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Growing seed

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# Editorial Board

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# MYCOPARASITISM OF *Mycogone perniciosa* IN EDIBLE FUNGI

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*Mycogone perniciosa* causes wet bubble disease in mushroom fungi such as white button (*Agaricusbisporus*), shiitake (*Lentinulaedodes*) and oyster mushroom (*Pleurotus*spp). It is among the major production lowering factors in these mushrooms. *M. perniciosa* has a worldwide distribution and may cause complete crop failure under favourable environmental conditions. The perfect stage of *M. perniciosa* is *hypomyces perniciosa*. Mycelium of the pathogen is white, compact and fluffy mycelium. Hyphae are branched interwoven, septate and thin-walled. One-celled phialoconidia on *Verticillium- like* conidiophores and bicellular conidia which are commonly referred to as either aleuriospores or chlamydospores are produced by the *M. perniciosa*.In India, button mushroom contributes 73 percent in total mushroom production of the country. This disease was first reported for Peris in 1888. The disease has also been reported to assume serious proportions in other major mushroom growing countries of the world such as France, United Kingdom, Netherlands, USA, China, Taiwan, South Africa, Brazil, Hungary, Australia and Poland. In India, this disease reported for the first time in 1978 in Jammu and Kashmir. At present, it is found in almost all the button mushroom growing areas of the country. Major reasons for the widespread of the disease are lack of knowledge about hygiene required for mushroom crops,poor sterilization of casing soil, semi-controlled growing/sterilization facilities and a higher population of disease-transmitting vectors like mushroom flies.

## Mycoparasitism

Mycoparasitism is refers to the parasitism of one fungus by another. To protect the edible fungi from mycoparasitism, understanding of its mechanism is very important. For instance, during spawn run stage of the *Agaricusbisporus* (button mushroom), mycelium is not infected by *M. perniciosa*. But after the completion of spawn run and case run, when the fresh air is introduced in the growing room and temperature is brought down to the range

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optimum for the primordial formation, the conidia of the *Mycogone perniciosa* are activated, and eventually, germ tubes are formed to invade the mushroom mycelium. At the onset of primordial formation, some openings are formed on the mushroom mycelium which allows the germ tube to enter into the mushroom hyphae to establish the parasitic relationship. The fact of the matter is that *A. bisporus*(button mushroom)genome is rich in the genes encoding hydrophobins. Hydrophobins form a uniform hydrophobic coat on the surface of mushroom hyphae and do not allow the *M. perniciosa* to penetrate the hyphae during spawn run. This is because the spores of *M. perniciosa* require sufficient moisture on the surface to be infected. Because of the hydrophobic nature of the surface of hyphae, germinated spores of *M. perniciosa* either get dried or stay as such near to the hyphae. However, in the beginning of primodia or pinhead formation, the hydrophobic coat may either be ruptured or temporarily removed or replaced with a new member of hydrophobins. Meanwhile, the pathogen may take the opportunity to enter into the hyphae. Reasons for rupture, temporarily removal or replacement could be many; however, the plausible cause may be the excessive internal pressure excreted on the hyphal cell wall to push out the newborn primordia. During the process of invasion, many lytic enzymes like chitinases, laccases, cellulases etc are also secreted by the pathogen to degrade the host tissues.*M. perniciosa* is a strong parasite of *Agaricusbisporus*, and it grows deep into the mushroom fruit body and completely deformed it into sclera dermoid masses that means primordia is not differentiated into stipe and pileus. At the later stages of infection, droplets of dark brown colour are formed on the surface of infected fruit bodies. Because of these dark colour droplets, the disease is called a wet bubble.

## Symptomatology

Wet bubble disease causes extensive damage by rotting and causing deformities in the whole fruiting body. If not managed well in time, the pathogen causes economic losses by damaging the entire crop. Wet bubble is characterized by the development of whitish growth of mycelium and protuberance on the surface of fruit bodies. If mushroom fruit bodies are infected before the differentiation of stipe and pileus, the sclera dermoid masses are formed, whereas if the infection takes place after differentiation that results in the production of thