and Ningxia) of China will receive minimal supports from the GSR project.

Chinese scientists proposed the GSR project in 2005, which aims to develop new rice varieties with various green traits. In 2009, the Bill and Melinda Gates Foundation funded the international cooperation project on "Green Super Rice for Resource-poor farmers of Africa and Asia" (OPP1130530). In 2010, the Ministry of Science and Technology of China granted the 863 Project, "Breeding and Development of Green Super Rice," with extended funding up to 2018 (Yu et al., 2020).

Five major objectives:
1. Development of GSR varieties with improved yield, stress tolerance, and quality.
2. Identification and dissemination of GSR varieties with improved yield, quality, stress tolerance, and input use efficiency.
3. Seed of GSR varieties disseminated to farmers in SSA, India, and Bangladesh.
4. New generation of NARES breeders will be trained in modern breeding technologies.

5. Project impact will be assessed, highly effective project management and communication will be achieved, and exit strategy for long-term sustainability in the target countries will be developed.

Development of GSR

Future breeding and breeder's goal should not only be on increased productivity per se but also include adequate levels of tolerance / resistance to multiple biotic (Brown plant hopper, Green leaf hopper, Blast, Sheath blight, etc.) and abiotic stresses (Drought, Submergence, Salinity, etc.), nutrient and water use efficiency traits along with the desired quality traits. In other words, Breeder's should focus on "Green traits" for mitigating the climate change along with the yield per se to develop sustainable high yielding resistant varieties (Fig 1).

Progress in modern plant breeding techniques in terms of genomic/genetic research in rice helps us to identify, mapping and cloning of the novel and superior haplotypes or genes for the green traits such as biotic and abiotic stress resistance. With the help of OMICS technology (Genomics, Proteomics, Metabolomics) integrated with the conventional breeding, currently more than 3000 genes affecting a wide range of phenotypes have been cloned and dissected in rice (Wing et al., 2018). Marker-assisted selection (MAS) allow us to introgress the major gene/QTL into elite adapted mega varieties to improve their tolerances to biotic/abiotic stresses. With the available information on identified and cloned green genes and haplotypes, gene pyramiding and backcross was conducted to develop IL (Introgression lines) with maximum of green traits. Thus, new pre-breeding lines with multiple resistance, high yield and quality were bred. These were screened and utilized for GSR variety development.

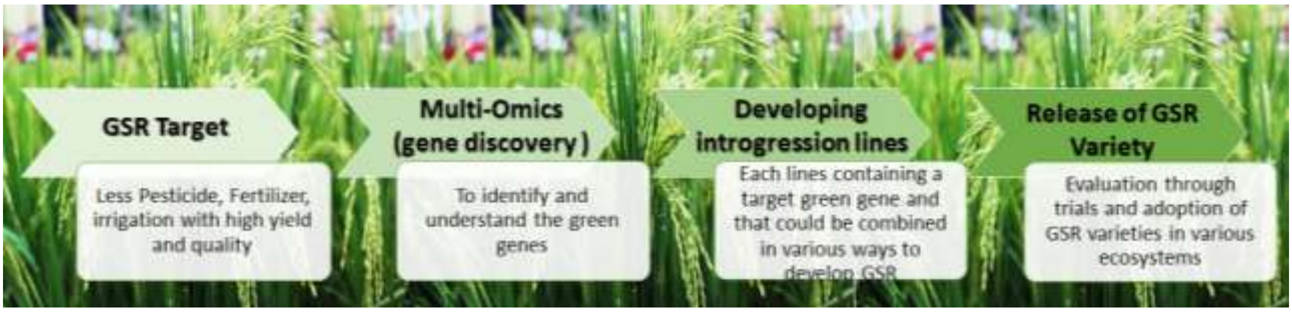

Fig 1: Strategy for the development of GSR

Table 1: Fifteen promising GSR varieties nominated into the national cooperative yield trials in India (Li and Ali, 2017).

S.No.	GSR line	Nominated Category – National trials
1	GSR IR1-11-Y6-Y1-Y1	Irrigated lowland
2	GSR IR1-5-S9-Y3-Y1	Irrigated lowland
3	IR 82858-B-B-1	Direct seeded rice
4	IR 83108-B-B-1 3	Direct seeded rice
5	GSR IR1-17-D6-S3-D1	Irrigated lowland
6	IR 83141-B-17-B	Early direct seeded
7	IR 83142-B-57-B	Irrigated lowland (medium)
8	GSR IR1-5-S10-D1-D1	Alkaline and inland saline
9	GSR IR1-5-Y4-S1-Y1-3953-1	Coastal saline
10	GSR IR1-17-D6-S3-D1	IVT-Aerobic
11	GSR IR1-9-D 12-D1-SU-1	IVT-Rainfed shallow lowland
12	GSR IR1-8-Y7-D2-S-1	IVT-Irrigated (medium)
13	GSR IR1-5-D 20-D 3-Y2	IVT-Irrigated (medium)
14	GSR IR1-5-Y4-S 1-Y1	IVT-Irrigated lowland (late)
15	IRRH-107 (HYBRID)	IVT-Aerobic

Conclusion

Global breeders are in need to develop sustainable varieties to meet the growing demands due to the dramatic change in population in future. GSR is therefore a vital concept proposed to meet this challenge. With the help of the GSR varieties along with the modern cultivation techniques, we can minimize the application of fertilizer and pesticides by more than 30% and can reduce the irrigation water by at least 30 % in irrigated conditions. Due to its ability to withstand in extreme stresses caused by climate change, GSR varieties can maintain stable and higher yield with less inputs to increase the rice production in sustainable way.

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Improved Production Techniques of Knol-Khol (*Brassica oleracea* var. *gongylodes*)

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Introduction

Knol-Khol (*Brassica oleracea* var. *gongylodes*) is a rabi season cole crop belongs to family Brassicaceae which is originated from the coastal countries of Mediterranean region. In India it is widely grown in Jammu and Kashmir, West Bengal and to a limited extent as a rare exotic vegetable in some parts of Maharashtra, Assam, Uttar Pradesh and Punjab (Thamburaj and Singh, 2010). Basically, edible part of knol-khol is knob, which is form swelling of the stem tissue above the cotyledons. The crop has tremendous medicinal properties like, asthma, cancer, cholesterol level, heart problems, indigestion, muscle and nerve functions, prostate and colon cancer, skin problems, weight loss etc (Chauhan et al., 2016). The knob is harvested for human consumption as raw or cooked vegetable, though in some parts, young leaves are also used. The fleshy edible knob is an enlargement of stem, which develops entirely above ground and is used as a vegetable. Kohl rabi has similar taste and texture as that of broccoli stem or cabbage, but milder and sweeter. The younger stems have crispy, pleasant taste, and rich flavour. Knol-khol contain good amounts of vitamin A and C, folic acid and dietary fibre. Moreover, it is an excellent source of vitamin B-complex such as niacin, pyridoxine, thiamine, pantothenic acid, etc. Besides that, it contains good levels of minerals viz. copper, calcium, potassium, manganese, iron and phosphorus especially in stem. It contains sulforaphane, which has anticancer properties.

Nutritive Value (Per 100g of Edible Portion)

Energy (kcal)	29	Riboflavin (mg)	0.04
Moisture (%)	90.3	Niacin (mg)	0.3
Protein (g)	2.0	Ascorbic acid (mg)	66
Fat (g)	0.1	Ca (mg)	41
Carbohydrates (g)	6.6	P (mg)	51
Vitamin A (IU)	20	Fe (mg)	0.5
Thiamine (mg)	0.06		

Climate and Soil

It is a cool season crop and thrives best under temperate and moist climate. It can withstand extreme cold and frost in comparison with other cool season crops. Seeds of knol-khol germinate well at 15 to 300C. The optimum temperature for crop growth ranges between 15.5 - 180C. In late varieties, low temperature does not have stimulating effect on bolting in early stages. Soils requirements of knol-khol are exactly similar to Brussels sprouts. It can be grown successfully on a wide range of soils; however, it performs best in well-drained loamy soil rich in organic matter. It does well in pH range of 6.0 to 6.8.

Origin and Distribution

Knol-khol or kohlrabi has originated from the coastal countries of Mediterranean region. It has then spread all over the world including South Asian countries. It is very widely used in the Northern state of Kashmir in India. It is also used popularly in many other states in this country listed above.

Major Recommended Varieties

S.N.	Name of Variety	Salient features
1.	Large Green	The knobs are green, round and large-sized with small tops. These are usually tender and delicately flavoured with white flesh. It is ready to harvest in about 75 days after transplanting. The average yield potential is 225–250 q ha-1. It is very much suitable for cultivation under mid and high hills of western Himalayas.
2.	White Vienna	It is an early maturing variety takes about 55–65 days to mature after transplanting. The plants are dwarf with medium green leaves and stem. The knobs are globular, light green, smooth and tender with delicate flavour. Its yielding potential is 175 q ha-1.
3.	Early Purple Vienna	Leaves are purplish in colour. The knobs are globular to round large in size, purple skin with light green flesh. It takes 55-60 days for knob formation.
4.	Early White Vienna	It is an early variety. Plants are dwarf, short topped having medium green foliage. The knobs are globular to round. Flesh is tender and crisp. It takes about 50-55 days for knob formation after transplanting.
5.	Purple Vienna	It is a late variety having purple coloured leaves and stems. Knobs are big in size with purple coloured spots. Knobs become ready for harvesting in 55-60 days after transplanting. An average yield of this variety is 150-200 q/ha.
6.	King of North	It takes about 60-65days to harvest after transplanting. It has dark green, flattish round knobs. Dark green leaves are well spread over the knobs.
7.	Palam Tender Knob	Early variety with light green knobs and gives average yield of 250-275 q/ha. Better shelf life.
8.	Pusa Virat	The variety has dwarf plant type and semi spreading habit. Individual knob weights around 800 g and average yield is 23 tonnes/ha. Harvesting can be done from 50-60 days after transplanting. Both knobs and leaves are edible. It can withstand high frost and cold conditions. There is little or no fibre development at maturity.

Average yield of Knol-khol varieties is 200 q/ha.

Agronomic Practices: Land Preparation

The land should be well prepared and of good tilth for sowing of knol-khol, 2-3 ploughing should be given to prepare a good tilth. Incorporate well decomposed FYM @ 15-20 t ha-1 at the time of land preparation. Application of organic manure or vermicompost improves plant growth, productivity and improves water holding capacity of field soil. The sterilization of soil by drenching, nursery beds with formalin @ 1:49, about 15-20 days before seed sowing is beneficial for preventing the attack of the fungal diseases. After drenching, seed beds should be covered with polythene for a week. Then beds are again dug and left open for 5-6 days to avoid injurious effect of formalin on seeds. The standard procedure for raising nursery should be followed. The beds should be covered with a proper mulching material before watering. Apply water with a water cane over the grass mulch during initial stage i.e.15-20 days of sowing, while during later stage watering should be done through furrows. The mulch should be removed as soon the emergence of seed sprouts. The beds should be provided with roof for shading against hot sunshine and rains.

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Seed Sowing and Management of Nursery

Knol-khol is usually propagated by seed, the seed rate being 1–1.5 kg/ha. Seed should be given a hot water treatment (50°C) for half an hour against black rot and Apron 35 @ 2g/kg seed against downy mildew before sowing in disease-prone areas. The seedlings are raised in the nursery beds. About 4-5 weeks old seedlings are ready for transplanting. Generally, 60 cm wide and 2.5 m long nursery beds are prepared. For 1m2 nursery 100 g of fertilizer mixture containing 15 g each N, P and K and 2.5–4 kg farmyard manure mixed well in soil and raised nursery bed must be prepared with 30 cm channel along with the nursery. On light and drought sensitive soils, sunken nursery beds are preferred. Acidic soils should be limed. For minimizing the seedling damage, the nursery beds should be treated with formalin (40% formaldehyde diluted in 5–6 parts of water). Soil is saturated with this solution, requiring 5 litres/m2. Fumes are then confined by covering nursery beds with canvas or polythene for 2 days and then the soil is aerated well for at least 4 days before sowing. This treatment can be replaced by the use of Captan (0.3%) for soil drenching. Seeds are sown in rows at a distance of 5–6cm for ease in manual hoeing, weeding and thinning. In too close spacing, the seedlings are liable to be attacked by damping off disease and become lanky. Proper spacing results in stocky and vigorous seedlings. A depth of 1.5–2 cm is optimum since deeper sowing delays the germination. The nursery bed is covered with grass to conserve moisture for uniform germination. It is watered as and when required with watering can. The mulch is removed just before the seed germination to control damping off, drenching with Dithane M-45 (0.2%) is recommended. Nitrogenous fertilizer (urea) may be added in the spray when the seedlings growth is poor. However, excessive N results in tender and lanky plants that show poor establishment after transplanting. Seedlings are hardened in the nursery by restricting the water supply for about a week before transplanting in the field to enable them to withstand the shock of transplanting.

Planting

In the plains of north India, planting may be done in September, while in the milder winter regions, October is best time for planting. In the hills of northern India, seeds are sown from March-April to August. About 4-5-week-old seedlings are transplanted for summer and autumn crops. The growing of nursery in March-April needs protection from cold and frost for which low cost polyhouses may be used. Preparation of land is done by 2–3 ploughings, firstly with soil turning plough and after ploughings with ordinary plough/tiller or disc harrow to get fine tilth. The beds and channels are prepared to facilitate irrigation. Transplanting of seedlings is done in the evening and/or on cloudy days. The soil around the plant should be well pressed to establish contact with the roots. This process should be followed by light irrigation. The dead plants should be replaced and gaps be filled 5-6 days after transplanting. The transplanting is done at a closer spacing of 25cm × 25cm, 25cm × 30cm, 25cm × 40cm or 30cm × 45cm depending on climatic conditions and fertility of the soil. The yield is more in close spacing but the size of knobs is reduced. The early varieties may be planted at closer spacing while the late ones require wider spacing.

Nutrient Management

Manure and fertilizer requirements in 'knol-khol' depend upon fertility status of the soil. Apply 20 tonnes well rotten FYM during field preparation. Beside that apply 90 kg N, 80 kg P2O5 and 80 kg K_2O per hectare in case of knol-khol. The half dose of N and full doses of P and K should be applied before transplanting. The remaining half dose of N should be top dressed in two equal splits viz. after one month of transplanting and at the time of knob formation. For acid soils low in Ca and Mg, application of 'dolomite' as lime should be followed.

Intercultural Operations

The intercultural operations are similar to that of other cole crops. Shallow frequent hoeing should be done in field by 'khurpi or hoe' to kill young weeds and provide soil mulch. Weeding should be started as soon as plants are set in the field. Four to five weeks after transplanting, plants should be slightly earthen up in the field. For chemical weed control, Stomp 30 EC (Pendimethalin) 2.5 litre ha-1 can also be applied one day before transplanting of seedlings under moist soil conditions.

Irrigation

Knol-khol requires a continuous supply of moisture for uniform growth and development of knobs. First irrigation is immediately after transplanting and thereafter irrigation is done when needed, depending on soil and weather conditions. Irrigations at 15 days intervals are adequate. Heavy irrigation should be avoided. There should be sufficient moisture in soil at the time of knob formation.

Plant Protection: Important Insect-Pests of Knol-Khol

S.N.	Insect-Pests	Control
1.	Aphids (*Brevicoryne brassicae*): The aphids are generally observed on lower surface of the leaves. The Yellowish green nymphs and adults suck cell sap and devitalize plants. Affected plant parts become discolored, malformed and weakened.	Spraying of Monocrotophos (0.05%) or Malathion (0.1%) at 10-15 days interval control aphid population effectively. To prevent recurrence of the pest granular insecticides like Phorate @ 1.0 kg a.i./ha should be applied to soil.
2.	Cabbage Diamondback Moth (*Plutella xylostella*): It is one of the most serious pests of cole crops. The green or brownish coloured caterpillars feed the inner leaves by making holes, rendering transparent cuticular patches. Severely affected leaves are completely skletonised.	Spraying of neem-based formulations @ 4 ml or Bt product like Delfin 3G @ 1 g per of water gave good control on pest or spraying crop with Malathion (0.1%) or Profenofos (0.25-0.5 kg a.i./ha) gives excellent control of the larvae.
3.	Leaf Webber (*Crocidolomia binotalis*): It is one of the most destructive pests of cole crops. Eggs are laid in clusters on the undersurface of the leaves. Green caterpillars web up the leaves and live inside the knotted mass. Flowering and pod formation are adversely affected.	Removal and destruction of webbed bunches of leaf help to check the further spread of the disease. Dusting the crop with Carbaryl (4%) or spraying with Malathion (0.05%) is effective.

Major Diseases of Knol-Khol

S.N.	Disease and their symptoms	Control
1.	Black Rot (*Xanthomonas campestris*): It is the most serious disease affecting brussels sprouts. This bacterial disease is common in areas with warm and humid climate. The typical symptoms of black rot are caused by local infection that results when bacteria enter leaves through natural openings of leaf margins. The infected tissue turns pale green-yellow and then turns brown and dies. Affected areas are usually wedge or V-shaped. These areas enlarge as the disease progresses and severely affected leaves may drop off. The veins in infected leaves, stems and roots sometimes become black. The heads of the infected plants remain small and its quality is reduced making it unfit for marketing	Seed treatment with Agrimycin-100 (100 ppm) or Streptocycline (100ppm) is effective in controlling disease. Planting should be done on raised beds to facilitate drainage. Cultivation in the fields where crucifers have been continuously grown during last 2 years should be avoided. Plants should be thoroughly inspected for black rot symptoms and the affected plants should be removed and destroyed.
2.	Downy Mildew (*Perenospora parasitica*): The disease is very serious in nursery and may also appear in field	All the weeds serving as alternate host to the fungus should be destroyed. Spraying

	planting. During periods of high humidity, light grey powdery patches appear on under surface of the leaves and shoots. The first symptom observed are small, light green-yellow lesions on the upper leaf surface, later showing on the under surface. The spots turn yellow as they enlarge.	seedlings as well as transplanted plants with Copper Oxychloride 0.3 and 0.5%, respectively is effective in controlling the disease. Moreover, spraying of 'Neem seed kernel' @ 5 ml per litre after 25-30 days of transplanting, control the disease incidence.
3.	Leaf Spot and Blight (*Alternaria brassicae*): There is appearance of small dark yellow spots on the leaf surface during initial stage, which later on enlarged to circular areas with concentric rings, surrounded by yellow halos. In severe cases, the entire plant defoliates.	Seed treatment with hot water (500C for 30 minutes) helps to minimize the disease incidence. Crops grown for seed purpose should be sprayed at full bloom, pod set and pre- harvest stage with Captan (0.2%) or Copper Oxychloride (0.5%) for the control of disease.

Harvesting and Yield

The knol-khol knobs are harvested by cutting the stem just below it, by a sharp knife or sickle, when they are about 5–8 cm diameter. The root portion is removed and plants are tied in bunches along with the tender leaves for the purpose of marketing. Generally, the yield may vary from 200–250 q ha^{-1}.

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Mushroom Cultivation at Home: A Sustainable Livelihood for Domestic and Commercial Purpose

Article ID: 31692

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Introduction

Mushrooms are the fruiting bodies of macro fungi. They include both edible/medicinal and poisonous species. However, originally, the word “mushroom” was used for the edible members of macro fungi. Mushrooms have been known to human since very early days. Even the early man knew their special properties of mushrooms. The Aztecs used them as hallucinogens and for divination. They call them gods flesh. China, USA, Netherlands contributes 60% of mushroom production worldwide. China alone contribute 46% and India 0.4% of mushroom production worldwide. Many people wonder that, is it possible to grow mushrooms at your home. Yes, it is possible. You can grow mushrooms on a small scale at home or for consumption purpose organically all away from super simple methods that require no special tools or equipment, whatsoever all the way up to more complex methods that might have better results but require more significant investment Growing mushroom really is one of these hobbies where there’s always an opportunity to learn something new to do. we can grow mushrooms as a valuable crop as long as they have the proper technology, the proper substrates, and the planting material called spawn. In some villages of India, it has been reported that farmers are growing mushrooms right in their own homes or immediate surroundings. Villagers growing mushrooms can rapidly begin to bring in more cash than some local landowners.

Nutritious Benefits of Mushrooms

1. The mushrooms are quite nutritious and may even considered superior to vegetables like cauliflower, spinach, and legumes. They are low in calories but rich in minerals.
2. Mushrooms are the good source of proteins. The protein contains some essential amino acids.
3. Mushrooms are also quite rich in their vitamin content, which includes significant amounts of Vitamin C (8.60mg).
4. Mushrooms are also good sources of minerals such as calcium, potassium, sodium and phosphorous in addition to folic acid which is known for enriching the bloodstream and preventing deficiencies.
5. Iron is also present in a quite good amount. Mushrooms are low in sodium, making them ideal for persons with certain types of heart and kidney ailments.

Health Benefits of Mushrooms

1. The antioxidants such as selenium, choline and vit c in mushrooms may help prevent lung, prostate, breast, and other types of cancer
2. The dietary fibre present in the mushrooms may help manage a number of health conditions, including type 2 diabetes.
3. The fibre, potassium, and vitamin C in mushrooms may contribute to cardiovascular health.
4. Folic acid, or folate and supplements present in the mushrooms are used by many women during pregnancy to boost fatal health, but mushrooms can also provide folate.
5. The most recent introduction of a medicinal mushroom is Ganoderma spp, for the treatment of fatigue, coughing, asthma, indigestion, neurosis and a variety of other.


Types of Mushrooms Commonly Grown at Home / Indoors

1. Shiitake mushroom *(lentinula edodes).*
2. Oyster mushroom *(Plerotus ostreatus).*
3. White button mushroom *(Agaricus bisporus).*

Substrate / Growing Media Used at Home for Mushroom Production

1. Oyster mushroom: Agricultural waste like wood chips/sawdust, sugarcane bagasse, different types of straws, rice bran, dried banana leaves, dried elephant grass, dried grass pieces etc.
2. White button mushroom: Composting is the best subtract to grow these mushrooms.
3. Shiitake mushroom: Fresh saw dust from the trees of the genera Quercus, Betula, Castanopsis, Castanea, and Carpinus can be used without prior fermentation.

Different Ways to Grow Mushroom at Home

1. By using mushroom growing kits: Used for domestic purpose.
2. By preparing a small room at your home: These methods are used for commercial purpose .Doors and walls are to be closed properly to prevent insects from entering the growing rooms. A double door, with a wire mesh for the second entrance, can help to keep insects out.
3. By preparing a small polyhouse / polynet side by your house in budget friendly: Used for commercial purpose.
4. You can even grow in your indoor in buckets and some baskets by using different types of straw for mushroom cultivation.

But for these make sure that Hygiene is vital on a mushroom farm. Since chemical control of pests and diseases is not possible in small-scale mushroom cultivation, the only preventive measure is hygiene, and to some extent disinfection. Make sure there is a proper drainage system to prevent from disinfectants.

Equipment's / Materials Required for Mushroom Production

Temperature of substrate: pocket thermometers (metal 1-inch dial and 5-inch stem).
Air temperature and relative humidity: battery operated LCD digital thermometer/hygrometer.
Relative Humidity: time-set semi-automated misting system.
Plastic bags, Buckets, Mushroom spawn, Straw Humidity tents.

Steps for the Cultivation of Mushrooms

There are different procedures for the cultivation of mushroom at home:

Procedure 1: Basement or crawl spaces are required for this cultivation and it is used for both domestic and commercial purpose.

a. Choose the growing area that is Cool, dark, and free from pests that may eat or contaminant your mushroom farm. The best growing areas are basement or crawl spaces.
b. Spread a dark, nutrient-rich soil evenly over a level growing bed to a thickness of about 2 inches.
c. Chop the straw into short pieces. Next wet the straw.

d. Sterilize your substrate by soaking it in hot water or putting it in a pressure cooker to kill undesirable fungi and bacteria that can ruin your mushroom batch. Different species of mushrooms thrive on different substrates, like straw, compost, wood chips, sawdust, newspaper, or cardboard.

e. Apply the appropriate substrate or growing medium over your soil to feed your hungry mushroom spores.

f. Implant or inoculate the substrate with your mushroom spores and fine tune the temperature and humidity levels based on the species. Some varieties require higher humidity than others.

g. Look for sprouting or pinning after about three weeks. The mushrooms will be ready for harvesting in a little as one month.

Procedure 2: Plastic bags are required for this cultivation and used for commercial and domestic purpose.

a. Sterilize you subtract by soaking them in hot water or boiling the cut straw for 30 mins to soften the lignin and cellulose of the straw and to sterilize the straw and it will be softening and can easily be packed.

b. Squeeze out all the water from the straw and spread it out to get the straw somewhat dried and keep it overnight so that maximum moisture can be out.

c. The next day we have to collect it and pack the semidried straw in the polythene bag. Pack two or three inches of straw into the plastic bag and then lightly sprinkle the spawn on the top repeat this until you have almost filled the bag, close the top and poke holes in the bag.

d. We have to keep all these plastic bags in a closed room or in polyhouse or polynets and maintain temperature and humidity.

e. For about 25 days, mushrooms will be ready for the first harvest.

Procedure 3: Mushroom growing kits are required for this cultivation and used for domestic purpose:

a. Soak the kit in water.

b. Scrap back some of the mycelium.

c. Keep moist and near indirect light.

Inter Relationship Between Mushroom Cultivation and Agriculture

1. Mushrooms are grown on some organic substrates, mostly waste materials from farms, plantations or factories. These otherwise useless by-products can therefore be recycled to produce value-added mushrooms.
2. Currently, millions of tons of agricultural wastes are discarded, burned and neglected. Examples of such agro-wastes in abundance in the tropics are straw corncobs, grass, sawdust sugarcane bagasse, cotton waste, oil palm waste, coffee pulp, water hyacinth plants, coconut husks, tree leaves, branches and logs
3. These all can be used alone or in combination to create mushroom growing substrate. With moderate effort and careful management, the very people hungry for food can have within their grasp a new food source in the form of cultivated mushrooms.
4. So here is another benefit to the farmers. Along with the agriculture they can even start mushroom cultivation with some skill and knowledge to get more benefits.

Mushroom as an Income Generating Activity

We can even increase our income through mushroom by sitting at home by preparation and selling of mushroom-based products such as Picking Royal oyster capsules, Wheat flour fortified with dehydrated oyster mushroom power, Mushroom bijoura, Urd/mung mushroom nuggets, Mushroom rice pappad, Mushroom biscuits/cookies etc.

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An Overview on Dessert Locust (*Schistocera gregaria* F.), its Importance and Mitigation

Article ID: 31693

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Locusts are short-horned grasshoppers in the family Acrididae that have a swarming phase. There are 19 locust species in the world and among them the desert locust *(Schistocerca gregaria)* is the most dangerous. Historically, the Desert Locust has always been a major threat to agriculture as well as other man's well beings within a very large area extending from the Atlantic Ocean and North Africa to the. The magnitude of the damage and loss caused by the locusts is very gigantic beyond imagination as they can cause starvation its being a polyphagous feeder. These insects are usually solitary, but under certain circumstances they become more abundant and change their colour, behaviour and habits, becoming gregarious to form swarms. Usually one swarm contains billions of insects per square kilometre which has the capacity to eat everything that falls in its flight path. Its main characteristics is that it has a highly developed migratory capacity over long distances, making the problem of international level (Meynard et al., 2020).

Biology and Life Cycle of Desert Locust

Life-cycle of a locust, it is an example of incomplete metamorphosis.

Life cycle parameters:

Stages	Egg, Hopper, Adult	
Duration	Egg	: 10-65 days
	Hopper	: 25-95 days (36 days average)
	Adult	: 2.5-5 month
	Laying-fledging	: 40-50 day
	Adult maturation	: 2-4 month average
	Total duration	: 2-6 month
Larval moults		5-6 (solitary phase) 5 (gregarious phase)
Phases	Solitarious, Gregarious, Transiens	

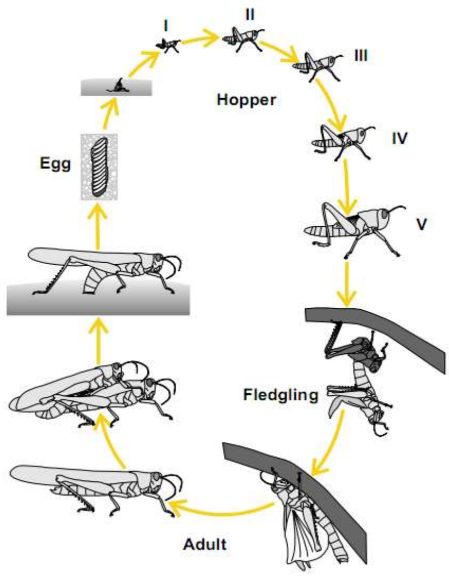

Fig.1: Life cycle of Desert locust

Ist Instar	Newly hatched are white but turns black in 1-2 hours.
IInd Instar	Head is larger and pale colour pattern is conspicuous.
IIIrd Instar	Two pairs of wing bud projects on each side of thorax.
IVth Instar	Colour is conspicuously black and yellow.
Vth Instar	Colour is bright yellow with black pattern.

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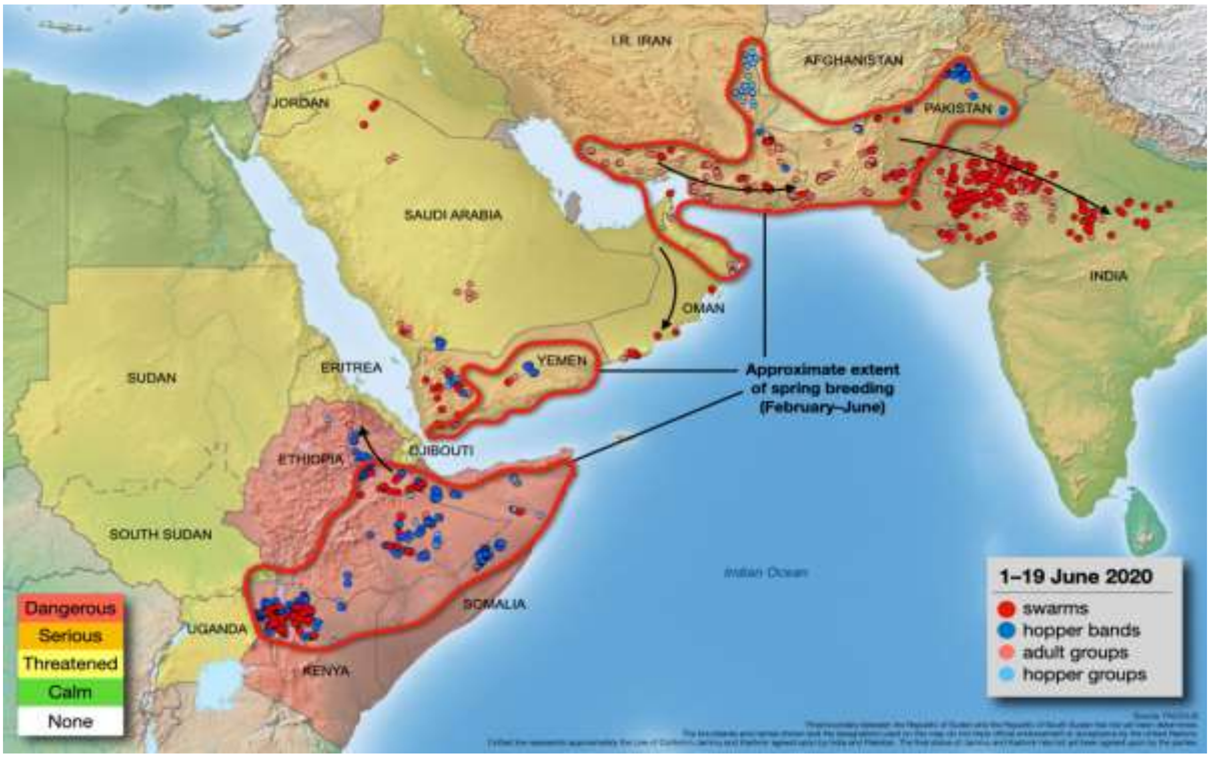
Egg of Desert Locust	**Hopper**	**Adult female laying egg in soil**

From Where these Locusts Come?

There are many breeding areas for these locusts in Africa, Middle East and India. The swarm that invades India originates in the desert of Pakistan or Arabian Peninsula which are carried to India through monsoon winds. Every year a Government organisation called Locust Warning Organization (LWO) usually monitors and destroys their breeding grounds. But this year climate change effect and unexpected cyclones in the Arabian Peninsula have aided their rapid multiplication and spread.



Pic: 1 Desert locust outbreak remains extremely alarming, new swarms continue forming and invading Africa, Middle East to India: FAO Desert Locust Bulletin

Effect of Climate Change in Current Locust Outbreak

The key driver of the current locust plague is climate change. The difference today is unusual weather conditions which generated strong cyclones and heavy rains in the Arabian Peninsula caused higher than normal vegetation growth, ideal conditions for locusts to feed on and surge.

According to Roxy Mathew Koll, a climate scientist from Indian Institute of Tropical Meteorology, said, “These warm waters were caused by the phenomenon called the Indian Ocean Dipole (IOD) with warmer than usual waters to its west, and cooler waters to its east. Rising temperatures due to global warming amplified the dipole and made the western Indian Ocean particularly warm” which leads to heavy monsoon and strong cyclone in Western Ghats during the post monsoon season. Besides, the rapid warming in the Arabian Sea has resulted in a threefold rise in widespread extreme rains, leading to large scale floods, along the west coast and parts of central India (Daniel, 2020). The positive phase of the IOD in 2019, the strongest for six decades, led to heavy rainfall and flooding in East Africa. According to FAO, increased extremely positive IOD years would likely bring flooding and cyclones like those seen in 2019 to already vulnerable and food-insecure regions in the Arabian Peninsula and the Horn of Africa have led a favourable condition also lead to worse locust outbreaks.

Desert Locust Plagues and Upsurges

Plague declines are often attributed to the combined effects of control operations and unfavourable environmental conditions. The recent major Desert Locust plague occurred from 1986 to 1989 and affected 43 countries. It arose from widespread heavy rains that fell in Western Sahara in the late summer of 1986.Four local outbreaks developed simultaneously and independently in the autumn of 2003 in north-west Mauritania, northern Mali, Niger and north-east Sudan, in October 2003 from Senegal to Morocco, during which some areas in Western Sahara. Environmental conditions remained favourable for the next six months and Desert Locusts increased rapidly. During the summer of 2004, large numbers of swarms from North-West Africa invaded the Sahel in West Africa and quickly moved into crops, In November 2004, they appeared in northern Egypt, Jordan and Israel for the first time in 50 years.

Due to unusually heavy and/or widespread rains, Desert Locust outbreaks occur almost every year in part of the recession area. Recent outbreaks took place in:

1. India/Pakistan (October–November 2010).
2. Sudan (October 2010–May 2011).
3. Libya/Algeria (January–May 2012).
4. Sudan (September 2012–April 2013).
5. Sudan/Eritrea/Yemen/Saudi Arabia (August 201–March everything 2014).
6. Northern Somalia (January–March 2014).
7. Sudan/Eritrea/Saudi Arabia (October 2014–March 2015).
8. Mauritania/southern Morocco (November 2015–May 2016).

Locusts and their Importance Towards Agriculture

The Desert Locust remains a major threat for food safety and social stability, in particular for many rural populations those are solely based on agriculture in Africa-central Asian countries including India. Each grasshopper can eat 2-3 times more of its body weight per day. A very small swarm of 1 square km can eat the same amount of food in one day as about 35 000 people. Bigger swarms eat that causing complete destruction. This locust was responsible for many famines in the past in countries where invasions took place, the most recent having been recorded in Ethiopia and in Sudan in the 1950's.At the time of the last invasion in 1987-1989 in Mauritania, losses were estimated at approximately 60% of the 200,000 ha of attacked grazing land, at 70% of the 200,000 ha of rainfed crops and at 50% of the 400,000 ha of irrigated crops. In Mali, the losses were estimated from 65% to 90% of the 700,000 ha of grazing land, from 5 to 75% of the 300,000 ha of rain crops, from 85% to 100% of the 550 ha of market gardening crops and 35% of the 200 ha of perennial crops (arboriculture) (FAO,2003). According to the data of the agriculture department ICAR, the cost of cultivation per hectare by a farmer in Jaisalmer about Rs 41,000 per hectare to cultivate wheat crop this Rabi season, would receive only Rs 13,500 as compensation for the crop loss suffered due to the locust attack.

Strategies for Managing Locusts

It is usually very difficult to control a locust swarm because of its huge population density. It is estimated that even a very small swarm of 1 km2 contains around 1 – 1.5 billion insects and any control measures will be futile against such a large population. FAO have recommended some precaution measures as an intergovernmental cooperation basis as early as possible, at case such as:

1. Institution of assessment, early warning and forecasting, ground surveillance and impact assessment mechanisms and establishment of locust control organisation both aerial and ground.

2. Deploy rapid surge support, intervention and coordinate cross border response. Improve national security. Strengthen national and regional capacity for surveillance and control operations to facilitate early warning and early response.

3. Usually spraying of insecticides is taken with helicopters and aircraft sprayers. However, if swarm is small and has a very low density (usually borders of the swarm). In such cases local/ isolated control measures might help. The following are the control measures that are adopted for locusts.

4. Digging trenches, beating and burning, making loud sound as a mechanical method of control.

5. Baiting – scattering locust food (carrier) impregnated with insecticide. Efficiency of baiting will be improved by spreading the bait actually amongst the hoppers, bait efficiency will be higher if they find it in their path because they are not attracted to it from a distance.

6. Farmers should form groups and monitor the field at night. Between 7 and 9 in the evening, millions of these insects can land in the fields to rest and take necessary steps.

7. Applying a fine dust impregnated with insecticide. The most suitable insecticidal dust for killing locusts and grasshoppers is bendiocarb.

8. Application of liquid insecticide as liquid spray either on locusts or on the vegetation they will consume can relief from locust.

After all, protect and restore the livelihoods of locust affected households, ensure food security, prevent human capital and asset loss and rehabilitate livelihoods by a cooperation by an association between local and governmental level.

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Desert Locust Attack: A Biological Disaster in India

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Summary

An attack by desert locust has hit huge wraps of India and Pakistan in the coronavirus pandemic. The United Nations have reported that the circumstance is very disturbing.

Introduction

The desert locust *(Schistocerca gregaria)* is a type of locust, an intermittently swarming, short-horned grasshopper in the family Acrididae. They are found principally in Africa, through Arabia and West Asia, and reaching out into parts of South Asia. During population flood years, they may reach out into parts of western Spain. The desert locust shows occasional changes in its body frame and can change, in light of ecological conditions, over ages, from a lone, shorter-winged, exceptionally fertile, nonmigratory structure to a gregarious, since quite a long winged, and transitory stage in which they may travel significant distances into new territories.

In certain years, they may in this way structure locust plauges, attacking new regions, where they may expend all vegetation including crops, and at different occasions, they may live unnoticed in little numbers. During plague years, desert locust can make boundless harm crops, as they are exceptionally versatile and feed on huge amounts of any sort of green vegetation, including crop pasture and fodder. A full swarm can be comprised of 150 million locusts for every km2 and fly toward the predominant breeze, up to 150 km in one day. Indeed, even a little, 1-km2 locust swarm can eat a similar measure of food in a day as around 35,000 individuals.

Effect of Locust Attack in Indian Agriculture

Insect sightings and attacks in India's state of Gujarat, Rajasthan, Punjab, and Uttar Pradesh have been giving restless evenings and nights to farmers and specialists since the previous winter. Concerns are strengthening as the planting time period for kharif or monsoon crops like rice, maize, millet, pulses, soybean, and groundnut approaches in June.

As per the Union Agriculture Ministry data, locusts damaged crops worth Rs 10 crore during the 1926-31 plague cycle. During the 1940-46 and 1949-55 locust plague cycles, the damage was estimated at Rs 2 crore per cycle, and at Rs 50 lakh during the last locust plague cycle (1959-62).

The administration doesn't consider locust upsurges during 1978 and 1993 and a few in the middle of as significant flare-ups. In any case, according to the administration records, 190 locust swarm had attacked a region of at any rate 3,10,000 hectares in Jaiselmer, Barmer, Bhuj and Jalore regions of Rajasthan in 1993. Enormous territories in these regions again must be treated with chemials and insecticides to dispose of locust swarms in 1997 and 2005.

Locust swarms eat food, food that farmers are developing for people. On the off chance that locust attacks of this extent proceed with unabated, the locusts will clear out lakhs of huge amounts of food grains and vegetables implied for human utilization. Aside from a potential absence of food grains and vegetables, locust attacks on homesteads will likewise dive India into new monetary difficulty. Tormented by a monetary stoppage and Covid-19 lockdown, the Indian economy is as of now on the edge. While specialists trust that things will improve after a vaccine for the novel coronavirus comes into the market, an agrarian emergency because of locust attack will rattle the administration's arrangements.

	
Fig 1: Locust attack in the crop field	**Fig 2: Locust eating the leaves**

Control

1. Controlling desert locust swarms primarily uses organophosphate chemicals by vehicle-mounted and aerial sprayers, and to a lesser extent by knapsack and hand-held sprayers.
2. Extensive research is ongoing regarding biological control and other means of non-chemical control with the current focus on pathogens and insect growth regulators.
3. Control by natural predators and parasites so far is limited since locusts can quickly move away from most natural enemies.
4. While people and birds often eat locusts, this is not enough to significantly reduce population levels over large areas.
5. While the traditional form of control considered is use of pesticides, the impact of these chemicals on the environment and other critical ecosystems key to food security such as bees and other insects, which not only pollinate up to 70 percent of our food but also may have an impact on human health cannot be overlooked.

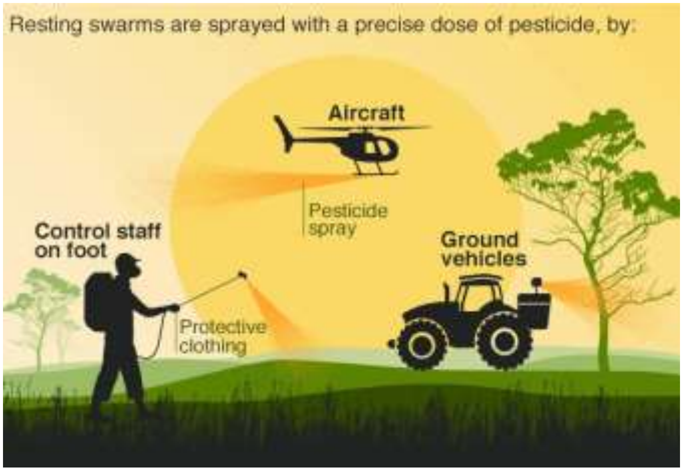

Fig 3: Different forms to control desert locust

Conclusion

Effectively hard-hit by the coronavirus, India's farmers are likewise doing combating a monstrous intrusion of insects. Attacking swarm of locust have been representing a danger recently to cultivating field. The potential for locusts' exponential development and yield annihilation has endangered the food and monetary security of arid and semi-arid regions just as rural livelihood to be reckoned with. Locust attack are not remarkable events, their ongoing invasion in India is likened to an extraordinary plague-like circumstance.

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Strategies for Virus Elimination in Fruit Crops

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Introduction

India is the second-largest producer of fruits in the world after China. Due to diverse agro-climatic conditions, many tropical, subtropical and temperate fruits are being cultivated in India. Commercial cultivation of some important fruit crops is still at a primitive stage in India, primarily because of the difficulty in procuring elite planting material or due to the unavailability of disease-free quality planting materials. Generally, fruit crops are propagated by vegetative means and are more susceptible to infection via obligate pathogens like viruses, viroids and phytoplasma which are transmitted to the planting materials from one generation to another generation via vegetative propagation. Pathogen or disease-free plants are needed as propagation materials in the nurseries and clean material are required in germplasm exchange between different regions via quarantine programs. In addition, plant gene banks also prefer to maintain pathogen-free planting material for germplasm collection. Among various fruit plants, grapevine, apple and peach are the most frequent targets of elimination protocols due to their health status is strictly regulated. The elimination of obligate pathogens (viruses, viroids, and phytoplasmas) from infected mother propagation material is a prerequisite for the production of healthy and elite planting material. Generally, in fruit plants, various methods are used for the elimination of viruses such as thermotherapy, tissue culture, in vitro micrografting, chemotherapy, and cryotherapy of shoot tips, followed by shoot-tip tissue culture or in vitro micrografting. Generally, thermotherapy represents the preferred method for the host to eliminate viruses in most of the fruit plants. In case of grapevine and apple viruses can also give a well response to chemotherapy and as well as tissue culture. Thermotherapy was successfully used against viruses belonging to 13 different families and an unassigned genus. The chemotherapy and tissue culture techniques eliminate the viruses belonging to 9 families. An elucidation of heat therapy influence considers the new metabolic pathway triggered via the natural antiviral response emitted by the infected plants, with particular context to virus-induced gene silencing. In chemotherapy, various groups of antiviral drugs pertain to inosine monophosphate dehydrogenase inhibitors, neuraminidase inhibitors and S-adenosyl homocysteine hydrolase inhibitors are used.

Thermotherapy

It is also known as a heat therapy which is the oldest method used for the elimination of viruses, viroids, and phytoplasmas from vegetative propagated plants. It has been in use since the end of the 19th century. The first reference to the application of heat therapy to the plants dates back to 1869 when Scottish gardeners engrossed bulbs in hot water before planting. Heat therapy treatment consists of keeping plants or parts of plants at temperatures ranges from 35 °C and 54 °C, within the physiological tolerance limits of each plant, for an appropriate period. Generally, the selected temperature represents the best reconciliation between virus degradation and plant survival, taking into account that the threshold of thermal sensitivity of some viruses is lower than which of plant cells and that damage caused to plant tissues by the thermal stress can more easily be reversed than viral damage. Thermotherapy has been successfully used for virus elimination in various fruit such as grapevines, stone fruits, citrus, pome fruits (apple, pear) strawberries, etc. Thermotherapy can also be applied in vitro with the advantage of reducing procedure time. Shoots collected from infected plants are cultured in vitro and then incubated in a controlled temperature cabinet at 30–40 °C for a period of 6-12 weeks. In vitro thermotherapy has been used successfully to eliminate Apple chlorotic leaf spot virus (ACLSV) from apricot shoot cultures, Prunus necrotic ringspot virus (PNRSV) and Apple chlorotic leaf spot virus (ACLSV) from peach shoot cultures and Prune dwarf virus (PDV) and ACLSV from sour cherry shoot cultures.

Cold Therapy

Thermotherapy at elevated temperatures (approx. 37 °C) does not eliminate most viroids and viruses thus low-temperature treatments have been used instead. Cold therapy consists of the culturing plantlet in vitro at low temperatures for some weeks or months. The effectiveness of this treatment depends on the host-pathogen system, especially with viruses accumulating rapidly at high temperatures that are not eliminated by heat therapy. For example, a severe strain of HSVd, which accumulated at high temperatures, was eliminated from peach and pear plant by cold therapy at 4 °C for 3 weeks with an eradication rate of 18%. The whole plantlets were grown in vitro at 4 °C, then the apical part about 1-2 mm in the length was transferred to a fresh medium and returned to the 25 °C growth chamber. In pear low-temperature treatment combine with meristem culture have also been used for the eradication of Apple scar skin viroid (ASSVd). High-temperature sensitive viroids also could be successfully eradication by cold therapy such as 86 % ASSVd free pear plants were obtained from meristem excised after 55 days treatment at 4 °C, an eliminated rate nearly identical to that obtained by thermotherapy.

Tissue Culture Technique

This technique is based on the isolation of small parts (cell) of plants like meristems, tips and somatic embryos and growing them on artificial media in aseptic conditions. So, these plants parts can grow and develop into complete plants in some weeks. In addition, this technique can be used to produce virus-free planting materials. The size of tissue such as shoot tip (5.0- 10.0 mm) or meristem portion (0.2-0.7 mm) is the critical point for the achievement of virus elimination, considering than a smaller portion of tissue or cell can be characterized by a lower virus concentration. The shoot apical meristem including the leaf primordia, that turns into leaves, and the apical dome, where the stem elongates and it is generally free of viruses. This is the main method applied in plant virus elimination programs. The meristems culture and virus elimination consist the excision of a suitable explant from the infected mother plants, the aseptic culture of the explant in a nutrient rich medium, which in most cases is based on MS (Murashige & Skoog, 1962) and finally the establishment of the new plantlet in soil. Somatic embryogenesis, usually adopted to regenerate plantlets in biotechnological breeding programs, has been used to eliminate viruses from plants. Other tissue culture techniques applied for virus elimination are protoplast culture, callus culture and the culture of reproductive tissues. Generally, meristem culture is used for the production of virus free plants, for example, grapevine freed from leafroll, fleck, yellow speckle, and summer mottle diseases, red clover freed from White clover mosaic virus, Red clover necrotic mosaic virus, clover red leaf diseases and white clover freed from phyllody.

Micrografting in Vitro

Fruit plants such as stone fruits, citrus and other woody species, meristem cultures are not much successful. In these cases, the shoot tip is grafted onto a virus-free rootstock grown in vitro. This technique was first used for the elimination of viruses and viroids in citrus by Navarro, Roistacher, and Murashige in 1975. Several scientists thereafter adopted this method to produce virus-free plant material in fruit plants. Shoot-tip grafting has been successfully used for the elimination of specific pathogens from fruit trees such as peach, almond, Prunus species, apple, pear, avocado, and cashew.

Chemotherapy

The development of research in the field of chemotherapy has not been as lively as the work conducted on thermotherapy, but valuable contributions have been provided by the most extensive investigations of antiviral chemotherapy performed in clinical medicine. In this regard, the discovery of ribavirin represented a defining moment in the research, marking a different route of investigation in the study of new chemical synthesis analogues of nucleoside or precursors of RNA bases. In chemotherapy, antiviral chemicals such as azidothymidine, asacycloguanosine, acyclovir, 2-thiouracil and ribavirin are added to the tissue culture medium to prevent virus replication and movement from infected tissue to healthy tissues. The application of these chemicals, in combination with meristem tip culture or in vitro micrografting, results in the successful elimination of various viruses. When chemotherapy is used in meristem culture, the chemicals are directly added to the nutrient rich medium in different dosages that are optimized for different plants and viruses. Chemotherapy, mainly with well-known pro-drugs such as ribavirin, was successfully performed against viruses belonging to 9 families and an unassigned genus. Ribavirin has been used for the elimination of ACLSV from apple shoot cultures. Recently, chemotherapy was successfully applied in the elimination of various serious viral pathogens from grapevine explants.

Cryotherapy of Shoot Tips

It is a novel application of the cryopreservation technique (the process where shoot tips are exposed to the ultra-low temperature of liquid nitrogen, stored and regenerated for multiplication) and is used for plant pathogen elimination. It is based on the fact that meristematic cells have lower water content compared to more differentiated cells and generally do not contain viruses. As a result, meristematic cells are not killed by the formation of ice crystals during the application of cryopreservation and it is possible to produce virus free plants by culturing them in vitro. When compared with traditional methods, such as meristem culture, cryotherapy of shoot tips facilitates the treatment of large numbers of samples, produces higher rates of pathogen-free plants, and is independent of shoot-tip size and cryogenic methods. The application of cryotherapy of shoot tips for a certain plant depends on the availability of tissue culture and cryopreservation protocols suitable for it. Many cryopreservation protocols are genotype-specific and this is the main limitation of applying cryotherapy. Modern dehydration techniques are based on vitrification that is the solidification of liquids without crystallization. Some of the basic steps for cryotherapy include the production of in vitro plantlets, preconditioning and preculture conditions for the shoot tips, osmoprotectant, cryoprotection, rewarming protocol, and regrowth conditions.

Conclusion

Although, attempts to eliminate viruses from plants or portions of diseased plants to obtain new plants have not led to miraculous results, some recent technologies seem to offer new opportunities in virus free plants. The culture of meristems, combined with thermotherapy or chemotherapy offers encouraging results. It is not sufficient just to select drug or thermal exposure. Other parameters have to be taken into account as well, for example the structural and biological characteristics of a virus can strongly interfere with the results of treatment and are important for the final outcome of elimination. Limited or partial knowledge of some of these parameters can lead to incomplete elimination of the pathogen, even if the applied treatment is actually capable of blocking the activity of viral replication.

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Biocontrol Agents of Uzi Fly: A Potential Solution for Silk Industry

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Abstract

Sericulture is the practice of rearing of silkworm with an aim of commercial production of silk. It emphasizes the growth and development of silk weaver's community and recognise their image at global level. Silkworm are the pioneer known silk producing agent for mankind. India accounts a major share in silk production and leads as the second largest silk producer next to China.

Among several factors that hinder the good silk yield, insect pest infestation plays a vital role, Uzi fly menace in particular. Several chemical control methods have been developed by various scientific community but found to be ineffective due to its ill impact on silkworm. So, different IPM methods are developed and among them, biological method is found to be effective. The present article briefs about some of the most potent biocontrol agents to control Uzi fly.

Introduction

Sericulture has been a powerful tool for the rural employment in India. Silk being popularly known as "Queen of Textiles", it paves a way for the reallocation of money from rich and urban market to the poor and rural producers. The role of sericulture in putting the country in its present position in the global scenario cannot be overlooked by any policy maker due to its huge potential and enormous growth in silk industry.

India enjoys the unique status of being the only country in the world to produce all the four commercial varieties of silk – Mulberry, Tasar,Eri and Muga . It is the second largest producer of silk next to China and has been recording persistence growth in silk production and productivity. Among several factors that influence the seed cocoon yield and quality silkworm insect, non-insect pests and diseases form an important component.

The mulberry silkworm, *Bombyx mori* is attacked by insects such as tachinid parasitoids, dermestid beetles, ants, earwigs etc (Narayanaswamy and Devaiah, 1999). Among the insect pests of mulberry silkworm, the Uzi fly, *Exorista bombycis* (Louis) *(Exorista sorbillans* Wiedmann) is a primary larval endo-parasitoid of the silkworm, *Bombyx mori.* There are more than 55 alternative hosts been recorded for this fly in nature but mulberry silkworm is the most preferred one to which the extent of damage ranges from 10-30 percent.

Life Span of Uzi Fly

Uzi fly belongs to family Tachinidae of order Diptera. The longevity of adult fly varies with sex and season. Generally, females survive longer than the males in any given season but, a pronounced seasonal variation is recorded in the longevity of both sexes. Both the sexes exhibit shorter life span during summer as compared to other seasons (Kumar, 1987). There are four distinct stages in the life cycle of the Uzi fly viz., egg, maggot, pupa and adult. Males survive for about 5-15 days while females live for 20-25 days (Patil and Govindan, 1984).

Biological Control of Uzi Fly

Biological control method of pests is the most safe and eco-friendly approach in the pest management strategy. In the biological control method, biocontrol agents called natural enemies are used. These natural enemies are having high searching ability, synchronous with host life, well adapted to field conditions and high host specificity.

A natural enemy with ease rearing and multiplication methods are highly preferred (Devanathan *et al*., 1982). Many natural enemies have been identified to control Uzi fly *viz., Nesolynx thymus, Nesolynx dipterae, Exoristobia philippinensis, Dirhinus anthracia* etc (Kumar *et al.*, 1989; 1993).

Table-1: Natural enemy complex of Uzi fly*

Sl. No.	Parasitoids	Family	Order
SOLITARY PUPAL ENDO-PARASITOIDS			
1.	*Brachymeria intermedia*	Chalcididae	Hymenoptera
2.	*Dirhinus* spp.		
3.	*Brachymeria lugubris*		
4.	*Brachymeria* spp.		
5.	*Dirhinus anthracia*		
6.	*Dirhinus philippinensis*		
7.	*Marmoniella vitripennis*		
8.	*Pachycrepoideus veeranai*	Pteromalidae	
9.	*Pachycrepoideus vindimmae*		
10.	*Pleurotropis* spp.		
11.	*Spalangia cameroni*	Eulophidae	
GREGARIOUS PUPAL ENDO-PARASITOIDS			
12.	*Nesolynx thymus*	Eulophidae	Hymenoptera
13.	*Nesolynx dipterae*		
14.	*Tetrasticus howardii*		
15.	*Spalangia endues*		
16.	*Trichopriya khandalus*	Diapriidae	
17.	*Trichopriya* spp.		
18.	*Exoristobia philippinensis*	Encrytidae	
19.	*Trichospilus diaptraeae*	Chalcididae	

(* Source: Silkworm crop protection: Concepts and Approaches)

Among all the parasitoids, Nesolynx thymus is the most popular biocontrol agent discovered so far. It is well known among the scientific community for the management of Uzi fly due to its high reproductive rate and higher female ratio. For effective utilization of biocontrol agents, parasitoids should be released immediately after sunset in the rearing houses, montage storage places and near the manure pits.

Conclusion

For effective suppression of Uzi fly infestation, an IPM package consisting of different sustainable methods have already been developed. Among all these methods, biological control is exceptional in managing the pest population as it can reach out to the hidden and unconventional places of Uzi fly pupation.

Biocontrol based IPM practices comprising of an ovicide (Uzicide) against eggs, augmentation or insinuative release of indigenous gregarious *N. thymus* and solitary *Dirhinus* spp. against pupae and dusting of Dimilin on maggots to supress the reproductive efficiency of adults has been recommended.

However, the use of biocontrol agents should be reached out at the grassroot level to the farmers so that they can make an effective use of it. Research, extension and technical knowledge dissemination at the ground level to increase the silk yield by eradicating the Uzi menace will make boost the financial strength of silkworm rearers.

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Nanotechnology in Agriculture

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Introduction

Over the last few decades, there has been considerable research on the possible application for effective and improved technologies to increase crop productivity and crop protection in a short period. Biotechnological approach has played pivotal role in crop production. However, to make intensification of crop production and protection environmentally sustainable, inflow of new technologies is must. Among the different technologies projected for precision agriculture, nanotechnology has the potential to revolutionize food production systems. The world's first roadmap for applying nanotechnology to agriculture was drafted by the United States Department of Agriculture (USDA) in 2002 (Manjunatha et al., 2016). From the Indian perspective, possible application of nanotechnology in agriculture sector was emphasized by the former president, late Dr. A. P. J. Abdul Kalam on April 2005 at Delhi as "We have to launch vertical missions under an umbrella organization with the public-private investment in at least 10 nanotechnology products in water, energy, agriculture, healthcare, space, defence sectors. Encourage the youth to take up the challenge in these missions with international collaborations".

Global Trends

Worldwide governments have launched many nanotechnology specific initiatives/ programmes to leverage the potentialities of nanotechnology for social and economic gains. In 2005 itself, more than 62 countries launched national nanotechnology-specific activities world over (Maclurcan, 2005). The research and development (R&D) effort was significantly promoted world over with the announcement of the National Nanotechnology Initiative (NNI) in the 2001 by the USA. The NNI is the most comprehensive R&D programme in nanoscience and technology in the world.

India

The 9th Five-Year Plan (1998-2002) had mentioned for the first time that national facilities and core groups were set up to promote research in frontier areas of S&T which included superconductivity, robotics, neurosciences and carbon and nanomaterials.

The Department of Science and Technology (DST) launched the Nano Science and Technology Initiative (NSTI) in 2001 under the leadership of Prof. C. N. R. Rao. The NSTI has been focusing on research and development in nanoscience and technology in a comprehensive manner so that India can become a significant player in the area and contribute to the development of new technologies, besides carrying out basic research at the frontiers of knowledge. The investment on biological sciences including agriculture is less than 5% and therefore lots of scope available for agricultural scientists to exploit the fascinating technology. Within the sphere of agricultural sciences, nanotechnology application in relation to soil and crop management is in its nascent stage and over the next few years is expected to grow exponentially.

Nanotechnology is a multi-disciplinary science. It includes knowledge from biology, chemistry, physics and other disciplines. Joseph and Morrison (2006) defined nanotechnology as the manipulation or self-assembly of individual atoms, molecules or molecular clusters into structures to create materials devices with new or vastly different properties. The term "Nanotechnology" was first defined in 1974 by Norio Taniguchi of the Tokyo Science University. Nanoscience and technology involve studying and working with matter on an ultra-small scale that allow us to work, manipulate and create tools, materials and structures at the molecular level, often atom by atom into functional structures having nanometer dimensions. Nanotechnology in agriculture in terms of nanoagrochemicals include: nano-fertilizers, nano-herbicides, nano-pesticides, nano-fungicides.

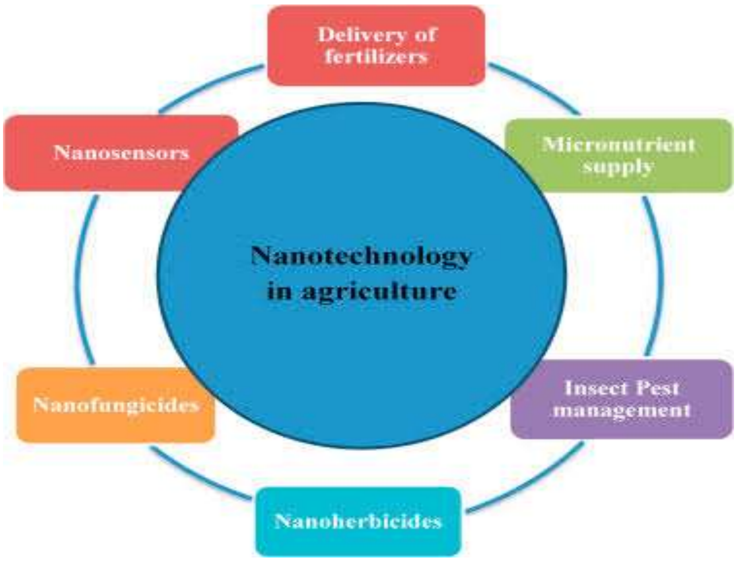

Fig 1. Nanotechnology in agriculture in relation to nanoagrochemicals

Nano-Fertilizers

Fertilizers play a pivotal role in agricultural production. 35-40% of the crop productivity depends upon fertilizer, but some of the fertilizer affects the plant growth directly. It has been estimated that around 40-70% N, 80-90% P and 50-90% K content of applied fertilizers are lost in the environment and could not reach the plant which causes sustainable and economic losses (Ombodi and Saigusa, 2000). Also, the government is subsidizing the cost of fertilizers, particularly urea to encourage farmers to use them to promote productivity of crops. This resulted in repeated use of fertilizer, occurrence of nitrate pollution in groundwaters and imbalanced fertilization which adversely affects the inherent nutrient balance of the soil. Since fertilizers are the main concern, developing nano based fertilizer would be a new technology in this field.

Delivery of Fertilizers

Localized application of large amounts of fertilizer in the form of ammonium salts, urea, and nitrate or phosphate compounds are harmful. Besides much of the fertilizers are unavailable to plants as they are lost as run-off leaching causing pollution (Wilson et al., 2008). Surface coatings of nanomaterials on fertilizer particles hold the material more strongly due to higher surface tension than the conventional surfaces and thus help in controlled release. Moreover, nanocoatings provide surface protection for larger particles (Brady and Weil, 1999).

Nanobiosensors

A biosensor is a device that combines a biological recognition element with a physical or chemical transducer to detect a biological product. Biosensors can detect when plant requires more nitrogen and allow microbes access to the fertilizer nitrogen inside the polymer protected particles. Nanobiosensors that will bind to these compounds can be developed so as to control of the release of fertilizers.

Nano-Herbicides

Agricultural production in the rainfed areas depends on various factors which interact either to enhance output or to limit production. Among the factors limiting the production, weed ranks top. Under rainfed condition, water is the most important resource which decides the success or failure of the crop. Chemical methods integrated with cultural practices proved to be the best option in rainfed areas. But, lack of sufficient moisture, limits the choice of chemical weed management. Due to lack of moisture in the top layer of soil, the weed seeds present, unable to germinate during initial growth stages of crop, subsequent rain favours the germination of weeds which will become too late to choose an herbicide. Lack of moisture at the appropriate times necessitates the need for new formulations to release the active ingredient in a controlled manner based on soil moisture status. To improve the existing weed management techniques development of nanodevices, a smart delivery system and nanocarriers for controlled release was developed to avoid wastage and better utilization of applied herbicides. Encapsulation of herbicides is one of the important strategies to regulate the release of herbicide molecules.

Nanoparticles in Plant Disease Management

Different types of organic, inorganic, salts and acids have been used for controlling disease for many years (Talibi et al., 2011). Besides, certain organic amendments are also used to control plant diseases. Use of nanoparticles in plant disease management is a novel and fancy approach that may prove very effective in future with the progress of application aspect of nanotechnology. The nanotechnology has potential prospects of use in plant disease management in different ways. The most simple and obvious way is direct application of nanoparticles in the soil on seeds or foliage to protect plants from pathogen invasion. In this way, the NPs may suppress the pathogens in a way comparable to chemical pesticides. When nanoparticles are to be applied directly in soil, their effects on non-target organisms especially the mineral fixing/solubilizing microorganisms will be of great significance.

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Weather Effects on Major Insects of Rice

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Abstract

Weather parameters viz., Temperature, rainfall, relative humidity, sunshine hours and wind speed are the major weather elements determining the insect pest's occurrence. Before green revolution, stem borer, gall midge, rice hispa, whorl maggot, cut worms and thrips were considered as major pests of rice. The major insect pests of National significance today are, rice yellow stem borer, brown plant hopper, white backed plant hopper, leaf folder, gall midge, green leaf hopper and gundhibug. Temperature conditions set the basic limits to insect distribution. Population outbreaks have been related to various climatic factors, such as previous winter temperature, temperature of the current season, and rainfall.

Introduction

Rice (*Oryza sativa* L.) is an important staple food crop for more than half of the world population and accounts for more than 50% of the daily calorie intake (Khush, 2005). In India, rice occupies one-quarter of the total cropped area, contributes about 40 to 43 % of total food grain production and continues to play a vital role in the national food and livelihood security system. In Odisha, rice is also the staple food of almost entire population. Insects as cold-blooded animals are directly under the control of temperature for their growth. They are also very sensitive to desiccation and hence to humidity.

1. Yellow Stem Borer *(Scirpophaga incertulas)*: Cold weather with high humidity and low temperature prevalent during Oct-Dec, has been found conducive for the multiplication of the insects. Scirpophaga incertulas eggs show some development at 13°C, hatching normally occurs at 16°C or higher. The incubation period decreases with temperature increase, beginning at 30°C and continuing up to 35 °C. Although embryonic development can be completed at 35 °C, the larvae die within the egg shell. The optimum egg hatching temperature is 24-29°C for Scirpophaga incertulas. It requires 90-100% RH, hatching is severely reduced below 70% RH. The rate of larval development is positively correlated with temperature between 17 and 35°C. The optimum temperatures for pupal development are 15-16°C for Scirpophaga incertulas. Above 35°C the pupae suffer high mortality and emerging moths are often deformed.

2. Gall Midge *(Orseolia oryzae)*: It is exclusively a pest of karif season. In summer or rabi crop its intensity is very low. Cloudy weather with continuous rains favours the pest buildup. The most serious gall midge infestation occurs when early rains make the flies active. The favorable condition for fly development is 26-30 °C and 82-88% RH. Heavy rains or storms cause high mortality.

3. Brown Plant Hopper (Nilaparvata lugens): Rainfall profoundly influences BPH buildup by creating favorable high humidity at the crop base. During kharif it is predicted that, BPH population in September will be low, if cumulative rainfall in august is less than 100 mm, BPH moderate if about 200 mm and outbreak of BPH is expected more than 300-400 mm. Adults of Nilaparvata lugens remain active from 10 to 32 °C. Females are somewhat more tolerant of temperature than are the males. Nilaparvata lugens eggs usually do not hatch if incubated at 33 °C, but more eggs hatch and growth is faster at 27 °C than at 25 °C. A temperature of 33 °C is lethal to freshly hatched nymphs and greatly reduces the life span of the adults. Nilaparvata lugens nymphs exhibit a positive relationship between rate of nymphal development and temperature of 11.6-27.7 °C.

4. Green Leaf Hopper (Nephotettix viresences): It is a serious pest in kharif season. The abundance of Nephotettix spp. has been attributed to high temperature, low rainfall, and abundant sunshine. It is widely accepted that for most rice leafhopper and planthopper species, the optimum temperature is 25-30 °C.

5. Rice Whorlmaggot (Hydrilla philippina): Whorl maggots have increased in importance because of irrigation systems. They live in aquatic habitat and does not occur in upland rice. Adults are active during day, locating rice fields by reflected sunlight from the water surface.

6. Leaf Folder (Cnaphalocrocis medinalis): Use of high level of nitrogen and cloudy weather with low sunlight favours pest buildup. Abiotic conditions such as minimum temperature, maximum relative humidity and average relative humidity had significant positive influence on C. Medinalis population. In case of minimum relative humidity and sunshine hours a negative influence was observed.

7. Gundhi Bug (Leptocorisa acuta): Rice bugs become active when the monsoon rains begin. During dry season adults move to wooden areas where they remain dormant. All stages of the rice bug are especially vulnerable to changes in temperature and humidity. The bugs are most abundant at 27-28 °C and 80-82% RH. During flowering of the rice crop, warm weather, overcast skies, and frequent drizzles favor population buildup, but heavy rains reduce it. The population usually increases at the end of the rainy season and declines rapidly during dry months and when temperature is unfavorable. When temperature declines from October onward, the insects hibernate in grasses. In such areas, late rice crops escape rice bug infestation.

8. Rice Hispa (Dicladispa armigera): Heavy rains, especially in pre monsoon or earliest monsoon periods, followed by abnormally low precipitation, minimum day-night temperature differential for a number of days, and high RH favor rapid buildup of hispa populations. It is more abundant in rainy seasons. Pest population buildup is favored by rainy and cloudy days.

9. Mealy Bug (Brevenia rehi): Dry spell favours population built up and damage under drought conditions become high.

10. Swarming Catterpillar (Spodoptera mauritia): Swarming caterpillars are cut warms which appear in wetland rice after the flood recede. Prolonged dry condition followed by heavy rainfall favours it outbreaks. Wind and rain storm helps in migration of moths to long distances. Heavy rainfall leads to mortality of larval population.

11. Rice Thrips (Stenchaetothrips biformis): More abundant in dry weather.

Conclusion

The seasonal effects of weather and ongoing changes in climatic conditions will directly lead to modifications in dispersal and development of insect species. The changes in surrounding temperature regimes certainly involve alterations in development rates, voltinism and survival of insects and subsequently act upon size, density. The developmental success of insect herbivores also indirectly depends on climate, as environmental parameters impact on plant physiology. Insects and plants are exposed to complex interactions among changes in temperature, precipitation and, increased levels of CO_2 and variations in nutrient availability.

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Intrinsic Competition in Host – Wasp Parasitoid Relationship

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Introduction

In nature, multiple species of natural enemies, such as predators or parasitoids, frequently attack a single species of prey or host. However, unlike most predators, which may attack many different kinds of prey, parasitoid wasps often have narrow host ranges, resulting in strong coevolutionary interactions between parasitoids and their hosts with respect to various ecophysiological traits of both parties. Competition involving parasitoids falls into two broad categories: extrinsic (among free-living adults searching for host resources) and intrinsic (among immature parasitoids developing on or inside the host).

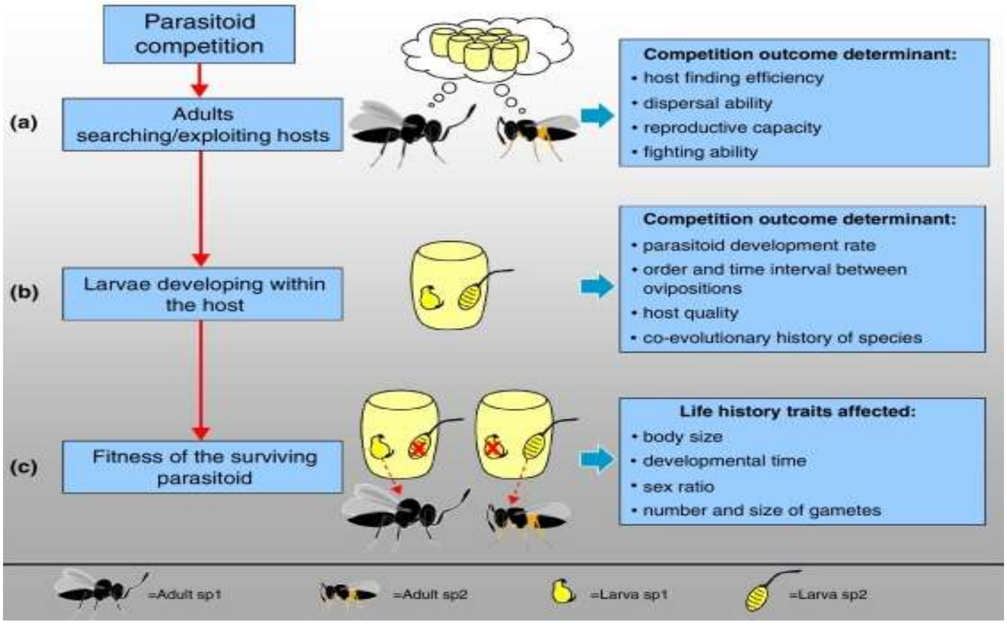
Coexistence may occur between two or more parasitoids sharing the same host species and stage provided that the levels of antagonism among them are mediated by various life-history traits, including degree of host specificity, searching efficiency, female body size, egg load, and ability to discriminate between hosts parasitized by each other in ways that dilute competition.

Development and Host Usage Strategies in Parasitoids And Intrinsic Competition

Six types of parasitoids strategies have been described:

1. Idiobionts: Idiobionts are parasitoids that kill or paralyze their hosts permanently at the time of oviposition.

2. Koinobionts: It attack hosts that continue to feed, grow, and defend themselves during much of the course of parasitism.



Hosts parasitized by idiobionts are static resources in which quality, defined as the condition of resources that affects parasitoid growth, development, survival, and hence fitness, is positively correlated with host size or else declines as hosts. Koinobionts, on the other hand, attack resources that may be highly dynamic, whereby the final size of the host is often many times greater than the initial size of the host at oviposition.

3. Ectoparasitoids: Lay their eggs on the external cuticle of their hosts, and their larvae perforate the host cuticle and imbibe fluids in this way, generally consuming the host piecemeal but never intimately interacting with the host's internal milieu.

4. Endoparasitoids: Oviposit directly into the host's body fluids, where the larvae feed and develop.

5. Solitary: (i.e., only one parasitoid larva can successfully develop on or inside a host).

6. Gregarious: (i.e., where several or many parasitoids develop in an individual host). These differences in host usage patterns can certainly affect the outcome of intrinsic interspecific competition.

For example, development of larvae of the koinobiont endoparasitoid *Venturia canescens* inside finalinstar caterpillars of *Plodia interpunctella* was arrested when the caterpillars were subsequently paralyzed by the idiobiont ectoparasitoid *Bracon hebetor*. Similarly, the idiobiont egg parasitoid *Trichogramma pretiosum* dominated when competing with *Copidosoma floridanum*, which oviposits in host eggs but completes its development only in fully grown host caterpillars.

Different Ways in Intrinsic Competition

To better understand the mechanisms involved in intrinsic competition in parasitoids, the different ways in which these insects may compete. Superparasitism is parasitism of a host by parasitoids of the same species. On the other hand, multiparasitism is parasitism of a host by parasitoids of different species.

Acceptance or rejection of a host is based a female parasitoid's ability to distinguish unparasitized from parasitized hosts, and on a combination of both ecological (e.g., habitat characteristics such as patch size, structure, and host abundance) and physiological (e.g., egg load, age, and other characteristics of the female parasitoids) parameters, as well as on the fitness consequences of decision-making processes. This field of research is large and is not covered here. However, many parasitoid species do not hesitate to oviposit in already parasitized hosts, and once this occurs, there is the potential for antagonistic interactions among immature stages seeking to monopolize host resources.

Conclusions and Future Directions

Advances with the use of molecular tools offer considerable promise in enhancing our understanding of how interspecific competition shapes both parasitoid communities and life-history traits including host range and habitat specificity. By developing primers for different parasitoid species sharing the same host, it will be possible to collect hosts in the field and to determine the degree of multiparasitism that occurs under different conditions.

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A Fortified Drink Is Incorporated into Molecular Gastronomy: Mangosteen Juice Along with *Clitoria ternatea*

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Introduction

Mangosteen is commonly called as "Queen of fruits" and it is under the guttiferae family. It is mostly grown in tropical rain forest areas. They are rich in some properties like anti-oxidant, anti-inflammatory, anti-bacterial, anti-viral, anti-tumoral & anti-allergic [1]. Mangosteen is rich in phytochemicals and other pharmacological activities. So, it can cure many diseases by improving the immune system. The whole plant contains a medicinal value, it is mostly used to extract a drug and the fruits are sweet in taste. They are used as a medicinal plant in some areas. It promotes loss of cholesterol, reduces the blood glucose level, simultaneously increases the immune system and it also maintain the function of brain, heart & digestive system. Along with this, it contains many minerals (Ca, Mg, P, K, Mn, Na, Zn, Fe, Cu) and some vitamins (B1, B2, B3, A, C & folate) [2]. The Mangosteen is peeled, pulp is removed and grinded to get a fruity drink and then it is fortified with a Clitoria ternatea flower (Fabaceae family), it is of two colours (purple & white) and it is called as various names as bluebellvine, blue pea etc. Because it is rich in butelase-1 enzyme, which is responsible for the protease's reverse reaction. It also contains some chemical compounds like tannins, phlobatannin, carbohydrates, saponins, phenols, flavonoids, anthocyanins, proteins, flavanol glycosides, cardiac glycosides, steroids and some volatile oils. It is a leguminous herb, mainly grows in a region of tropical & temperate zone and it is a natural nitrogen fixing crop. Main application of this flower is to obtain food colour and other cosmetic items. Now-a-days, they are used in many food industries due to anti-oxidant and phytochemical properties [3].

	
FIG:1- Mangosteen	**FIG:2- Clitoria ternatea**

The *C. ternatea* flowers are soaked in a warm water to extract the all essential nutrients from that flower. Which contain many nutrients. Traditionally, this extract drink is consumed to prevent the tumour formation in the body, due to the presence of anti-tumours property. In some areas this drink is consumed as a tea and it promotes a refresh nature to our body. That flowers are dried and grinded into powder to use as a natural food colouring agent.

Table:1 chemical constituents & uses of Mangosteen and *Clitoria ternatea*

	Chemical constituents	Uses
Mangosteen	Saponins	Reduce lipids in blood, inhibit tumour formation
	Crude protein	It is used to build bones, muscles, cartilage etc.
	Condensed tannins	Astringents and clarifying agent

	Fibre	Reduces Bp & sugar, maintain bowel health
	Xanthones	Rich in anti-oxidant, anti-cancerous, anti-inflammatory & anti-diabetic properties
	Garthanin	It responsible for healing purpose
	Mangostin	Anti-aging & anti-wrinkling property
Clitoria ternatea	Steroids	Supress redness, swelling
	Tannins	Rich in anti-oxidant & anti-inflammatory effect
	Phenols	Prevent cellular damage
	Flavonoids	Increase cellular activity & prevent free radicals
	Anthocyanin	As a food additives & colouring agent
	Cardiac & flavanol glycosides	Enhance the sweetness
	Anthraquinone	Laxative, anticancer, anti-injury & anti-oxidant etc

Molecular gastronomy is a modified form of food based on science dealed with a molecule in food. The Mangosteen juice is mixed with the C. ternatea flower extract, then it formed a fortified health drink with a natural food colour obtained from that flower, which is more attractive one. After getting that drink, it undergoes a process of molecular gastronomy. In that process, the drink is blinded with calcium lactate and freeze it. Then, it is dipped in a sodium alginate solution to obtain a sphere like texture with a transparent look. After few minutes, they are dissolved in a distilled water to remove the chemicals attached on the surface of the sphere [4].

FIG:3- Flow process of fortified and molecular gastronomy of healthy drink.

Summary

Overall conclusion of this article to form a nutrients rich and modern form of food. Now-a-days most of the kids and youngster are attracted by appearance and colour, they don't take nutrition rich foods. So, they are affected with malnutrition. This kind of foods are attracted them and with a high nutrition. But the cost of this process is high compared to others, it is the only one limitation in this process. Final product of this process, to a drink in the form of transparent jelly like structure with spherification. Normally, most of the products are undergoes a fortification alone. In this, one step advanced to get this product with two techniques fortified and molecular gastronomy. While consume this kind of product, people enjoying and they get a nutrition rich food. It is drink but we are consumed it like a jelly with a glazy layer.

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Mycotoxins and Food Poisoning

Article ID: 31701

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Mycotoxins are fungal metabolites. Some are highly toxic to many animals and potentially toxic to human beings. Recent concern is related to their carcinogenic properties and their presence in many food items. The fungi include the molds, yeasts, mildews, blights, rusts, and mushrooms.

Many fungi are useful. The two predominant genera of fungi in stored products are probably *Penicillium* and *Aspergillus,* members of which produce mycotoxins. The syndrome resulting from the ingestion of toxin in a mold-contaminated food is referred to as mycotoxicosis. Historically, the first documented case of mycotoxicosis attributed to a fungus-containing food was that of rye ergot.

Claviceps purpurea parasites rye and other grains and elaborates six lysergic acid derivatives, which are responsible for the syndrome. Consumption of the grain or flour made from it over a period of time can result in gangrenous ergotism. Some important mycotoxins are as follows.

Aflatoxins

Aflatoxins are one of the highly toxic secondary metabolites derived from polyketides produced by fungal species such as *Aspergillus flavus, A. parasiticus,* and *A. nomius*. These fungi usually infect cereal crops including wheat, walnut, corn, cotton, peanuts and tree nuts, and can lead to serious threats to human and animal health by causing various complications such as hepatotoxicity, teratogenicity, and immunotoxicity. The major aflatoxins are B1, B2, G1, and G2, which can poison the body through respiratory, mucous or cutaneous routes, resulting in overactivation of the inflammatory response.

Patulin

First isolated and described as an antibiotic, patulin is structurally synonymous with expansin, penicidin, claviformin, clavatin, clavacin, mycoin C, and gigantic acid. Several molds have been reported to produce patulin. Many patulin-producing strains have been isolated from food and animal feeds. *Pencillium expansum* produces patulin in accountable quantity. Peptone, glycine, methionine, *p-aminobenzoic* acid, asparagines, sodium sulfate, sodium thiosulfate, and casein hydrolyzate have an inhibitory action on patulin. It is possible, therefore, that some foods, which will support patulin-producing fungi, do not constitute a problem because of their inherent composition. Patulin is also resistant to heat. This mycotoxin resists boiling e.g. it is stable at 100°C for 15 min.

Ochratoxin

A toxic metabolite of *Aspergillus ochraceus* named as ochratoxin A. Some strains of *P.viridicatum* and *P.palitans* produce citrinin and *ochratoxin* A. There is some speculation that these two mycotoxins can act synergistically in animals to result in nephrotoxicity. Ochratoxin A is toxic to ducklings, rats, chicks, and trout. It is about one-third as toxic as aflatoxin B_1 to rats. The other derivatives or analogs are all equally or less toxic than ochratoxin A.

Luteoskyrin

Penicillium islandicum produces two metabolites, luteoskyrin and cyclochlorotine, which are hepatotoxic to some animals. Although luteoskyrin is not as carcinogenic as aflatoxin B_1, mice seem to be more sensitive to luteoskyrin than to aflatoxin B_1. There are no known acute human intoxications attributed to luteoskyrin or cyclochlorotine.

Sterigmatocystin

Structurally similar to aflatoxin, sterigmatocystin has a carcinogenic potency probably between one-tenth and one-hundredth of that of aflatoxin.

Penicillic Acid

Several molds have been reported to produce penicillic acid, and its carcinogenic ability has been noted. Many commodities, including oats, wheat, rice, corn, and barley, support the growth of penicillic acid-producing strains.

Alimentary Toxic Aleukia (ATA)

The syndrome in man is caused by the toxic metabolites fusariogenin, epicladosporic acid, and fagicladosporic acid. ATA is not a problem if grain is harvested and stored properly. most outbreaks of ATA have all resulted from the consumption of overwintered grain i.e. grain that has been allowed to remain in the fields during the winter and harvested late.

Roquefortine

A toxic substance present in commercial blue cheese. Heavily moulded portions of the cheese contain higher concentrations than the white portions. *Penicillium roqueforti* producing a mycotoxin during curing of Roquefort cheese (blue cheese). The toxic factor, tentatively named roquefortine, acts as a neurotoxin.

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Role of Nano Fertilizers in Crop Production Technology

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Introduction

Nanotechnology is a rising field of interdisciplinary research. The potential uses and benefits of nanotechnology are vast. A large proportion of those living in developing countries face daily food shortages as a result of environmental footprint. For developing countries, the drive is to develop drought and pest resistant crops, which also maximize yield. The application of nanotechnology in crop production and food industries is also getting attention now a days. Investments in agriculture carry potential benefits range from improved food quality and safety to reduced agricultural inputs and improved processing and nutrition. While most investment is made primarily in developed countries, research advancements provide glimpses of potential applications in agricultural, food, and water safety that could have significant impacts on rural populations in developing countries. This review is concentrated on modern strategies used for the management of water, pesticides, limitations in the use of chemical pesticides and potential of nanomaterials in sustainable agriculture management as modern approaches of nanotechnology. Nanotechnology is a new scientific approach involving the use of materials and equipment capable of manipulating physical and chemical properties of a substance at molecular level. On other hand, biotechnology involves using the knowledge and techniques of biology to manipulate molecular, genetic and cellular processes to develop products and services and is used in diverse fields from medicine to agriculture. Nano biotechnology can improve our understanding of the biology of various crops and thus can potentially enhance yields or nutritional values, as well as developing improved systems for monitoring environmental conditions and enhancing the ability of plants to absorb nutrients or pesticides. Among the latest line of technological innovations, nanotechnology occupies a prominent position in transforming agriculture and food production. The development of nano-devices and nanomaterials could open up novel applications in plant biotechnology and agriculture.

Nano Fertilizers and their Roles

Fertilizers have an axial role in enhancing the food production in developing countries especially after the introduction of high yielding and fertilizer responsive crop varieties. In spite of this, it is known that yields of many crops have begun to depression as a result of imbalanced fertilization and decrease in soil organic matter. Moreover, excessive applications of nitrogen and phosphorus fertilizers affect the groundwater and also lead to eutrophication in aquatic ecosystems. Such cases along with the fact that the fertilizer use efficiency is about 20-50 percent for nitrogen and 10-25 percent for phosphorus fertilizers implies that food production will have to be much more efficient than ever before. According to Royal Society, Nanotechnologies are the design characterization, production and application of structures, devices and systems by controlling shape and size at nanometre scale. Nowadays, nanotechnology is progressively moved away from the experimental into the practical areas. For example, the development of slow/controlled release fertilizers, conditional release of pesticides and herbicides, on the basis of nanotechnology has become critically important for promoting the development of environment friendly and sustainable agriculture. Indeed, nanotechnology has provided the feasibility of exploiting nanoscale or nanostructured materials as fertilizer carriers or controlled-release vectors for building of so-called “smart fertilizer” as new facilities to enhance nutrient use efficiency and reduce costs of environmental protection.

Encapsulation of fertilizers within a nanoparticle is one of these new facilities which are done in three ways:

1. The nutrient can be encapsulated inside nano porous materials.
2. Coated with thin polymer film.
3. Delivered as particle or emulsions of nanoscales dimensions.

In addition, nano-fertilizers will combine nanodevices in order to synchronize the release of fertilizer-N and -P with their uptake by crops, so preventing undesirable nutrient losses to soil, water and air via direct internalization by crops, and avoiding the interaction of nutrients with soil, microorganisms, water, and air. In addition to cases where mentioned, some of advantages related to transformed formulation of conventional fertilizers using Nanotechnology are presented below. Smart fertilizers might become reality through transformed formulation of conventional products using nanotechnology. The nanostructured formulation might permit fertilizer intelligently control the release speed of nutrients to match the uptake pattern of crop. Solubility and dispersion for mineral micronutrients cause controlled release formulation. Nanosized formulation of mineral micronutrients may improve solubility and dispersion of insoluble nutrients in soil, reduce soil absorption and fixation and increase the bioavailability leads to increased nutrient uptake efficiency.

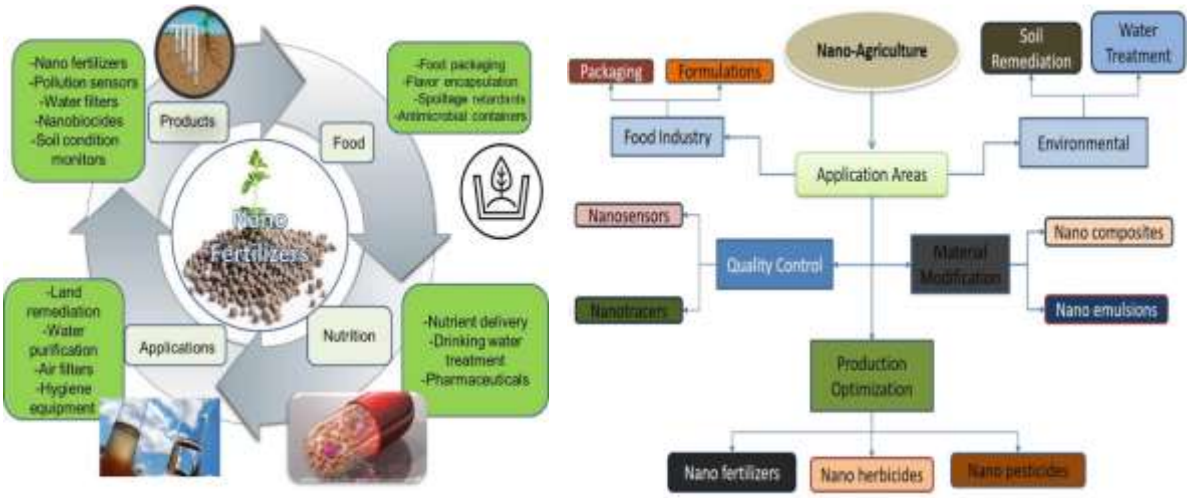

Fig. 1: Design and Production of Nanofertilizers

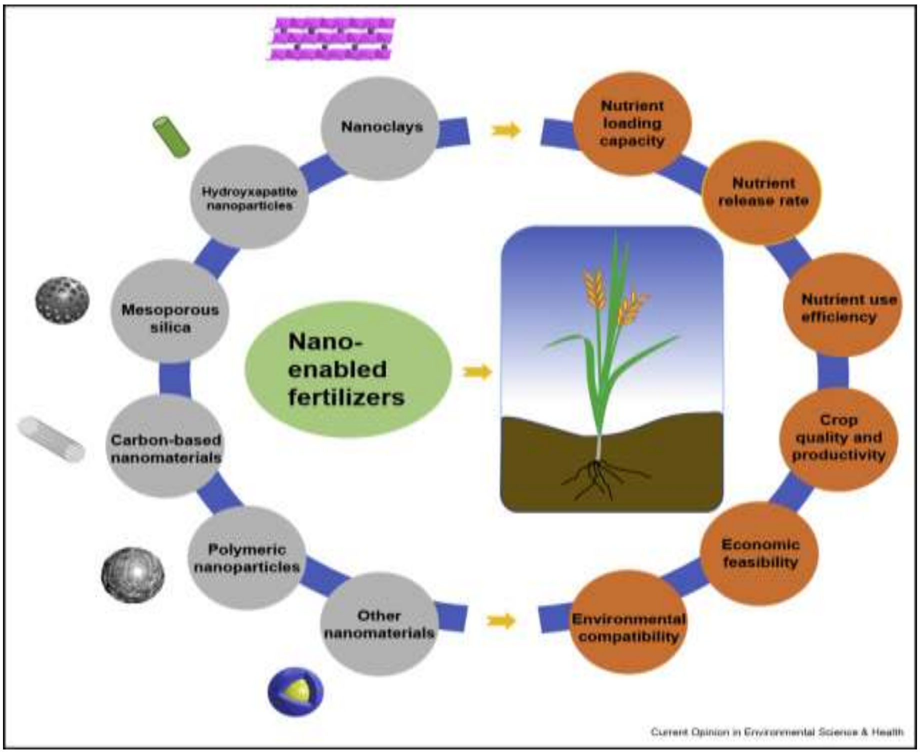

Fig. 2: Nano-enabled fertilizers to control release and use efficiency.

Nanostructured formulation might increase fertilizer efficiency and uptake ratio of the soil nutrients in crop production, and save fertilizer resource. Controlled release modes have properties of both release rate and release pattern of nutrients for water-soluble fertilizers might be precisely controlled through encapsulation in envelope forms of semi-permeable membranes coated by resin-polymer, waxes and sulphur. Effective duration of nutrient release has desirable property of Nanostructured formulation, it can extend effective duration of nutrient supply of fertilizers into soil. Nanostructured formulation can reduce loss rate of fertilizer nutrients into soil by leaching and leaking.

Summary and Conclusions

Nanotechnology is progressively moved away from the experimental into the practical areas, like the development of slow/controlled release fertilizers, conditional release of pesticides and herbicides, on the basis of nanotechnology has become critically important for promoting the development of environment friendly and sustainable agriculture. Indeed, nanotechnology has provided the feasibility of exploiting nanoscale or nanostructured materials as fertilizer carriers or controlled release vectors for building of so-called “smart fertilizer” as new facilities to enhance nutrient use efficiency and reduce costs of environmental protection. Encapsulation of fertilizers within a nanoparticle is one of these new facilities which are done in three ways a) the nutrient can be encapsulated inside nano porous materials, b) coated with thin polymer film and c) delivered as particle or emulsions of nanoscales dimensions. In addition, nanofertilizers will combine nanodevices in order to synchronize the release of fertilizer-N and -P with their uptake by crops, so preventing undesirable nutrient losses to soil, water and air via direct internalization by crops, and avoiding the interaction of nutrients with soil, microorganisms, water, and air. The emerging new science and enabling technology, working with the smallest particle, the nanotechnology raises hope for new innovations in the field biology, especially in agriculture. Many unsolved and bottle necks in the field of life sciences and agriculture could be addressed through this technology. More focused research is required in the area of energy, environment, crop improvement, disease management and efficient resource utilization for increasing the productivity, profit, without hampering the natural ecosystem.

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Status and Prospects of Kiwi Cultivation in Nagaland

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Introduction

Kiwi fruit (chinese gooseberry) *(Actinidia deliciosa)* is known as "China's miracle fruit and the Horticultural wonder of New Zealand". It has many nutritional properties where it is used as tonic for women after child birth and also for new born children. Like most of the plants, Kiwi plant is pollinated by wind and insect. It requires 700-800 chilling hours for its growth.

Total area being cultivated under Kiwi in India is around 4'000ha and production in 13'000MT (NHB, 2018-19).It is mostly grown in Himachal Pradesh, Uttar Pradesh, Jammu Kashmir and Kerala. In North East, it is being cultivated in Arunachal Pradesh in some sizable area and other north eastern states has negligible area in its cultivation. States like Sikkim, Meghalaya, Nagaland and hills of Manipur have immense scope for successful cultivation of Kiwi fruits.

Status of Kiwi fruit in Nagaland

The total area covered by fruits in Nagaland is estimated at around 33.94'000 ha. and production of about 315.34'000MT (NHB, 2018-19). Among them kiwi occupies the following area and production:

Total area and production of under kiwi in different districts of Nagaland is as follows:
Area & Production of Major Fruits during 2017-18 (A=area in hectare, P=Production in mt

SN	Fruits	Area & Production	Kohima	Wokha	Zunheboto	Phek	Nagaland
1.	Kiwi	A	55.00	3.00	92.00	106.00	256.00
		B	560.00	8.00	881.00	318.00	1767.00

Source: Directorate of Horticulture, Nagaland

1. Kiwi is mainly grown in Zunheboto and Phek districts of Nagaland.
2. Tsupfume a village in the Kupamedzu Mountain Range, Phek district is known as Kiwi fruit village of Nagaland.
3. The favourable climatic condition and suitable soil for Kiwifruit in Tsupfume is the main reason for its successful cultivation. The Land Resources department provided 12,000 Kiwifruit saplings (Hayward variety) (which is the most popular biennial bearing cultivar, with broad and fruit flat, superior in flavour and sugar and ascorbic acid) for the village in 2009 after giving training and management to the villagers/farmers.
4. Tsupfume has harvested 50 Kg of Kiwifruit in the year 2012 and in the year 2013 it has harvested 200 Kilo and in the year 2014 it is having harvested 2500 Kilo and sold for Rs 120- 150 depending on the quality of the fruit. Farmers also disclosed by 2020 the harvest is expected to 80,000-95,000 Kilo a year.
5. An MOU has also been signed with Exotic delicia Nagaland only for Kiwi fruit on behalf of Phek District farmers union for Kiwi fruit marketing.
6. Tichibami village is growing 2000 Kiwi plants of which nearly 200 are harvested and fetched about Rs 28 lakh annually. (Morung express, 2017)
7. A plan was proposed by Nagaland government for organic cultivation of Kiwi fruit crop during the period from 2020-2025 in 100ha (for a period) and cumulative total of 400ha. (Vision 2050- Prosperity through agriculture, 2012).

8. The state government is expecting to bring 300-550Ha of additional area under Kiwi cultivation is by 2025 (Vision 2050 prosperity through agriculture, 2012).

Prospects

1. Kiwi fruit has been considered as one of the important future commercial fruits of Nagaland.
2. Particular districts in Nagaland for example Zunheboto and Phek has favourable and varied agro climate for cultivation of Kiwi.
3. It holds a good medicinal property, thus recommended for patients suffering from diabetes and heart diseases.
4. Nagaland is one of the states in India where most of the farming is done without using chemicals, so it will be added advantage for Kiwi production and its market.
5. Most of the exotic fruits are imported from foreign to India and Kiwi is one among them. Cultivation of Kiwi in Nagaland may create good market throughout India.
6. Kiwi provides high return per unit area which is an added advantage to farmers.
7. Kiwi fruit bears heavily every year without failure, hence its cultivation provides no loss for farmers.
8. As far as in Kiwi cultivation in Nagaland is concerned, no serious pests and diseases attack have been observed.
9. Morphology of the fruit, like presence of hairy skin prevents the damage of fruit from animals and birds.
10. It has a longer shelf-life which creates lot of opportunities in processing industries and it can be stored for one month in open at room temperature and for 4-6 months in cold storage.

Strategies

1. Providing quality Kiwi planting material to farmers through nurseries is best strategy to increase the cultivation.
2. Encouraging farmers to grow their own planting material for future use.
3. Adopting integrated nutrient management practices.
4. Introduction of superior varieties which gives high yield and are tolerant to disease and pest attack. .
5. Establishment of fruit preservation units to ensure marketing of fruits.
6. Development of agri-corridors to transport produce from the sites of production to the market.
7. Providing package of practices for organic cultivation of kiwi.
8. Construction of cold storages helps to store fruits for longer periods till farmer gets the good price.
9. A direct online portal application should be developed for sale of Kiwi fruits directly to the consumer without involvement of middle men and also helps the farmers to get good income.

Conclusion

Being a highly suitable crop for Nagaland climate kiwi cultivation can fetch good prices to the farmers both locally and internationally.

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Green Manuring for Sustainable Agriculture

Article ID: 31704

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Introduction

Decline in soil organic matter is the principal reason for the decrease in productivity. Improvement of physical aspects, water retention, and biological activity, as well as the storage and slow release of nutrients are determined by the amount of organic matter. A periodical application of organic matter is, essential to replenish the loss of humus, which is necessary for keeping the soil health in good condition by enhancing the supply of nitrogen and by promoting the growth of microorganisms. To improve soil health and meet the nutritional need of succeeding crop, green manuring is the best alternative. Green manure constitutes a technology that is appropriate and essential to achieve sustainable agricultural production.

Green Manuring

Green manuring is a practice of ancient origin. It is defined as the use of undecomposed green plant material, grown in situ or cut and brought in for incorporation to improve physical structure and fertility of a soil. Leguminous crops should be selected as a green manure crop since it adds a lot of nitrogen into soil due to *Rhizobium* symbiosis. By incorporating the 8 to 25 tonnes per ha of green matter of leguminous crops will add up about 60 to 90 kg of nitrogen/ha this amount is equivalent to an application of three to ten tones of farmyard manure on the basis of organic matter and its nitrogen contribution. The species commonly used for green manuring are of the *Leguminosae* with C*rotalaria juncea* (sunn hemp) and *Sesbania aculeate* (Dhaincha) being the most popular in India, and *Vicia spp., Trifolium spp* etc in cooler climates (Meelu *et al*. 2007).

According to the suitable soil and climatic conditions of that particular area, different ways of green manuring is practiced. In India, it can be divided into two ways:

1. Green manuring *in-situ*: It is a system in which green manure crops are grown and incorporated in to the same field. It is followed in the northern India. The commonly used for green manuring crops are Leguminous crops: Sunhemp, Dhaincha, black gram, cowpea, berseem etc. Non leguminous crops: Jowar, Maize, Mustard, Coriander etc.

2. Green leaf manuring: In this system leaves and tender twigs from shrubs and trees grown on bunds, waste land and nearby forest areas are collected and then incorporated into the cultivable fields. This system is followed in central and eastern India. Suitable crops for green leaf manuring are Gliricidia, Subabul, Wild cassia, Neem etc.

Characteristics of Ideal Green Manure Crop

1. Preferably a legume crop with good nodular habit having high capacity to fix atmospheric nitrogen
2. It should have deep rooting system, facilitating nutrient mining from subsurface soil
3. Low water and nutrient requirement
4. Yield a large quantity of green material within a short time.
5. The biomass produced should have low fibrous material to accelerate decomposition.

Time of Sowing and Age of Incorporation

Green manure crop should be grown immediately after the monsoon rains. Seed of green manure crop is broadcasted with higher seed rate. Fertilization of green manures with phosphatic fertilizers can be done by broadcast, because it improves the availability of phosphorus to the succeeding crop as compared to phosphorus applied to succeeding crop. To get the maximum benefit, they should be incorporated at proper age of crop. It should be turned into soil during flowering stage. Majority of the crops takes 6-8 weeks to reach flowering stage from sowing.

Advantages of Green Manuring

1. Adds organic matter to the soil and thus stimulates the activity of soil microorganism's inhabitant to the soil.
2. Absorb nutrients from the deeper layers and adds to the upper layer of soil.
3. Organic acids are produced on decomposition of green material which enhances the availability of phosphorus, calcium, potassium, magnesium and iron
4. Leguminous crop used as a green manure crop fix atmospheric nitrogen to the soil that becomes available to the succeeding crop.
5. Green manures improve the structure of the soil thereby improving water holding capacity, decreasing the run off and soil erosion.
6. Green manuring crop absorbs nutrients from the soil and protects them against leaching losses.

Disadvantages of Green Manuring

1. Under rainfed conditions, the germination and growth of succeeding crop may be affected due to depletion of moisture for the growth and decomposition of green manuring.
2. Green manure crops could also harbour pests and diseases which harms the succeeding crop.
3. The practice of green manuring may be uneconomical, especially in the regions where irrigation facilities are available along with easy availability of fertilizers. As it is more economical to add the quantity of N in the form of fertilizer which the crop is expected to fix from the atmosphere.

Conclusion

In order to overcome the negative effects of chemical farming, organic farming with green manuring need to be encouraged. Since, green manuring is cost effective, eco-friendly, improves the soil organic matter, and enhances plant growth and yield. So, green manuring is one possible way to attain sustainability in agriculture.

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Birds Pest Management

Article ID: 31705

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Introduction

Birds are important part of the natural balance. quite a few species of birds pollinate plants and disperse seed while many others are insectivorous and predatory, which destroy insect and rodent pests of crops. On the other hand, some species of birds are pests of agricultural crops causing significant losses in yield. useful bird's species associated with insect control: Birds live an important beneficial role in agriculture like insect-pests control, pollination and insect pathogen dispersal. Rosy Pastor was the major predator of castor semi looper. and it visited the field in the large flocks. most number of birds was active during evening hour as compared to morning hours and more predatory birds' activity. Yellow Wagtail is highly relative abundance in wheat crop having predaceous in chickpea crop for pod borer. Barn owl effectively prey on rodents. Neutral bird's species associated with agricultural pests: Some bird's species of avian community viz. House Sparrow, Indian Myna may be or may not be harmful but beneficial to agricultural pests Harmful bird's species associated with agricultural crops: Some species of birds causes damage to crops like cereals, pulses, oilseeds, fruits vegetables as well as they disperse the disease, pest and weed seeds, which cause crop losse. Parakeet was highly preferred Pearl Millet food for consumption in morning and evening. Agricultural crops create ideal foraging sites for gregarious bird species, and virtually everything that humans growow or raise for food is subject to some level of bird damage. For most farmers, bird damage is a fact of life, but not a major concern. The unlucky few producers for whom depredations are severe, however, do incur substantial financial losses.

Management Strategies for Birds

1. Physical methods: methods use of visual and aural scare devices like birds netting, scaring method, keeping human effigy toward off birds, automatic bird scarcer, bird reflective tape, wrapping and Shock tracks are an easy way to keep birds away from any area and while they sound like a cruel option, shock tracks are actually both safe and humane for scaring birds away. They produce very mild electric shocks when the birds land on any surface. Not harmful yet highly effective in keeping birds away from an area, shock tracks can be discreetly laid, nailed or glued to any flat or curved surface including parapet walls, eaves, beams, ledges, and rooflines.

2. Chemical methods: These involve repelling birds from a habitat or deterring them from feeding by using sticky repellents dispersing baits and seed dressing method. Reflective flash tape scares off birds with movement from the wind and the sunlight reflecting off the Mylar tape.

3. Biological control: These involve use of predators of birds like snakes, monitor lizard's mongoose, Indian Yellow throated marten, parasites and disease-causing organisms like protozoans, bacteria, fungi, and viruses. However, in India, very little attention has been given to this aspect of bird's control.

Conclusion

Most of bird species play an important role in agriculture by having a potent check on insect pests' control. Insect-pests' controls by birds are economically cheaper and environmentally safer as compared to the chemical control. Birds are important components of the agro-ecosystem. We need to keep all exist in avian species in balanced numbers in the cultivated landscapes so as to have a sustained agricultural production. To protect the crop from bird's damage, it is not appropriated to use only single method but combine use of two or three methods together are effectively for birds' pests management.

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Conflict Management: An Effective Tool for Enhancing the Solidarity

Article ID: 31706

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Introduction

Conflict is normal part of human existence and is a basic fact of life in a group and organizations. It is a fundamental, sensitive and often neglected social process. People with divergent personalities, perceptions, attitudes and values occupy different position in the organizations. These positions often have differing or contrasting job charts; different levels of status attached to them and also foster competition among the employees. People of different divisions in organizations have to compete for scarce resources in order to achieve their targets. As a result, in every human endeavour conflict exists.

Meaning of Conflict & Conflict Management

1. Conflict: According to Thompson (1960) conflict can be defined as the behaviour of organization members which is expended in opposite to other members. Rao (2004) explained the concept of conflict given by Nelson and Campbell, in which he mentioned that conflict means any situation where incompatible goals, attitudes, emotions, or behaviours lead to disagreement or opposition between two or more parties. In simple words we can say that conflict is a process that begins when one party perceives that another party has negatively affected or is about to negatively affect something that the first party cares about.

2. Conflict Management: Conflict management is the process of limiting the negative aspects of conflict and increase the positive aspects of conflict with the aim of enhance the learning and group outcomes, including effectiveness or performance in an organizational setting.

Process of Conflict

The conflict process can be thought of as progressing through four stages:

1. Potential opposition: It is the first step characterized by the presence of conditions that create opportunities for conflicts to arise. Here, antecedent conditions for conflict existence at the interpersonal level can be seen.

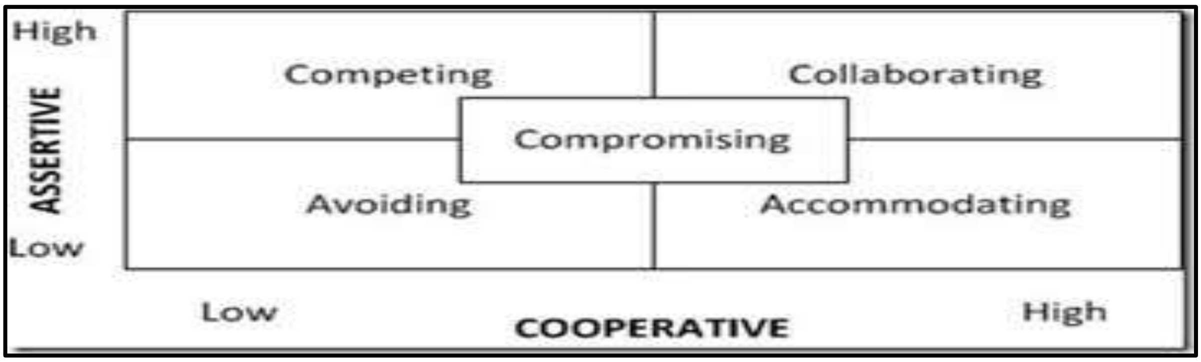
2. Cognition and Personalization: If the conditions cited in the stage-I negatively affect something that one-party cares about, and then the potential for opposition or incompatibility becomes actualized in the second stage. Realization makes him emotionally involve himself. Emotional involvement makes him feel frustrated, anxious and tense all of which are symptoms of conflict. Here, the thing that we should keep in our mind while understanding this stage is the antecedent conditions can lead to conflict only when one or more parties are affected by, and cognizant of the conflict

3. Behaviour: This is the stage where conflict becomes visible. The behaviour stage includes the statements, actions and reactions made by the conflicting parties. Overt conflict covers a full range of behaviours, from subtle, indirect and highly controlled forms of interference to direct, aggressive, violent and uncontrolled struggle. Once the conflict is overt, the conflicting parties will develop the methods to deal with the conflict.

4. Outcomes: It is the last stage of conflict process where result of conflict comes in form of functional or dysfunctional outcomes. If the conflict is handled well, the result will be functional otherwise dysfunctional.

Conflict Management Approaches

The conflict management approaches can be seen from the following figure.



1. Competition: When one person tries to satisfy his or her own interest, regardless of the impact on the other parties to the conflict, he or she is competing. If the situation of competition is avoided by individual, then there will be very less chance of conflict.

2. Collaboration: When each of the parties in conflict desires to satisfy fully the concern of the all parties, there will be cooperation and the search for a mutually beneficial outcome; this is collaboration. Here, the behaviour of the parties is aimed at solving the problem and at clarifying the differences rather than accommodating various points of view.

3. Avoidance: Here, in this approach a person may recognize that the conflict exists and wants to withdraw from it or suppress it. If one tries to just ignore a conflict and avoid others with whom he/she disagree, he/she can handle the conflict.

4. Accommodation: When one party seeks to appease an opponent, that party may be willing to place the opponent's interest above his or her own. In other words, for the relationship to be maintained, one party is willing to be self-sacrificing. This approach is referred to as accommodation of conflict management.

5. Compromise: When each party to the conflict seeks to give up something, sharing occurs which results in a compromised out-come. There is no clear winner or loser. Rather, there is a willingness to ration the object of conflict and accept a solution that provides incomplete satisfaction to all the conflicting parties.

Conclusion

On the basis of the above-mentioned information, one can get a clear-cut idea about the nature of the conflict as well as mitigating approaches for its management to strengthen the relationships in his/her personal as well as professional life. Above mentioned conflict management approaches will definitely work as an effective tool for enhancing the solidarity.

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Bajra Napier Hybrid: An Ideal Crop for Round the Year Green Fodder Production

Article ID: 31707

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Introduction

Livestock sector is one of the most promising sectors in agriculture and is providing livelihood to majority of households. Its importance is well acknowledged since, India has one of the largest livestock population in the world and despite of around 35% deficit in green fodder, leading in milk production globally. The livestock in India constitutes 16% cattle population, 20% goat, 5% sheep and 55% of world's buffalo population (IGFRI). It not only fulfils the milk and meat requirement but also provides manure, drought power, fuel and rural transport.

Due to urbanisation there is shrinkage of agricultural land while there is a need to increase the livestock population so as to fulfil the human requirement of milk and meat. Average milk and meat production of Indian animals is lower than global average which offers considerable scope of enhancement. The major cause of low productivity is scarcity of feed and fodder. Therefore, there is urgent need to increase feed and fodder potential to enhance milk production. Green fodder crops are the cheapest source of feed for livestock. A number of factors such as type of animals, climate of locality and cropping pattern of area and socio-economic status of farmers determines the fodder produced.

Commonly grown fodder crops such as sorghum, maize, pearl millet, berseem, oat etc. are seasonal in nature hence, could not provide green fodder for the round the year in sufficient manner. Therefore, it is required to cultivate such fodder crops which are perennial in nature and having high green biomass production potential. In this way, Bajra Napier Grass, which is the hybridization product between bajra *(Pennisetum glaucum)* and Napier grass *(Pennisetum purpurium)*, is having the characteristics of bajra that is good palatability and taste along with perennial nature and deep root characteristics of Napier.

Combined characters of high productivity and good palatability makes Bajra Napier hybrid an ideal fodder crop for round the year fodder production. It contains 7-10 % crude protein, 28-30 % crude fibre and 10-11.5 % ash on dry matter basis. Once planted, it can give 8-10 cuts in a year and if managed properly, it can provide fodder for 5-6 years. The farmers are also able to reap the benefits for a decade with proper agronomic management and maintenance of moisture level and nutrient management.

Due to these advantageous characteristics, it is becoming very popular among farmers. Its chief advantages are mentioned below:

1. Perennial nature.
2. Quick growth.
3. Very productive and convenient for hay and silage making.
4. Edible young leaves and shoot which can be cooked to make soups and stews.
5. Easily propagated.
6. More palatable leaves which are easily digestible.
7. Can be intercropped with various fodder legume.
8. Used as mulch to prevent soil erosion.
9. Suitable as trap crop to fight against stem borer.
10. Used as wind breaks and production of bio fuel.

11. Simple in cutting because of soft stem.
12. Soil restoring crop and improves fertility of the soil.
13. Resistant to drought due to deep root system.
14. Protects the other field crops from heat stress if planted in bund areas.

It has several drawbacks:
1. Not suited for direct grazing.
2. Less preferable older stems as it causes constipation in animals.
3. Act as weeds if the growth is uncontrolled.
4. Less production in winter months owing to dormancy.

Climate and Soil

It is versatile in nature and can be grown under a wide range of climatic conditions but it grows best under moist and warm environment with optimum temperature of 31^0C. It is susceptible to frost and becomes dormant below temperature 15^0C.

Hence it is not recommended for the hilly areas. However, Napier grass survives in moisture deficit conditions for short duration and with the commencement of rain it regenerate again. It can grow in all types of soil. However, deep fertile soil having good moisture holding capacity and adequate drainage is most favourable for its optimum growth and development while very acidic and saline soil should be avoided.

Improved Cultivars

1. Pusa Giant Napier: It is twice as productive as ordinary Napier and has better nutritional quality and palatability. It constitutes around 25% higher protein and about 12% more sugar content than usual Napier grass. Its stem contains fewer fibres and is juicier at all the growth stages.

2. PBN346: It is also a leafy hybrid and contains smooth leaves which are long and broad in nature. It flourishes primarily in the spring seasons and continues in vegetative growth till the inception of winter. It makes better quality silage and generates around 715q green fodder in an acre.

3. PBN 342: It is a leafy hybrid having smooth, non-hairy long leaves which are very broad. It generates around 877 quintal green fodder in an acre.

4. NB-21: It has high tillering capacity and has thin stem without hairs. It grows very fast and produce thin long leaves which are very smooth in nature. It yields its first cutting in 50 days after planting and can be cut consequently after 35-40 days and generates around 2000q green fodder in a hectare.

5. PBN 233: It is a leafy hybrid having long, smooth and broad leaves which are non-hairy. It thrives well in spring and continues its vegetable growth up to winters. It generates 1100q green fodder in an acre. Besides, the other promising varieties of Bajra Napier hybrid are Pusa Napier1, Pusa Napier2, IGFRI-3, IGFRI-6, IGFRI-7 and APBN-1, PBN83, CO- 1, 2, 3 and 6.

Sowing Time and Method of Sowing

The grass is propagated mainly by vegetative propagation as it does not produce viable seed. The land should be prepared with a soil invert plough followed by 2-3 harrow or cultivator and it must be free from weeds. The stem cutting having two to three nodes and buds is planted with spacing of 60*60 cm about 27, 800 root slips or stem cutting are needed for planting one hectares of land. In irrigated conditions, planting should be done in the month of February-May whereas in rainfed conditions, July-August is proper time of planting. Stem cuttings are placed into the soil at an angle of 45 degree, so that one node is pushed into the soil and one remains above the soil surface.

Nutrient Management

Incorporate 15- 20 tonnes of well rotten FYM and 60: 50: 40 kg N: P: K/ha at the time of planting and apply 30 kg nitrogen/ha after each cut.

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Weed Management

Regular hand weeding/hoeing makes crop field free from weeds. Additionally, it aerates the soil by surface pulverisation that makes the soil microclimate conducive for optimum plant growth.

Water Management

The crop should be planted in well moist soil condition. During monsoon season, the irrigation is rarely needed except in the event of long monsoon failure. The crop needs regular irrigation at an interval of 15-18 days in March- April and 10-12 days interval in summer months.

Harvesting Management and Production

First cutting should be done 50 days after planting and subsequent cuts with an interval of 30 days at about 1-meter height since, nutritional value of the crop diminishes if the crop grows beyond this. Crop should be cut 15 cm above the ground level. In this way, properly managed Bajra Napier hybrid crop could provide 150-200 tons of green fodder/year/ha.

Conclusion

To fulfil the nutritive fodder requirement of the livestock, Napier bajra hybrid is considered one of the best options as it is planted once and being harvested for over the years. It has high productivity than other fodder crops and is favourable for animal consumption due to its juicier stem and leaves. As the farmers are spending 70 percent of their dairy expenditure on feed and fodder of the animals, Napier bajra hybrid makes the most economical fodder.

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Rythu Barosa Kendras (RBK): A Great Start-up by Dr. YS Jagan Mohan Reddy (Andhra Pradesh Chief Minister)

Article ID: 31708

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Introduction

1. As chief minister of Andhra Pradesh YS Jagan Mohan Reddy completed one year in office, the YSR Congress Party government launched its ambitious 10,641 Rythu Bharosa Kendras (RBK) -- digital kiosks for farmers to know real-time market price and to place orders. RBKs will also be selling products tested, packed, and graded by the government.

2. CM Jagan Reddy launched Rythu Bharosa Kendras at an event held at the Tadepalli CM camp office.

3. Along with the RBKs, the Andhra Pradesh government also launched the Comprehensive Monitoring of Agricultural Prices and Procurement (CMAPP), a tool developed to monitor the agricultural activity at the farm level.

4. As the government of Andhra Pradesh is an agriculture state the primary focus is on the welfare of farmers in the allied sectors of agriculture. The availability of proper consultant with quality farm equipment is crucial in improving crop productivity and reducing the cost of cultivation .By providing appropriate integration between farmer, scientist, extension officers, service providers in the recent technological advancement and bringing up-to-date sustainable practices in allied sectors of agriculture will enable speed and delivery of quality of services.

5. A common platform is needed to integrate the various function related to accelerating government services in terms of quality and quantity and to provide financial discipline ,in this context the government of Andhra Pradesh has taken steps to mobilize knowledge and provide the most innovative effective and efficient platform, finance to provide quality equipment selected services to farmers.

6. The government proposes to set up all gram panchayat, where adequate agricultural activities are carried out in an effective and integrated platform for mobilization of knowledge to provide quality equipment and services to the farmers and also by bringing all the stock holders of agriculture and allied sectors as a single platform to the state agriculture sectors.

7. The government will look into the matter carefully and ensure that quality farm equipment's such as seeds, fertilizers and technology are available to the farmers.

Rythu Barosa Kendras (RBK)

The RBKs are acting as a one stop shop to supply government-certified agricultural and allied sectors inputs to farmers. These RBKs are also attached to provide scientific advice to farmers in the fields of agriculture and allied fields. There RBKs are also attached to some of the fields of agriculture and allied fields to provide scientific advice to the farmers.

1. Agriculture input shops:

a. The agriculture input shops will make sure that multi brand quality agriculture inputs, agricultural equipment's, fish feed, fodder, seeds, are available to the farmers at the village at the right price. This allows the tested and certified seeds to be sold only through the agri input shops by the markets. They do not allow the duplicate and fake products to be sold.

b. Agriculture inputs shops in RBK works on the hub and spoke model.

c. Digital kiosks are available in every RBK for farmers to place their orders .The order is mapped at the designated hub. The orders placed will be delivered within 48-72 hours (or)with in time given to them through the RBKs.

2. Rythu barosa kendras (farmer science centre):

a. It is a training centre. It provides advanced low-cost technology to the farmers, agricultural allied sector officials and scientists. Audio visual aids, mini soil testing labs, methods presentations and library are the part of farmer science centre.

b. The best practices to follow are to increase the efficiency of the farmers through the presentation of the classroom and field trainings on the new technology.

c. Connecting farmers with the scientists and extension staff from the department of agriculture and allied fields.

d. The latest technologies serve as a single contact centre for information about government schemes.

e. Maintaining farmer’s database in the village with details of land area crops and livestock etc.

f. Conducting field demonstration on organic farming methods.

g. Maintaining maximum level of farm input utilization through monthly test Base nutrient management.

h. Providing proper information to farmers to help in generating income through modern technologies.

3. Nodal agency:

a. AP state agro industries development co-operation limited acts as nodal agency to manage all the operations of RBK agri input shops including revenue management, supply chain management, economic management, and profit loss management.

b. AP agros complies list of companies and enters into MOU with them to enable farmers to select available products.

c. It also handles all operations at hubs. RBK is managed by the department of agriculture.

d. AP agros supplies products to the RBK for the exhibition show.

e. AP agros has setup a designated project monitoring unit to enable the product-based range demand forecasting, range estimation, pricing, Inventory management, and liquidation.

4. Agricultural input quality assurance:

a. The government has decided to allow the sale of only pre tested certified inputs through the RBKs with a view to provide quality agricultural produce to farmers.

b. Pre tested quality certified agricultural and allied sectors inputs should be displayed at the digital kiosks of RBK only after the verification done by the Dr ysr agri labs. The department of agriculture should take quality control seeds, fertilizers and pesticides in the hub using the unified digital system.

c. Technical supports unit -establishment of state technical supports unit with universities of agriculture and allied departments in the office of the commission of agriculture under the chairmanship of the special commissioner, department of agriculture, Andhra Pradesh.

d. The state technical support unit will guide the expansion activities in the state. It also provides solution to farmers from time to time. It performs activities throughout the year.

e. In addition quality farm input sales, they also provide farmers with the latest low-cost technologies needed.

5. Warehouse management:

a. The carrier forwarding agency is responsible for managing operations in the hub.

b. It maintain in-ward inventors and stock bills for orders received and direct delivery of the specified goods to the shipping company for delivery.

6. Logistic partner:

a. The logistic partner will be appointed for the chain supply. The selection of the logistic partner will be undertaken through the transparent mechanism. The software agency must provide software for the full management of KIOSKS to mobilize orders and to display products.

b. The app is integrated into hubs to indicate the real time visibility of the products. the logistic partner should supply the stocks to the farmers in the gram secretariats within 24-48 hours are in the given time by them.

c. Putting the software in the integrated app to be optimized for demand advance list, management billing system, supply range management, farmer confirmation management and so on.

7. Integrated call centre:

a. The commission rate of agriculture will set up a one- stop call centre to show solutions to the problems of the farmers in the agricultural allied sectors.

b. The call centres should be operated by two systems. Cal centres should include a mini digital studio to provide technology through smart TVs at RBKs.

8. RBK management:

a. RBK will be managed by village assistant, horticultural assistant, and silk industry assistant.

b. Fisheries assistant, veterinary assistant should perform their duties from RBK.

9. RBK partners: Agriculture, horticulture, silk industries, fisheries, agricultural marketing, livestock, agricultural assistance, electricity, distance management, civil supplies, panchayat raj, revenue department. AP state seed development corporation, AP state agro industries development management corporation, AP dairy development co-operative federation limited, Acharya NG Ranga University, Dr. YSR horticulture University, Sri venkateswara veterinary University, are all being partners with banks.

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Role of Organic Matter in Crop Production

Article ID: 31709

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Introduction

What is organic matter? Organic matter contains a large amount of carbon–based compounds. Soil organic matter is the organic matter component of soil consisting of plant and animal residues at various stages of composition, cells and tissues of soil organisms and substances synthesis of soil organisms.

Role of Organic Matter

Organic matter is the store house of food for the plant. Mainly nutrients viz., nitrogen, phosphorus and potassium remain in organic matter and released nutrient throughout year which becomes available to the plants. It helps to improve soil structure by enhancing the granulation of soil particles, conserve fertility of soil, and increase water holding capacity of the soil. It imparts a dark colour of the soil and thereby helps to maintain soil temperature. On the other hand, water holding capacity of sandy soil increases though organic matter. Organic matter also increases Cation Exchange Capacity (CEC) of soil. Thus, it prevents losses of nutrient by leaching and retains them in available form. It increases the availability of phosphorus by locking up the calcium, iron and aluminum which is responsible for phosphate fixation and increases the buffering capacity of soil. It also helps for rapid chemical changes in soil pH and reaction. Organic matter reduces the losses of soil by wind erosion and reduces the surface run-off and makes soil water more available to plants. It may be said that 'A field without organic matter is as useless as a cow without a calf'.

Positive Impacts of Soil Organic Matter

Soil organic matter effect on soil functioning includes improvements related to soil structure, aggregation, water retention, soil biodiversity, absorption and retention of pollutants, buffering capacity, and the cycling and storage of plant nutrients. It increases soil fertility by providing cation exchanges sites and acting as reserve of essential nutrients, especially nitrogen, phosphorus, and sulphur along with micronutrients, which are also slowly released upon soil organic matter mineralization.

Source of Organic Matter

Several sources of soil organic matter as per following heads:

1. Plants: The portion of the crop (i.e. top, stubbles, roots etc.) left in soil after harvesting of the crop also serves as a source of organic matter. Thus, the plant tissue is the primary sources of organic matter.

2. Animals: Animals are usually considered secondary sources of organic matter. Soil organisms like insects, millipedes, nematodes etc. also contribute some organic matter to the soil. Soil microorganism makes a considerable contribution of soil organic matter after their death.

3. Manures: Vermicompost, FYM, compost, castor cake, sewage and sluge, nigh soil, poultry manure, cotton cake and green manure crops.

Maintenance Organic Matter

1. Application of manures: Manures (compost, farm yard manure, oil cakes etc.) are the good source of organic matter of the soil and their addition increase the organic matter of the soil.

2. Crop rotation: Adaption of proper crop rotation and inclusion of leguminous crop (Sunhemp, Dhaincha, Cowpea etc.) will help to maintain the organic matter level of the soil.

3. Good aeration: Good aeration is necessary for proper decomposition of organic compounds added to the soil. Tillage will help in proper aeration of the soil as this process makes the soil loose and friable.

4. Application of fertilizers: Fertilizers encourage the growth of crop plants and addition of leaves, stubbles etc. in the soil increases which in turn converted to organic matter by microbiological decomposition.

5. Application of lime in the soil: The growth of the plant and activity of soil organism are affected in acid soil. It helps to improve the physical condition of the soil and the plant grows well in that soil.

The roots, stubbles, leaves etc. are added to the soil and they in turn, converted to organic matter by microbial decomposition and the organic matter content of the soil increases.

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Organic Farming through Weed Management in Vegetable Crops

Article ID: 31710

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Farmers have struggled with the presence of weeds in their fields since the beginning of agriculture. Weeds can be considered a significant problem because they tend to decrease crop yields by increasing competition for water, sunlight and nutrients while serving as host plants for pests and diseases. Since the invention of herbicides, farmers have used these chemicals to eradicate weed from their fields.

Critical Period of Weed Control

This period has been defined as an interval in the life cycle of the crop when a must be kept weed-free to prevent yield loss. If weeds have been controlled throughout the critical period, the weeds that emerge later will not affect yield and can be controlled prior to harvest with a harvest and to burn down the weeds and desiccate the crop.

Crop	Critical weed- free period
Apples, new plantings	During May and June
Apples, bearing	Bud break until 30 days after bloom
Beets	2-4 weeks after emergence
Cabbage, early	3 weeks after planting
Carrots	3-6 weeks after emergence
Cucumbers, pickling	4 weeks after seeding
Lettuce	3 weeks after planting
Onions	The whole season
Potatoes	4 weeks after planting
Squash	Early plantings compete better
Strawberries, new	During May and June
Tomatoes, fresh	36 days after transplanting
Tomatoes, seeded	9 weeks after seeding

Cultural Method

1. Crop rotation: Crop rotation involves alternating different crops in a systematic sequence on the same land. It is an important strategy for developing a sound long term weed control program. Weeds tend to thrive with crops of similar growth requirements as their own and cultural practices designed to contribute to the crop may also benefit the growth and development of weeds. Monoculture, that is growing the same crop in the same field year, results in a build-up of weed species that are adapted to the growing conditions of the crop.

2. Cover crops: Rapid development and dense ground covering by the crop will suppress weeds. The inclusion of cover crops such as rye, red, clover, buckwheat and oilseed radish or over wintering crops like winter wheat or forages in the cropping system can suppress weed growth. Highly competitive crops may be grown as short duration ‘smother’ crops within the rotation.

3. Intercropping : Intercropping involves growing a smother crop between rows of the main crop. Intercrops are able to suppress weeds. However, the use of intercropping as a strategy for seed control should be approached carefully.

4. Field scouting: It involves the systematic collection of weed and crop data from the field (weed distribution, growth stage, population, crop stage etc.). The information is used, in the short term, to make immediate weed management decisions to reduce or avoid economic crop loss.

5. Mulching: Mulching or covering the soil surface can prevent weed seed germination by blocking light transmission preventing seed germination. Allelopathic chemicals in the mulch also can physically suppress seedling emergence. There are many forms of mulches available.

6. Living mulch: living mulch is usually a plant species that grows densely and low to the ground such as clover. Living mulches can be planted before or after a crop is established. It is important to kill ad till in, or manage living mulch so that it does not compete with the actual crop. A living mulch of *portulaca oleracea* from broadcast before transplanting broccoli suppressed weeds without affecting crop yield.

7. Organic mulches: Such materials as straw, bark, and composted material can provide effective weed control. Producing the material on the farm is recommended since the cost of purchased mulches can be prohibitive, depending on the amount needed to suppress weed emergence. An effective but labor-intensive system uses newspaper and straw.

8. Planting patterns: Crop population, spatial arrangement, and the choice of cultivar (variety) can affected weed growth. Fr example, studies have shown that narrow row widths and a higher seeding density will reduce the biomass of later-emerging weeds by reducing the amount of light available for weeds located below the crop canopy.

9. Variety selection: Careful selection of crop varieties is essential to limit weeds and pathogen problems and to satisfy market needs. Any crop variety that is able to quickly shade the soil between the rows and is able to grow more rapidly that the weeds will have an advantage.

10. Tillage system: Tillage systems alter the soil seed bank dynamics and depth of burial of weed seeds. Studies have found that almost 75% of the seed bank was concentrated in the upper 5 cm of soil in no-till fields. In the mouldboard plough system however, the seed bank is more uniformly distributed over depth.

11. Sanitation: It is possible to prevent many new weeds from being introduced onto the farm and to prevent existing weeds from producing large quantities of seed. The use of clean seed, mowing weeds around the edges of fields or after harvest to prevent weeds from going to seed, and thoroughly composting manure before application can greatly reduce the introduction of weed seeds and difficult weed species.

12. Nitrogen fertility: Nitrogen fertilizer can affect the competition between crops and weeds and in the subsequent crops. For example, nitrate is known to promote seed germination and seed production in some weed species. Nitrogen fertilization may result in increased weed growth instead of increased crop yield. Selective placement of nitrogen in a band can favour the crop over the weed. Use of legume residues are opposed to chemical nitrogen fertilizer to supplement nitrogen needs of the crop can enhance weed suppression.

13. Pre-germination of weeds.: In pre-germination irrigation or rainfall germinates weed seeds just before the cash crop is planted. The newly germinated weeds can be killed by light cultivation or flaming. Pre-germination should occur as close as possible to the date of planting to ensure that changes in weather conditions do not have an opportunity to change the spectrum of weeds (cool vs. Warm season) in the fields.

14. Buried drip irrigation: Drip tape buried below the surface of the planting bed can provide moisture to the crop and minimize the amount of moisture that is available to weed closer to the surface. If properly managed, this technique can provide significant weed control during dry period (http://agritech.tnau.ac.in/org_farm/orgfarm_weed mgt.html).

15. Mechanical weed control: Mechanical weeders include cultivating tools such as hoes, harrows, tines and brush weeders, cutting tools like mower and stimmers, and dual-purpose implement and the timing and frequency of its use depends on the morphology of the crop and the weeds.

16. Hand hoes, push hoes and hand-weeding are still used when rouging of an individual plant or patch of weed is the most effective way of preventing the weed from spreading. Hand-weeding may also be used after mechanical inter-row weeding to deal with weeds left in the crop row.

17. The hoe-ridger is specially designed to achieve intra-row control is sugar beet, Thistle-bars are simple blades used to undercut perennial weeds with minimal soil disturbance. The brush weeder, or brush hoe, is used primarily for inter-row weeding of vegetable crop.

Thermal Weed Control

1. Flamer: Flamers are useful for weed control. Thermal weed control involves the use of flaming equipment to crate direct contact between the flame and the plant. This technique works by rupturing plant cells when the sap rapidly expands in the cells. Sometimes thermal control involves the outright burning down of the weeds.

2. Soil solarization : during summer and fall, organic farmers sterilize their soil through solarization. In this process, a clear plastic film is placed over an area after it has been tilled and tightly sealed at the edges. Solarization works when the heat crated under the plastic film becomes intense enough to kill weeds.

3. Infrared weeders: Infrared weeders are a further development of flame weeding in which the burners heat ceramic or metal surface to generate the infrared radiation directed the target weeds. Some weeders use a combination of infrared and direct flaming to kill the weeds.

4. Freezing: Freezing would be advantageous only where there is an obvious fire risk from flaming. Liquid nitrogen and solid carbon dioxide (dry ice) can be used for freezing weeds. Various test system using electrocution, microwaves and irrigation have also been evaluated for weed control purpose, but high energy inputs, slow work rates and the safety implications for operators have hampered developments.

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Success Story: Increase Potato Yield through Fertigation Scheduling

Article ID: 31711

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Introduction

Cultivation of non-traditional vegetable like potato is more profitable than traditional methods. Patel Pravinbhai Faljibhai is a progressive farmer and growing potato crop through drip irrigation system in our field and obtained maximum quality production of potato. He is selling potato for contract farming and rates are already fixed before sowing of the potato. Mainly it is used for Chips, Tikdi, Wafers and others products. Among all agronomic practices, water and nutrient are the major factors affecting the production in irrigated system and key inputs in contributing for higher productivity. Fertigation is important parameters for saving the amount of fertilizer, use of water efficiency and reduction of leaching for obtained better yield and quality of the production. Pravinbhai share knowledge to other farmers and motivate to use of fertilizer and water through fertigation methods.

Personal Information

Name of the Farmer: Patel Pravinbhai Faljibhai.
AT & Po. Goral; Taluka: Ider.
District: Sabarkantha (Gujarat).

Fertigation Schedule is Given Below

Basal dose of fertilizer/acre: DAP-175kg, MOP-180kg, SSP-50 kg and FYM-10 t/acre

Days After Sowing (DAS)	Mgso4 (kg)	Phosphoric acid (kg)	Urea (kg)	Ammonium Sulphate (kg)	Water Soluble fertilizer (13-0-45)	CaNo3 (kg)	Other (Micro-nutrients)
21				20			
23		3		20			
25							
27		2		20		8	
29				20			1 kg Chelated form of micro nutrient mix with foliar spray
33	10		20				
35	10					8	
39			20				1 kg Chelated form of micro nutrient mix with foliar spray
43	10						
47			15				
51						9	
55			15				
57			10		8		

59			10		6		
61			10		8		
63					5		
Total	**30**	**5**	**100**	**80**	**27**	**25**	

Economics Details (Last Three Years)

Area in Acre	Year (s)	Production (tonnes)	Rate (tonnes)	Total (Rs)	Total Expensive (Rs)	Net Profit (Rs)
6	2017	104	9250	962000	150000	812000
8	2018	128	9250	1184000	224000	960000
8	2019	131	9250	1211750	228000	983750

Details of Innovation

Shri Patel Pravinbhai Faljibhai used the fertigation scheduling technology suggested and supported by Dr. Himmat Patel, Assistant Professor (Agronomy) and his team to make increase the productivity of potato, which includes all schedules from days of sowing (DAS) to harvesting of the crop.

Conclusions

The technology has improved the multidimensional profitability of the potato growers and is being expanded from one corner of district to others.

Visit at farmer field AT & Po. Goral; Taluka: Ider, District: Sabarkantha (Gujarat)

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Fruit and Shoot Borer of Brinjal and their Management

Article ID: 31712

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Uttar Pradesh, India.

Introduction

Brinjal (*Solanum melongena* L.) is a purple, green, white and spongy berry type edible fruit. It is commonly known as Eggplant and is grown mostly in tropical and temperate areas of the world. It was originated from India and grown more than 2 million ha with production of 33 million t (Hanson *et al*., 2006). It contains low amount of essential nutrients and 0.98g Proteins, 3g Dietary fibers, 0.18 g Fat and 5.88g Carbohydrates providing about 104 KJ of energy. It is a perennial crop and is available in all the season and thus is affected by a lots of insect pests like Fruit and Shoot borers (*Leucinodes orbonalis*), Hadda Beetles (*Epilachna vigintioctopunctata*), Brown leafhopper (*Cestius phycitis*) etc., among these pests *Leucinodes orbonalis*is most common and destructive in all brinjal growing area of the world (Butani and Jotwani, 1984 and Chattopadhyay, 1987), which can cause a huge loss in the yield about 30 -50% of fruits or more Raju *et al.,* 2007). The pest is spreader to wide areas of eggplant cultivation with India, Bangladesh, China, Burma, Sri Lanka, Philippines, Malaysia, Thailand, etc. It is a major and regular pest of brinjal causing damage up to 80% of fruits (Raju *et al*., 2007). The Larva of *Leucinodes orbonalis* is the only damaging stage of this pest which feeds inside the fruit and form large exit holes that's why market value of the fruits drastically reduced (Alam *et al.,* 2003).

Causal Agent: *Leucinodes orbonalis.*

Life Cycle of Insect

The adult female laid eggs about 250 or more within two to five days. The eggs are laid singly on the leaves surface and appear in white and flat. Larvae hatch out within 3 to 5 days from the eggs. Immediately after hatching larva enters into the plant tissues and after five moulting it becomes fully matured. The matured larva comes out from the host tissues and forms pupa on the surface of stems, fallen leaves and fruits of the host plant. After 6 to 8 days pupal stage lasts and adult moth appears and it lives for 2 to 5 days. The life cycle of *Leucinodes orbonalis* completed within 21 to 23 days.

Symptoms

1. The initial symptoms are appeared as the presence of an insect is showin wilting on apical shoots,
2. Terminal shoots and flowers are dropped.
3. Leaves may dry and fall off.
4. Dead heart symptoms can be seen.
5. Holes pierced by pests are present on shoots and fruits having their excreta extruding out of it.
6. Larva bores and enters into tender shoots and causes withering of terminal shoots and also bores petioles of leaves. Attacked fruits are with boreholes plugged with excreta. The shape of fruits may change also.

Management

1. Deep ploughing in summer seasons.
2. Should uproot and destroy old plants before planting new plants since they harbour pest and carry over infestation.
3. Avoid continuous cropping and rationing of brinjal in same field.
4. Should grow some resistance varieties like Pusa purple round, Annamalai, Arka Kusumakar, Chaklasi, Pusa Purple Round etc.
5. Affected fruits and shoots having boreholes should be removed. & destroyed.
6. Apply light traps @ 1/ha to attract and kill the insect.
7. Disperse egg parasitoids i.e. Trichogrammachilonis about 1.0 lakh/ha.
8. 5% Solution of Neem Seed Kernel extracts can be sprayed.
9. Azadirechtin 1.0% EC @3.0 ml/lit., or Chloropyriphos 20% EC @ 1.0ml/lit., or Dimethoate 30% EC 7.0 ml/10 lit., can be sprayed at 12-15 days interval starting from one month of the planting.

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Entrepreneurial Attributes of Nursery Growers

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Abstract

As a result of urbanization, the demand for high quality planting material is steadily increasing in cities. Nursery raising is one of the commercial and economical enterprise in horticulture sector. There is a need of setting up ornamental plant nurseries by small and marginal farmers, agriculture graduates which will augment their income. As Akola city is the service sector, with urbanization, industrial development, social transformations occur very fast in and around the city. Hence demand of ornamentals and floriculture plants, landscape gardening is increased which leads for development of nursery raising business around the city. There is wide scope for small and marginal farmers to become successful entrepreneurs in nursery business. With this background, present study was conducted to know the profile of nursery raisers, study entrepreneurial attributes, their relationship and constraints faced by them. Based on maximum number of nurseries, selected area of Akola district was considered, total 50 respondents were selected purposively for the study. Data were collected with well-structured interview schedule and analysed by using statistical tools. As concerned to entrepreneurial attributes, study revealed that majority of them (66.00 per cent) possessed medium level of overall entrepreneurial attributes. Among which leadership ability(76.00 per cent), economic motivation(62.00 per cent), and management orientation (76.00 per cent) were possessed by most of the respondents and more scope to develop innovativeness, risk taking, decision making abilities etc.

Keywords: entrepreneurial attributes, nursery growers.

Introduction

As a result of urbanization, the demand for high quality planting material is steadily increasing in cities. Nursery raising is one of the commercial and economical enterprise in horticulture sector. There is a need of setting up ornamental plant nurseries by small and marginal farmers, agriculture graduates which will augment their income. A nursery is a starting point for successful production. Nursery has emerged in this country as an important sector for diversification of agriculture with view to improve economic condition of farming community. Economic growth and development of advanced countries is largely due to entrepreneurship among their community rather than capital. A major ornamental and floriculture nursery growing area as the demand of ornamentals and floriculture plants is increasing in the city. Also there is ample scope for agriculture graduates, small and marginal farmers to become a successful entrepreneurs in nursery business by setting up small nurseries.

Methodology

As a greater number of nurseries are located around the Akola city, so this formed the research area for present study. As selected area fall under the Akola district. From the selected area 20, 20 and 10 private nursery growers engaged in ornamental and floriculture nurseries from Akola district respectively were selected by using purposive sampling method. Data were collected with the help of well-structured and pretested interview schedule. For obtaining results, frequency, percentage and correlation coefficient was worked out .Data were categorized by calculating mean and standard deviation.

Results

After analysing the data related to Entrepreneurial attributes of the nursery growers, the following results were obtained. It is revealed that majority (78.00 and 66.00 per cent) and of the respondents had medium innovativeness and achievement motivation respectively, due to their awareness and small land holding in near about city area insisted them to go always for new things. The findings of the present study are in line with the findings of Bhagyalaxmi et al. (2003) and Gamit et al. (2015). It is revealed that (62.00 per cent) of the respondents had medium level of economic motivation. Two third (74.0per cent) of the respondents had risk preference. 76.00 per cent of the respondents had medium decision-making ability. This might be due to that uncertainty in nursery business, fluctuation in demand for nursery plants. The result of present study is in accordance with Bhagyalaxmi et al. (2003) and Suresh (2004). It observed that, Majority (76.00 and 66.00 per cent) of the respondents belonged to medium management orientation and Decision-making ability, as respondents had medium experience of nursery business and in medium age group. The results of present study are in line with findings of Suresh (2004), (66.00 per cent) of the respondents had medium over all Entrepreneurial attributes.

Conclusion

Study further may be concluded that there is a need to make coordinated efforts by public and private nursery growers to address their problems, agriculture graduates should come forward, organize and tap this opportunity. Moreover, well trained and skill manpower should be developed for boosting the nursery enterprise.

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Storage Structures of Food Grain in Agriculture

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Introduction

To cope with the current and future demand of the increasing population for the food grains, it is emphasized to reduce the loss of seeds during and after harvest. Seeds are stored for varying periods to ensure proper and balanced public distribution throughout the year. Post-harvest losses in India are estimated to be around 10 per cent, of which the losses during storage alone are estimated to be 6.58 per cent. But, with the advent of improved agricultural technology, the producer can afford to store the seeds for longer period with minimum loss.

For Best Storage Performance

The produce must be thoroughly cleaned and graded. Dried to the safe storage moisture level of 10-12 % for cereals and 7-9% for oil seeds (on wet basis) for a safe storage period of 6-12 months. Storage structures should to be properly repaired, cleaned and disinfected. Structures should bear the load of seeds stored and do not permit contact/exchange with outside humid air. Structures should be constructed in the coolest part of the house/ farm.

An Ideal Storage Facility Should Satisfy the Following Requirements

It should provide maximum possible protection from ground moisture, rain, insect pests, moulds, rodents, birds etc. It should provide the necessary facility for inspection, disinfection, loading, unloading, cleaning and reconditioning. It should protect grain from excessive moisture and temperature favourable to both insect and mould development. It should be economical and suitable for a particular situation.

Seeds can be Stored in Bulk or in Bags

1. Bulk (open) storage: It is preferred over bag storage for the following reasons:

a. Large quantities of grain can be stored.
b. No difficulty in loading and unloading of grain.
c. No need to purchase storage containers like gunnies.
d. Insect incidence is less than bag storage; even this can be eliminated by fumigation in situ.
e. Avoids waste from leaking bags.
f. Easy inspections - save labour and time.

2. Bag storage: Commodities are mostly stored in gunnies. Storage in bags requires considerable labour, but the minimum investment is enough on permanent structures and equipment. The storage in bags has the advantage of being short-term storage.

Bag storage can be done under a roof galvanized iron sheets, a plastic covering where grain is intended for very early onward movement. Bags can be easily handled for marketing purpose. There is no sweating of bags as they are arranged in racks with proper inter-bag space, but, initial cost is high and they can easily pickup infestation and retain even after treatment.

Mud bins having 100 -1000 kg capacity

Baked earthen containers of 5 – 100 Kg Capacity.

In heaps on flat floor in the corner of houses (100-1500q).

Bamboo Structures

Pusa Bin

1. It is a modification of the ordinary mud storage structure commonly used in villages.
2. To provide moisture proof and airtight conditions, polyethylene film of 700-gauge thickness has been embedded at the top, bottom and on all the sides of the mud bin.
3. The embedding process provides mechanical support and safety to polyethylene film.
4. The construction of outer walls with burnt bricks up to 45 cm height makes the structure rat proof.
5. The bin is constructed with unburnt bricks on burnt bricks or concrete floor to avoid rat burrowing.
6. The grain and seed both remain safe in the bin for more than one year with proper precautions.

Pusa Cubicle

1. This is a room like structure (3.95 x 3.15 x 2.60 m), a modification of Pusa bin to provide large storage capacity of 24 tonnes on a platform of 3.73 m x 2.93 m x 0.07 m is made with unburnt bricks on a concrete floor (except 22 cm of outer sides with burnt bricks).
2. A polyethylene sheet is placed on this platform and another platform of similar dimension is made with unburnt bricks.
3. The 22 cm thick inner walls are constructed upto 2.6 m height.
4. A wooden frame of 1.89m x 1.06 m for door is fixed in the front side of 3.95 m wall.
5. The roof can be made by wooden beam placed at 15 cm distance and covered with unburnt bricks.

Conventional Storage Structures

Structures	Make	Stored items	Capacity	Remarks
1. Bamboo structures	Split bamboo woven in the form of a cylinder	Paddy, wheat and sorghum	500 kg	Life 4-5 years. Weight loss due to insect attack is 5 % in paddy and 15 % in sorghum.
2. Mud and earthen structures	Clay, straw and cow dung- 3:3:1. Earthen structures are made, sun dried and then burnt in fire	Paddy, wheat, sorghum,oil seeds and pulses	5 to 10 q	Life 8- 10 years. During rainy season develop cracks and moisture absorption followed by insect and mould infestation.

Metal Bins

1. Bins made of steel, Aluminium, R.C.C are used for storage of grains outside the house.
2. These bins are fire and moisture proof.
3. The bins have long durability and produced on commercial scale.
4. The capacity ranges from 1 to 10 tonnes.
5. Silos are huge bins made with steel/ aluminium or concrete.
6. Usually steel and aluminium bins are circular in shape.
7. A silo has facilities for loading and unloading grains.

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Steps Necessary for Good Storage Practice in Respect of All Food Grains

1. Stored product pests can be managed either behaviourally (traps viz., probe traps, light traps, pitfall traps etc.,) or with several preventive and curative measures (both chemical and non-chemical methods).
2. Once a facility is obtained, a number of steps are to be taken to ensure safe storage of grains.
3. These steps comprise:
    a. Before Storage.
    b. After receipt of seed.
    c. During storage.

Before Storage

1. Checking for leakage of rain water and sufficiency of drainage facilities.
2. Cleanliness of the facility and environment.
3. Assessment of capacity of the facility.
4. Pesticides treatment.
5. Security and firefighting arrangements and
6. Repairs to available equipment.

After Receipt of Seed

1. Inspection for variety and soundness of quality.
2. Inspection carefully for infestation, it any, and when present, for type and extent of infestation.
3. Inspection whether grain has excess moisture, whether it had been heated up in earlier storage and has any musty or rancid odour.
4. Any grain rendered wet or damaged to be segregated with facilities available and check the weight received.

During Storage

1. Maintenance of cleanliness.
2. Ensuring aeration where necessary.
3. Checking for leakage after rains.
4. Inspection for insects, rats and mites at fortnightly intervals.
5. Watch for advancement in deterioration, if any.
6. Pesticidal treatments necessarily based on observations.
7. Arrangement for segregation, processing, wherever, damage owing
8. To leakage of water and other causes might have taken place.

Seed Protectants

1. Chemicals that can be directly applied to grains are formulations of chemicals having residual toxic or repellent action or both.
2. Those are applied directly to the grain to prevent damage by stored product pests. Eg., clay minerals (red earth, Kaolin) before 1950.
3. Now their use is restricted only to seeds and grains meant for animal feed.
4. These grain protectants can be applied in the form of spray/ dust on the uninfected grain.

Advantages Over Fumigants

1. Used as a prophylactic treatment.
2. Can be effective when the grains are stored in loose containers where fumigation is not possible.
3. Less dangerous than fumigants.
4. Don’t affect germination adversely.
5. One application at harvest time is sufficient for one year.

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Repercussion of Brassinosteroids on Multidimensional Aspects of Seed Quality

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Introduction

Brassinosteroids or Brassins are a recently discovered group of steroids in plants. That has distinct growth promoting activity in some plants especially in stems. These compounds were first isolated in 1979 from bee collected pollen grains of *Brassica napus* (Grove *et. al.,* 1979) (hence the name brassins). Brassinosteroids are now known to be widely distributed throughout the plant kingdom. More than 60 brassinosteroids have so far been identified from different parts of plants such as pollens, seeds, leaves, stems, roots and flowers.

Endogenous BRs have been identified in the seeds of several species, including pea (Yokota *et. al.,* 1996), *Arabidopsis thaliana* (Schmidt *et. al.,* 1997) and *Lychnis viscaria* (Friebe *et. al.,* 1999). They cause marked biological effects on plant growth and development at very low concentrations. It regulates multiple physiological functions including seed germination, cell elongation, cell division, senescence, vascular-differentiation, reproduction, root development, photo-morphogenesis and also respond to various biotic and abiotic stresses (Li and Chory, 1999).

Owing to their diverse functions, extensive research has been conducted to promote BR as essential plant growth regulators for modern agriculture. This paper summarizes recent progress of BRs on multidimensional aspects of seed quality and future prospects of BRs on seed quality enhancement.

Role of BRs on Seed Development and Seed Yield

BRs are important for plant growth and development. It influences the seed development and seed yield**.** Numerous developmental processes are affected when BR signaling is perturbed, such as seed development (Jiang *et. al.,* 2013), flowering time (Domagalska *et. al.,* 2010) and pollen development (Ye *et. al.,* 2010). The functions of BR in seed development have been demonstrated by studies of BR deficient and insensitive mutants of *Arabidopsis*, *Oryza sativa*, *Pisum sativum* and *Vicia faba*.

In *Arabidopsis* BR deficient mutant's *dwf5* and *shk1-D* produces small seeds (Choe *et. al.,* 2000; Takahashi *et. al.,* 2005). Rice BR deficient mutant's *brd2* and *dwf11*exhibits shortened and smaller seeds (Hong *et. al.,* 2005; Tanabe *et. al.,* 2005). Contrarily, overexpression of BR-biosynthetic gene increases rice seed filling and yield (Wu *et. al.,* 2008). These facts indicate that BR is required for normal seed development and seed size/mass determination.

Ectopic overexpression of a BR-biosynthetic gene *DWF4* in *Arabidopsis* transgenic plants results in increased seed yield due to a greater total seed number (Choe *et. al.,* 2001). Enhancement of BR biosynthesis in transgenic rice enhances the seed yield due to more tillers and seeds, and higher seed weight (Wu *et. al.,* 2008). These studies suggest that BR causes an increase of branches and seed number that leads to increased seed yield.

Role of BRs on Seed Dormancy and Germination

Abscisic acid (ABA) is a positive regulator of dormancy induction and most likely also seed viability maintenance, while it is a negative regulator of germination. Brassinosteroids (BRs) antagonize the germination-inhibiting actions of ABA (Bishop and Koncz, 2002). Recent publication demonstrates that BR releases the light and ABA induced seed dormancy and promotes the seed germination in tobacco (Leubner-Metzger, 2001). In *Nicotiana sp*. seed germination occurs in two-steps: testa rupture followed by endosperm rupture. ABA inhibits endosperm rupture but not testa rupture. GA, ethylene and BRs promote endosperm rupture and counteract the inhibitory effects of ABA and promote the seed germination (Finch-Savage and Leubner-Metzger, 2006). ABA represses *Arabidopsis thaliana* seed germination and post-germinative growth, while BRs antagonize ABA-mediated inhibition and promote these processes (Hu and Yu, 2014). It insists that BRs involved in release of ABA induced seed dormancy.

Role of BRs on Seed Physiological Parameters

BR application has been reported to enhance germination of certain parasitic angiosperms (Takeuchi *et. al.,* 1995), cereals (Yamaguchi *et. al.,* 1987), Arabidopsis (Steber and McCourt, 2001) and tobacco (Leubner-Metzger, 2001). Pretreatment with brassinolide stimulates the germination and seedling emergence of aged rice seeds (Yamaguchi *et. al.,* 1987) and seed treatment of barley accelerated subsequent seedling growth (Gregory, 1981).

BR regulates elongation growth of shoots and photo-morphogenesis of seedlings (Bishop and Koncz, 2002). BR seed treatment has enhanced the germination, seedling length, seedling fresh and dry weight in radish (Raghu *et. al.,* 2014). *Brassica juncea* seeds pre-soaking with 24-epibrassinolide has increased the germination, shoot length, root length and fresh weight of the seedlings when compared with the control (Sharma and Bhardwaj, 2007). Seed treatment with BR has improved the seed germination in several tree species such as red pine (*Pinus tabuliformis*) and black locust (*Robinia pseudoacacia*) (Li *et. al.,* 2002); sycamore (*Acer pseudoplatanus* L.) and ash (*Fraxinus excelsior* L.) (Prochazka *et. al.,* 2015).

Role of BRs on Seed Biochemical Parameters

Seed treatment with brassinosteroid has decreased the malondialdehyde content and increased the soluble proteins, free proline, catalase, superoxide dismutase, peroxidase activity compared to control in radish (Raghu et. al., 2014). Foliar application of BR increased the tocopherol content and ascorbic acid content in pea and lupine seeds (Biesaga-Koscielniak et. al., 2014). It indicates that application of BRs enhances the antioxidant enzyme activity. So, it may involve in strong enzymatic defense system in seeds under adverse condition. Wheat seeds supplemented with brassinolide increased the carbohydrates and total soluble protein, and it also increased the hydrolytic enzymes activity such as α- amylase and protease (El-Feky and Abo-Hamad, 2014). Seed priming with BR increased the protein, lipid, sugar, vitamin E, C and provitamin A content in pea and lupine seeds (Janeczko et. al., 2015). It indicates that BRs stimulates the seedlings metabolic activity; and enhances the seed vitamin contents and nutritional value; it may help in vigorous seed production.

Role of BRs on Seed Storage

Aging is known to reduce seed viability in many crop species. The phenomenon is due in part to the aging-induced lipid peroxidation, which has the potential to damage membranes of the seed tissues and ultimately reduces the seed viability. Well known fact that malondialdehyde (MDA) levels are quantitative indices of lipid peroxidation and the consequential membrane damage and electrolyte leakage. The application of brassinosteroid reduced the MDA content in radish when compared to control (Raghu et. al., 2014). It indicates that BRs lowered the lipid peroxidation in seeds. Brassinosteroid seed treatment may help in prolonged seed storage.

Conclusion and Future Perspective

The economic potentiality of BRs in agricultural production was recognized as early as the 1980s, and the ability of exogenous BRs to increase yield was shown in a variety of plant species. Combining previous reports, this paper conclude that BRs has crucial role on seed development, seed yield, dormancy and germination, seed physiological and biochemical parameters, and seed storage. The molecular mechanisms of BRs on different seed quality parameters are not well elucidated, thus is a suitable avenue for further research. BRs can be effectively used to enhance the seed quality and improve the seed yield.

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Effect of Covid-19 on Indian Agriculture

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Introduction

Since its arrival the COVID-19 Pandemic is considered as the most audacious global health calamity of the century and the greatest challenge to the mankind since World War II. Like any other sectors, Agriculture sector of our country has been severely affected. As we all know Agriculture is the backbone of Indian economy. It is the primary sector which employment to a large no of people so that the entire economic circulation goes smoothly. With the ongoing pandemic, livelihoods of all the farmers and the people who are indulging in this sector are at high risk. The nationwide lockdown due to COVID-19 was proclaimed at an unfortunate time for farmers, as it was the harvest season for the Rabi crops. In several areas' farmers were not able to harvest their crops because their laborer's had fled back to their village, among those crops cereal, pulses and also high value oilseed crops were included which would have given a large benefit to the farmers. Along with this issue closure of borders, stoppage of inter-state trade due to quarantine measures are causing disruption of food supply chain that may restrict people's nutritional sources of food. In this serious time, if we try to remember the last Bengal famine of 1942-43 at that time there was no lack of food but entire food chain disruption took away millions of lives. Similarly, we may also face the food crisis in near future unless the proper measures are taken by our government. At present time, we can only hope that one day the pandemic will go away but we do not know when and how it would happen and at the end how much negative impact it would fell on our economy & as well as our Agriculture sector.

Methodology

This research is mostly descriptive in nature. Present trends, beliefs, public minds, scientific viewpoint and attitudes are being described. Required information are collected from secondary sources of data like research papers, newspapers, magazines, websites & books.

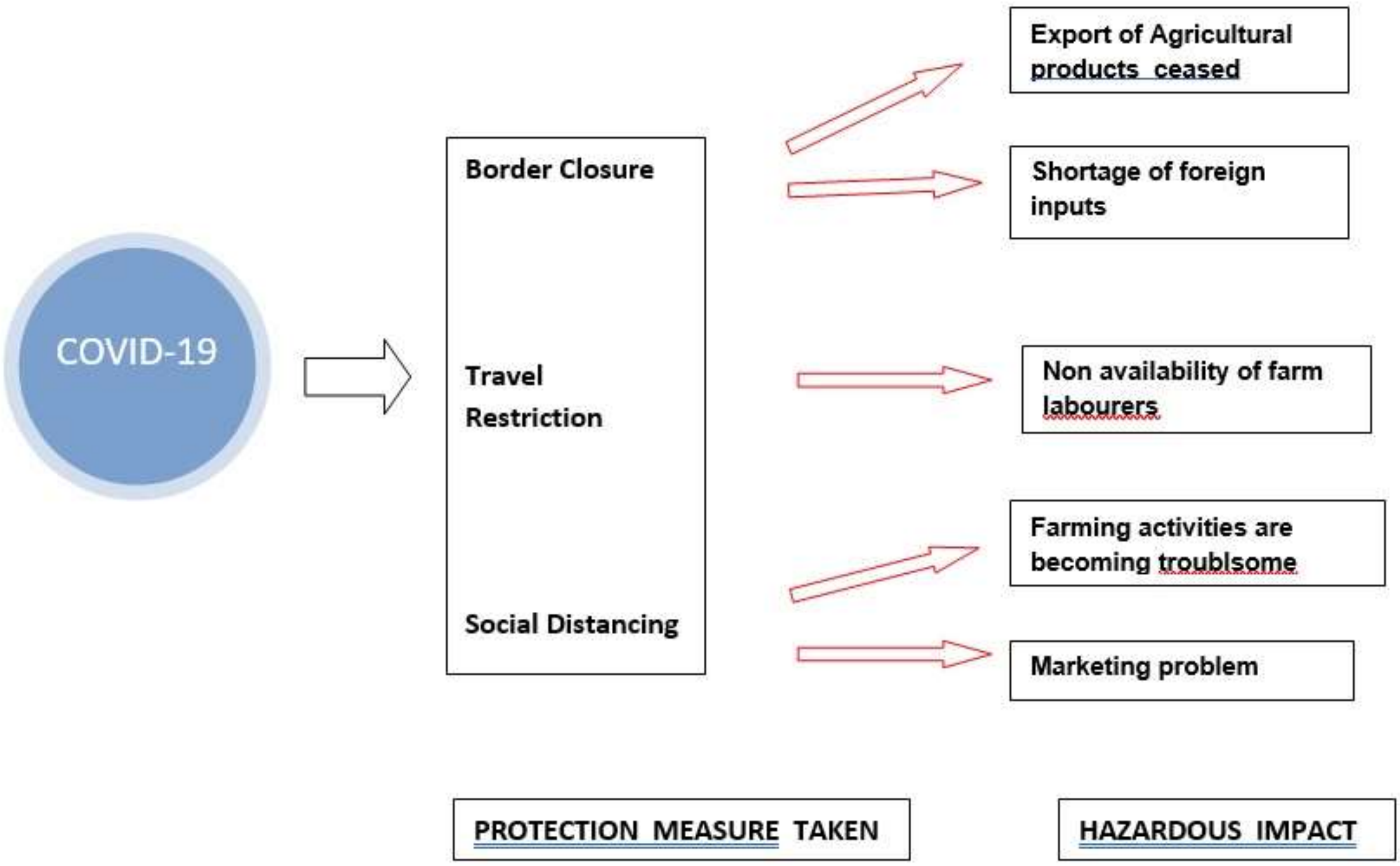
Discussion

COVID-19 has affected all the processes which connect farm production to final consumer. Both lives and livelihoods are at risk from this pandemic. Though in some countries the spread of the pandemic has been slowing down and cases are decreasing, in others, COVID-19 is resurging or continuing to spread quickly. According to FAO, still there is no need to panic at this moment as globally there is enough food for everyone. But we can anticipate the fact easily that a large buffer stock of foodgrains will also be declined in near future considering less yield comparatively of this year. When the pandemic came into scene in our country that was the peak Rabi season and crops like wheat, gram, lentil, mustard, Boro paddy(paddy in irrigated tracts) are at harvestable stage or almost reaching maturity stage. This was also the time when farm produces reach the mandis (or market yards).To maintain quarantine safety, government has imposed several restrictions on transportation of public distribution system(PDS) that might have elevated the time taken for the farm produces to attain the market. It can be a major problem for the perishable vegetables, fruits and dairy products.

In developing countries like India no matter what happens, the poor section of the society will always suffer most. As in keeping with the government 85% of the Indian farm households come under small and marginal farming activities which includes almost 9 crore landless migrant labourers. The entire concept of lockdown without any prior notice had forced a large number of migrant labourers to go back to their home. The reason may be of their safety, but it affected their breadwinning hardest as well as made the harvesting activities cumbersome for the farmers.

The next massive impact is the complete shutdown of exports. India has been a major exporter of crops and as per APEDA, India's overall agri-exports in 2018-19 were to the tune of Rs 685 billion. Currently, all the ports have been locked and huge inventory has piled up with the traders and farmers. This may affect the Indian economy to a large extent in the upcoming days.

Similarly, due to global trade disturbances, imports in India has also been affected for which farmers are facing the shortage of Agricultural inputs like seed, fertilizers and pesticides. China is the biggest producer of fertilisers and exports into almost every nation. Closure of borders will block the international fertilizer trade and Indian farmers will also be a victim of that. According to ICAR, India alone need 250 lakh quintals of seed for Kharif season but with various barriers coming out, this has not been procured till now.



Moreover, India is not just affected by the pandemic but it is also affected by few other factors in the meantime. A deadly cyclone 'Amphan' hit during the month of May in West Bengal, has devastated a large farming area. Besides that, a massive locust attack in the north western part amid pandemic caused a huge yield loss to the farmers. Farmers all across the country are wondering over their feet, living in a conundrum and hoping for any way out.

Conclusion

Presently we are passing through an exigence period and this is the challenging time for both Union and State Government to confront the pandemic. They should operate their full capacity to alleviate the plight of the farmers of our nation. Various reforms such as land leasing, contract farming and private agricultural markets could have been announced at this time to give a boost to the agriculture sector and to push its growth. To sustain the demand for agricultural commodities, investment in key logistics must be enhanced. Emerging e-commerce, delivery companies and start-ups need to be encouraged with suitable prices and incentives. To obviate the immediate concerns of scarcity of farm labourers, policies need to be arranged to facilitate easy availability of machinery through state entities. It is also necessary to urge the MSME and SME's to hold their employees to lessen activity cuts. The good news is that our Government are now increasing its focus towards this sector. Central Government has already announced several relief packages, schemes considering the losses of farmers, state governments are also closely working by providing farm inputs and logistic support. Finally, we should always keep in mind, this is not a time to wait and let the tide pass, but to rise and re-engineer the system for the benefit of all the stake holders.

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Hydroponics: A Valuable Soil-Less Culture

Article ID: 31717

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Summary

Hydroponics is a valuable soil-less culture method to grow fresh vegetables in countries having little arable land and those that are very small in area yet have a large population. It could also be particularly useful in some smaller countries whose chief industry is tourism. In such countries, tourist facilities, such as resort hotels, can grow their own products instead of importing them from many thousands of miles away, with long shipping periods.

Introduction

Hydroponics is a type of horticulture and a subset of hydro culture, which is a method of growing plants without soil, by using mineral nutrient solutions in an aqueous solvent (Santos, et al., 2013). Growing plants with their roots immersed in a nutrient solution without soil are known as hydroponics or soilless culture. Water, nutrients, and light are important determinants for hydroponics, and plants can be grown anywhere as long as their growth requirements are met.

Indian agriculture is witnessing a gradual change particularly in the land use system, cropping system, input utilization, marketing and above all the monetary returns. On the one hand, the land area available for agriculture is shrinking due to expanding urbanization, while on the other hand; the demand for higher productivity and returns from the cultivable land is increasing.

At the same time, the quest for higher productivity is leading to serious problems of saline soil and high-water table in irrigated areas. All these factors have provided ideal conditions for major trends towards diversification, mostly in favor of horticultural crops such as fruits, vegetables and ornamental crops. The separation of horticultural wing from agricultural department in each state, main stress is now on the development of horticultural crops. India has made a fairly good progress on the horticultural map of the world with a total production touching over 313.8 million Tonnes during 2018-19 (NHB, 2018-19). At present, India is the largest producer of fruits (98.5 million Tonnes) and the second largest of vegetables (185.8 million Tonnes) in the world, next to China.

 

Uses

Hydroponics is a space-age science, but at the same time can be used in developing countries of the third world to provide intensive food production in limited area.

1. Its only restraints are sources of fresh water and nutrients. In areas where fresh water is not available, hydroponics can use seawater through desalination. Therefore, it has potential application of providing food in areas having vast regions of non-arable land.

2. Hydroponic operations can be located along coastal regions in combination with petroleum-fueled or solar, or atomic desalination units, using beach sand as the medium for growing the plants.

3. Horticulture has improved economic status of farmers, seasonal availability of fruits and vegetables throughout the year increased per capita consumption.

4. It has also played a significant role in women endowment, providing employment opportunities to them in floriculture and vegetable seed production etc.

5. The unremitting trends of increasing population, urbanization, diminishing water supply, and continued climate change have contributed to declining stocks of arable land per person and is projected to decrease by 2050 to one-third of the amount available in 1970 (FAO 2016). Therefore, our planet is running short of farmland to feed the growing population resulting in an increasing need for alternative methods of food production.

6. To maintain the sustainability of earth and effective utilization of resources like soil, water, nutrients, and sunlight; soilless cultivation remains as one of the options.

7. The pursuit of urban agriculture as part of a city's green infrastructure is often a challenge, particularly within compact cities, where there is a limited amount of space between buildings for urban farming and gardening.

8. Soilless farming, though it has been around for over two millennia, is becoming more prevalent in modern food production as it not only saves water and space but also provides an effective option for indoor urban farming.

Importance of Hydroponic Farming

Greenhouse farming using the hydroponic system is more advantageous compared to conventional production systems with soil, including a greater density of plants and a decreased area requirement. Furthermore, the yield could in some cases be larger than when plants are grown in soil. When plants are grown in a closed, dense system, evaporation is kept at a minimum thus reducing the amount of water use and the plants are protected from the weather, insects and pests and fewer outbreaks of diseases when no soil is used. Recently, the application of hydroponic techniques in Vertical Farming (VF) has gained importance in the cities which combines the design of building and farms all together in a high rise building to effectively utilize the underutilized space. This technology needs to be manifested both in agriculture and architecture together. Improved growing space and water conserving methods, efficient nutrient management for food production under hydroponic have shown some promising results all over the world. Therefore, food production can be augmented in the non-arable region, space shrinking condition with this technology. In addition, underutilized space can be utilized efficiently for soilless culture in the future.

Conclusion

Especially in a country like India, where urbanization is increasing, there is no option but adopting soilless culture to help improve the yield and providing quality produce to the people, therefore hydroponics is better option to achieve this. However, Government intervention and Research Institute interest can propel the use of this technology sooner and faster.

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Micronutrient Status and Factors Affecting Micro Nutrients Availability

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Introduction

The word "micronutrient" represents some essential nutrient that are required in very small quantities for the growth of the plants and microorganisms, micronutrients also called as trace elements: are zinc (Zn), copper (Cu), iron (Fe), manganese (Mn), boron (B), molybdenum (Mo) chlorine (Cl) and nickel (Ni), the importance of micronutrients has been realized during the past four decades when wide spread micronutrient deficiencies particularly that of Zn were observed in most of soils in our country, where intensive agriculture is practiced. Micronutrient not only important for better crop productivity, but also essential for sustaining human and animal health.

Indian soils are exposed to multi-micronutrient deficiencies that are closely associated with yield and quality of crop. Proper plant nutrition is one of the most important factors in improving the quality as well as quantity of plant products. Even though plants need micronutrients in minor quantities, they are involved in a wide variety of metabolic processes as well as cellular functions within the plants. In general, micronutrients play an active role in the plant metabolic processes starting from cell wall development to respiration, photosynthesis, chlorophyll formation, enzyme activity, nitrogen fixation etc. Besides these functions, micronutrients also work as co-enzyme for a large number of enzymes. (Shukla and Behera, 2018) In India, an analysis of over 2 lakh soil samples revealed deficiency of micronutrient in India and Maharashtra (Table. 1).

Table: 1 Micronutrients deficiency and their critical limits in soil

Nutrient	India (%)	Maharashtra (%)	Critical limit in soil (mg kg-1)
Iron	12.80	23.12	4.5
Manganese	7.10	3.02	2.0
Zinc	36.50	36.60	0.6
Copper	4.20	0.14	0.2
Boron	23.4	20.69	0.5
Molybdenum	-	-	0.1

Soil Factors Affect Nutrient Availability

Various soil characteristics affect the availability and uptake of micronutrients – mainly soil pH, organic carbon content, temperature, calcium carbonate content and other nutrients.

1. Soil pH.
2. Soil organic carbon.
3. Soil temperature.
4. Soil calcium carbonate.

Soil pH

The degree of acidity or alkalinity in the soil is expressed on the pH scale. Soil pH ranges from 0–14, where 0–7 is acidic and 7–14 is alkaline. Soil pH between 5.5 and 7.5 is considered optimal for growth of most plants and microorganisms. Soils with acidic pH have a high concentration of H^+, Fe^{3+} and Al^{3+} ions which usually combine with other ions like Mo, Ca, Mg, S and N and make them unavailable for plants. Availability of most micronutrients is higher in acidic soils as compared to alkaline soils. Alkaline soils contain free hydroxide (OH^-) ions which react with free cationic 7 micronutrients like Zn^{2+} and Mn^{2+} and precipitate into minerals, making them unavailable for plant uptake. Except Mo, availability of all micronutrients decreases with an increase in pH. Soil pH between 6 and 7 shows the highest availability of micronutrients. Since 71 per cent of Indian soils are moderately alkaline, soil micronutrients tend to be deficient in them. Soil alkalinity can be corrected by adding gypsum or magnesium salts.

Soil Organic Carbon

Important factor that affects availability of micronutrients. Cationic ions are held by clay particles or humus and are made available to plants when required. Clay soils with good organic matter content have high cation exchange capacity (CEC) and are better at supplying nutrients to the crop. Due to intensive cultivation, soil erosion and depletion on land, soil organic matter levels have gone down, which has affected availability of micronutrients to plants. Dwindling organic carbon in Indian soils is another reason for widespread micronutrient deficiencies.

Soil Temperature

Micronutrient uptake is also affected by the soil temperature. Micronutrient uptake increases with increasing rates between temperatures of 16 ˚C to 24 ˚C and becomes maximum at temperatures between 24˚C and 33 ˚C.

Soil Calcium Carbonate

High calcium carbonate content low micronutrient availability. Calcium carbonate application increased exchangeable calcium and decreased exchangeable aluminium and manganese but had little effect on the exchangeable levels of other cations.

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New Innovations of Vertical Farming that could Revolutionize Agriculture in Future

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Introduction

These revolutionary vertical farming innovations can soon replace the traditional agriculture techniques. Many have wondered for years if vertical farming is really the answer to the shortage of food in the world. However strange the concept of vertical farming might seem to many start-ups; it is an indigenous method to produce food in environments where arable land is unavailable or rare at the most.

This method is especially handy for challenging environments such as deserts, mountainside towns and cities where many diverse types of vegetables and fruits are grown using precision agriculture methods and skyscraper-like designs. Vertical farming is a revolutionary and more sustainable method of agriculture than its counterpart as it lowers the requirement of water to up to 70% and saves considerable space and soil. This innovation in the field of agriculture with sustainability as its motto is making more and more heads turn today with its eco-friendly methods and making the possibility of farming real in difficult environments.

1. Hydroponics – Growing Plants without Soil: Hydroponics is a predominant system of growing that is used in vertical farming, and it is slowly but steadily, gaining importance. It involves around the growth of plants in solutions of nutrients that are essentially free of soil. In this vertical farming innovation, the roots of the plants are submerged in a solution of nutrients. This is frequently circulated and monitored in order to ensure that there is the maintenance of the correct chemical composition in the nutrient solution.

2. Aeroponics – Growing Plants with No Soil and Very Little Water: The National Aeronautical and Space Administration (NASA) made the innovation of aeroponics in the field of vertical farming. This sustainable growing technique was invented by NASA in the 1990s when it was looking for efficient techniques to grow plants in space.

This technique was then coined *aeroponics* and was defined as "growing plants in an air/mist environment with no soil and very little water." However, these systems are yet to rise from an anomaly in the world of vertical farming even though they continue to create interest.

It is undoubtedly the most efficient way in vertical farming as it uses a staggering 90% less amount of water than the most efficient hydroponics systems too. It has also been observed that the plants that are grown with the aeroponics system uptake more vitamins and minerals, thus making the plants potentially healthier and more nutritious.

3. Aquaponics – An Ecosystem that Promotes Plants and Fish Farming Together: An Aquaponics System is much like the Hydroponics System but is only better. It aims to combine the fish and plants in the same ecosystem. In this system, fish grow in indoor ponds and produce a nutrient-rich waste that further acts as a food source for the plants grown in vertical farms. The plants, doing their part, purify and filter the wastewater that gets recycled directly to the fishponds. Aquaponics is definitely used at a smaller scale than most vertical farming innovations.

However, it is still used by many commercial vertical farms that wish to produce just a few fast-growing crops instead of including the component of aquaponics. As a result, the production and economics issues are simplified and it maximizes efficiency.

4. Lokal – Serving Fresh Food Right Where It's Grown: The Space10 innovation lab of IKEA came up with the idea of Lokal that uses a Hydroponic farming system. It also uses LEDs to have your kitchen garden in stackable trays.

According to the designers of Lokal, the greens grow three times faster in Lokal than traditional gardens. They are also testing another innovation wherein they will integrate sensors into the growing trays, which will help you check the status of the crops with the help of smartphones or Google Homes.

5. AeroFarms – The Smart Vertical Farming Innovation: When it comes to indoor farming, aeroFarms are the commercial leaders in this field with their innovation of using the aeroponic system of farming that ensures predictable results of your harvest, less impact on the environment, faster harvesting period and superior quality of food. The technology helps growing greens without using any sun or soil.

Therefore, it is easier to control the results of the harvest. The vertical farming innovation makes use of smart light, smart aeroponics, smart nutrition, smart data, smart pest management, smart substrate and smart scaling.

AeroFarms aims to transform the whole system of agriculture by building and making farms that are environmentally responsible. They are building farms around the world to make sure there is a local production of food that is nutritious, safe, sustainable and delicious.

In short, they want to grow more crops in less space, which can bring about a food revolution.

6. Plantscapers – A Building that Provides Food for its Occupants: A Swedish food tech company called Plantagon is coming up with a creative solution that would allow office spaces and buildings to help feed a large number of people. In order to use the innovative methods of vertical farming, Plantagon has bought the rights to a vertical greenhouse from an organic farmer named Åke Olsson who believes in using technical innovation to find effective farming solutions.

Olsson developed a rack transport system that gradually moves the planting boxes from the floor to the ceiling of a vertical greenhouse, thus requiring no artificial light. These vertical greenhouses or plantscapers are integrated directly into the office buildings with the functionality of hydroponic farming. The building would be named the *World Food Building* with the aim of producing at least 550 tons of vegetables every year and is planned to be constructed in Linköping, Sweden. This is an estimated amount of vegetables that can provide food for almost 5000 people. High-level automation will be employed for the maintenance and harvest of plants in order to keep the costs very low. Moreover, everything starting with sunlight, temperature and nutrition, as well as air quality, will be measured through autonomous and controlled systems. To sum up, it is a great innovation that keeps in mind sustainability and the requirements of people by keeping the costs of transportation very low and by saving high amounts of energy, emissions, and water. If the concept becomes a success, more countries like Singapore, Hong Kong, United States and others have plans to adopt it too.

7. VertiCrop – A Sustainable Farming Technique for Urban Areas: VertiCrop is a proprietary agriculture technique that has been deemed as one of the World's Greatest Inventions by TIME Magazine in 2009. This patent-pending technology was designed and developed so that food could be grown naturally in the environment of bustling urban areas. This proprietary method offers quite a paradigm shift in food production and sustainable farming methods. It provides up to twenty times the yield of your standard field crops and uses merely 8% of the water that is usually needed for soil farming.

The vertical farming innovation works on a suspended tray configuration that is unique in itself and moves on a conveyor system. VertiCrop offers optimal exposure to both artificial and natural light in addition to nutrients that are precisely measured for every plant.

It has been designed in a way that it can promote the healthy growth of crops in controlled and closed-loop environments. Furthermore, it entirely gets rid of the need for using harmful herbicides and pesticides and maximizes food value, nutrition and above all, taste.

8. Modular Farms – Produce Fresh Plants Virtually Anywhere in the World: The very exclusive and sustainable Modular Farm System is another great innovation in the world of vertical farming from the company called Modular Farms. It is an indoor system of vertical farming that has the ability to produce healthy and fresh plants virtually in any climate and anywhere in the world.

The Modular Farm System concentrates solely on farmer and plant health. This system is the perfect pairing of container farms and the tried & tested technology of vertical farming. This balance between the two promotes an endless growth of fresh and locally produced plants. A highlight of this vertical farming innovation is that you can customize your system and extend its functionality according to your agriculture needs to accommodate any sized operation.

9. Cubic Farming Systems – The Next-Gen Sustainable Farming System: Cubic Farms, as its CEO Dave Dinesen points out in his TEDx Abbotsford speech, is the next generation of consistent, predictable and profitable farm productions. It works on the conveyor rotation method, automated nutrient delivery system and LED lighting.

The machines used for growing crops create an optimal environment for the greens. It also uses 1/26th the amount of water that is utilized in traditional agriculture, thus making it sustainable. One would usually not associate these words with agriculture or growing. However, the patented Dutch Cubic Farming system eliminates risks of common farming to standardize the outputs by controlling the inputs. This, in turn, means a steady and more predictable income in addition to more consistency in the size, taste, and colour of the produce. It also promises a longer shelf life and higher nutritional content for your greens.

10. ZipGrow – Vertical Farming for the Modern Farmers: The motto of ZipGrow is to 'EDUCATE. EQUIP. EMPOWER.' The ZipGrow team has come up with innovative farming solutions for the modern farmers who do not have the required tools and experience to scale or start a hydroponic farming business.

ZipGrow understands the challenges that are faced by the average farmers today in terms of suboptimal growing equipment, poor farming or poor understanding of what the market really wants. As a result, ZipGrow has built a multitude of services and products so that the deck can be stacked in their favour. They have revolutionized the industry of vertical farming with system controls, vertical plane growing technology and high-tech workflow designs to help countless farmers globally.

11. Bowery – The Most Technologically-sophisticated Commercial Indoor Farm: The indoor farming company, Bowery is developing a technologically advanced farming system that will be capable to yield 30 times more produce and grow more than 100 kinds of herbs and leafy greens. The system according to the company will control the entire growing process indoors without using pesticides through their technology system BoweryOS.

The technology will automatically generate ideal conditions for the plants while collecting the data as they grow. The data will help in providing the plants with the exact amount of light, nutrients or purified water.

In addition, the sophisticated analysis will further allow harvesting the crops at the right time when its flavour is at its best. The produce cultivated through Bowery's system utilizes **95%** less water compared to the traditional farming.

12. Skyfarm – A Wind-Powered Vertical Farming Tower: An architectural firm, Rogers Stirk Harbour + Partners from London demonstrated a concept called Sky farm during the World Architectural Festival in 2014. The idea is to build a hyperboloid tower that makes use of different farming techniques including aquaponics and traditional soil-based planting methods to produce crops within high-density urban areas or at places where land availability is less.

The multi-story building uses bamboo to create a rigid circular frame while maximizes the sun exposure onto the farm. The tower supports both the growth of crops and fish together through a re-circulating system where the nutrients from fish water are fed to the crops while the plants provide filters for the fish to thrive.

The bottom of the tower is designed to have a large transparent tank consisting of freshwater for the farming of fishes like bass, tilapia, and barramundi. In the middle of the tower, the plants are grown through hydroponics using water.

Above this, the plants are grown through aeroponics using only water mists and no soil. The top of the tower consists of water tanks and turbines.

The tower is an example of a sustainable solution for growing produce with a short shelf life around the year with easy accessibility for the urban population.

13. Sky Greens – The World's First Hydraulic Driven Vertical Farm: The Singapore-based company Sky Greens has developed a revolutionary vertical farming system, which is also the world's first low carbon, hydraulic driven farm. The vegetables are planted on shelves that keep on rotating throughout the day.

The plants at the bottom receive water, while the ones at the top get sunlight and the process continues. This approach minimizes the use of water, land, and energy over the conventional farming techniques.

In addition, the Sky Urban Vertical Farming System is capable of producing 10 times more yield compared to traditional farms. While the system is currently used to grow Asian vegetables, it can also be used to grow all kinds of fruits and veggies.

Vertical farming is definitely an attractive option for farmers these days as more and more industry experts embrace it and for a good reason. It promises a much more sustainable way of farming in addition to not just producing quality produce but also cutting down on costs and making agriculture more eco-friendly.

Conclusion

Vertical farms in urban areas are a relatively new phenomenon, but interest in this approach is growing the number of vertical farms in the United States is expanding every year. There are several variations of vertical farms being tested throughout the world and innovations and technology will likely increase the energy efficiency and profit margins of these farms in the future. In the near term, most vertical farms will focus on high-return and short-rotation crops such as salad greens, with nearby restaurants often buying all of the production. Whether vertical farms will become more widespread in cities is uncertain, but urban planners and the sustainable agriculture community under construction or already in production are closely observing the innovative vertical farms currently.

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Chelate: Its Advantages and Different Forms of Micronutrients

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Introduction

Micronutrient deficiencies are major constraints in crop production in the present day agricultural programmes. Micronutrient fertilizers are gaining importance day by day and would play a major role in bringing stability and sustainability in the production of food grains, pulses and oilseeds in the coming decade (B. S. Sekhon, 2003).

Chelates are considered to be organic molecules. The word "Chelate" is derived from a Greek word which when translated comes to mean "Claw." Chelates is that an organic molecule will cling on to the metal cation to form a ring like structure. Chelation is important because it makes the metal ions more available for uptake. Since Zn, Mn, Cu, and Fe are all cations they can react with Hydroxide (OH–) Ions which will make them unavailable and make your micronutrient fertilizer non effective. The "Claw" that is part of the chelates binds to the metal atom and protects it so that it cannot link with OH– ions. This will allow the plant to be able to absorb the metal ion. One thing to note is that other positively charged ions such as Calcium or Magnesium can compete with the metal ion for binding. This metal ion can then be replaced, making the chelate ineffective in delivering the metal ion to the plant.

Advantages of Chelates Over Sulphate Forms

1. Much lower quantities are necessary compared to inorganic compounds because they are completely assimilatable by crops.
2. Chelates are much more easily absorbed by plant roots or leaves because chelates are of organic nature. The chelation process removes the positive charge from the micro nutrients allowing the neutral or slightly negatively charged chelates to slide through the pores on the leaf and root surface more rapidly.
3. Chelates are more easily translocated within the plant as their action is partly systemic.
4. Chelates are easily assimilated within the plant system.
5. The chances of 'scorching' of crops while using chelates is less because they are organic substances.
6. Chelates are not readily leached from the soil as they adsorb on to the surface of soil particles.
7. Under alkaline conditions, chelated iron, zinc, manganese and copper is a better way to provide micronutrients to a crop.

Disadvantages to Chelates

1. Most expensive.
2. They are so readily available and very water soluble, it is easy to over apply and create toxicity problems.

Different Forms of Micronutrients

1. Oxides: Oxides are considered to be inorganic. For oxides, micronutrients such as Cu, Zn, Fe, and Mn will be bonded with oxygen to form oxides. Since the bond is so strong with oxygen it will not be soluble in water. The form will have to be converted in the soil. Once it is converted then it will be plant available. They are typically sold as powders or they are in a granular form. They are typically not effective in this granular form. Oxides usually have a higher analysis of the micronutrient compared to chelates. Where the oxide form could be effective is when it is applied as a powder form broadcasted and then incorporated.

Advantages to Oxides: Least expensive form of micronutrients

Disadvantages to Oxides:

i. They are insoluble in a single crop season and therefore unavailable to a crop.

ii. Can be ineffective as a fertilizer source.
iii. Must be finely ground to be effective in soils.
iv. Often have to be applied months before a crop is to be put in to be effective.

2. Oxysulfates: Are considered to be another inorganic source. These are a combination of oxides and sulphates. It stems from a micronutrient that has reacted with sulphuric acid. By having the oxide form be acidified by the sulphate form it will increase the water solubility of the micronutrient and make it more effective. They are usually sold in granular form.

Advantages of Oxysulfates:

i. More cost effective then chelates, and still do a good job.
ii. If small amounts are required you are better to go this route, since low amounts of chelated micronutrient does not seem to work as good since it is hard to achieve a uniform application.

Disadvantages of Oxysulfates:

i. Low water solubility especially at higher pH levels.
ii. Greater risk for creating toxicity or damage if over applied.

3. Sulphates: Sulphates are also considered to be inorganic. Sulphates such as Zinc Sulphate ($ZnSO_4$) and manganese sulphate ($MnSO_4$) are 100 % water soluble. They are the most commonly used form for field crops. The nice thing about sulphates is that they can be applied to the soil or directly onto the leaf and stem of the plants. They are sold in crystalline or granular form.

Advantages of Sulphates:

i. Can provide long term residual value.
ii. Can be foliar applied.

Disadvantages of Sulphates: Greater risk for creating toxicity or damage if over applied.

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Tiger’s Claw Plant – Invasive Weed with Medicinal Property

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Martynia annua Linn is an herbaceous annual medicinal plant found as wild source throughout India. It is a weedy species native to tropical and sub-tropical region of Mexico, Central America, Burma, West Pakistan and distributed throughout India. It is found commonly in dense clumps on roadsides, dry deciduous forest, waste lands and over-grazed pasture areas.

The plant is known commonly as the Cat's claw or Devil’s claw as 2-hooked form of their seed pods. In Ayurvedic system of medicine, the plant is known as Kakanasika and it is also important ingredient of Chyavanprasha avaleha & Tryushnadi Ghrita. Though Martynia annua Linn. is an invasive weed, the literature survey reveals the therapeutic efficiency of the plant?

Decoction of whole plant in folk medicine, is used to cure pneumonia and cold fever. Leaves are used to cure epilepsy and its juice is gargled for problems associated with sore throat. The fruits of the plant are used for the treatment of asthma; the seeds are also applied locally for itching and eczema. The Roots are boiled along with milk and taken as a tonic and roots made into a poultice and applied for incidence of snake bite

Taxonomy of *M. annua*

Kingdom: Plantae
Phyllum: Magnoliophyta
Order: Scrophulariales
Family: *Martyniaceae*
Genus: *Martynia*
Species: *Martyniaannua*

Vernacular Names of *M. annua*

Tamil: Thelkodukkukkay, Puli-nagam
English: Devil’s claw, Tiger’s claw
Hindi: Hathajori, Bichu, Ulat-kanta,
Malayalam: Puli – Nakam
Telugu: Garudamukku, Telukondicchhettu
Marathi: Vinchu
Gujarati: Vichchida
Konkani: Shernui.

Potential Medicinal Properties

1. Antipyretic activity and Analgesic activity.
2. Wound Healing activity.
3. Antibacterial activity.
4. Anthelmintic activity.
5. Anti-convulsant activity.
6. Antioxidant activity.
7. Antifertility activity.
8. Antidiabetic activity.

9. Antinociceptive activity and Central Nervous System (CNS) depressant activity.

Sl. No	Plant part	Phyto-constituents
1.	Fruits	Gentisic acid.
2.	Leaves	Chlorogenic acid, p-hydroxy benzoic acid.
3.	Seed	Arachidic acid, HCN, Linoleic acid, Malvalic acid, Cyclopropenoid.
4.	Seed, leaves	Palmitic acid and Stearic acid.
5.	Whole plant, Flowers	Pelargonidin-3, 5-diglucoside, Cyanidin-3-galactoside.
6.	Whole plant, Seed	Oleic acid, Apigenin, Apigenin-7-O-beta- D- glucuronide.

Propagation

It is propagated by seed which remains inside the pod and attaches itself by its spines to machinery, animals and humans. fruiting season is Aug.-Sept.

Conclusion

Martynia annua Linn. is an invasive weed, the research survey reveals the therapeutic value of the plant? The phytochemicals isolated from *Martynia annua* has been effectively using in many health problems since a long time. The present review work provides a wide area of interest for planning and conducting research on this excellent plant for the development of novel drug for the future diseases which are outbreaking.

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Immune Boosting Probiotics

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Introduction

We have two kinds of bacteria constantly in and on our body i.e. good bacteria and bad bacteria. Probiotics are made up of good bacteria that helps keep your body healthy and working well. The Food and Agriculture Organization of the United Nation (FAO) defines probiotics as “live micro-organisms, which, when administered in adequate amount produce beneficial effect to the host when taken orally”. They can be found in yogurt and other fermented foods, dietary supplements, and beauty products. Some bacteria help digest food, destroy disease-causing cells, or produce vitamins. Many of the microorganisms in probiotic products are the same as or similar to microorganisms that naturally live in our bodies.

Common Types of Probiotics

Though there are many types of bacteria that can be considered probiotics, there are two specific types of bacteria that are common probiotics found in stores. These include:

Bacteria		Yeast
Lactobacillus species	***Bifidobacterium Species***	
L. acidophilus.	*B Adolescentis*	*Saccharomyces boulardii.*
L. Crispatus	*B Animalis*	
L. casei	*B Breve*	
L. plantarum	*B infantis*	

1. *Lactabacillus:*

a. There are more than 50 species of lactobacilli.

b. Foods that are fermented, like yogurt, and dietary supplements also contain these bacteria.

c. It helps in preventing yeast infections, urinary tract infection, IBS, traveler's diarrhea , diarrhea resulting from Clostridium difficile, treating lactose intolerance, skin disorders (fever blisters, eczema, acne) and prevention of respiratory infections.

2. *Bifidobacteria:*

a. There are approximately 30 species of bifidobacteria.

b. They are found in the intestinal tract within days of birth, especially in breastfed infants.

c. They help in the improvement of abdominal pain, bloating, bowel dysfunction, incomplete evacuation, straining, and the passage of gas.

3. *Saccharomyces:*

a. The only yeast probiotic.

b. It is effective in treating diarrhea associated with the use of antibiotics and traveler's diarrhea.

c. It has also been reported to prevent the reoccurrence of Clostridium difficile, to treat acne, and to reduce side effects of treatment for Helicobacter pylori.

4. *Streptococcus:*

a. This produces large quantities of the enzyme lactase, making it effective.

b. It helps in the prevention of lactose intolerance

Enterococcus

c. This is normally found in the intestinal tract of humans.

d. Enterococcus faecium SF68 is a specific probiotic strain that has been used in the management of diarrhoeal illnesses.

Sources of Probiotics

It is also possible to increase beneficial microbes in our body from the daily foods we eat. Certain foods have good bacteria in them and can benefit the health of our microbiome. These foods can be introduced into diet at any point of the day. A few suggestions for just some of the probiotic-rich foods we can add to our diet and sometimes to try them include:

Breakfast	Lunch	Snack	Dinner
Yogurt.	Cottage cheese.	Fermented pickles	Fermented sauerkraut.
Buttermilk.	Kombucha.	-	Kimchi.
Sourdough bread.	Tempeh	-	Miso soup.

Mode of Consumption

There are several ways you can take a probiotic supplement. They come in a variety of forms, including in:

1. Foods.
2. Drinks.
3. Capsules or pills.
4. Powders.
5. Liquids.

Properties of Probiotics

1. It should produce lactic acid.
2. It should stimulate the immune system of the body.
3. It should be safe to the host.
4. It should not produce any pathogenic or toxic effect.
5. It must be resistance to hydrochloric acid, bile and pancreatic juice.
6. It should have anti-carcinogenic activity.
7. It should have the ability to colonize the gastrointestinal tract.
8. It should retain viability during storage and use.

Conclusion

Probiotics are live microorganisms that are intended to have health benefits when consumed or applied to the body. Probiotics suppress the growth of harmful bacteria and help increase the number of beneficial bacteria in the intestine. This overview summarizes the introductory and basics of most commonly used probiotic microorganisms and their health claims.

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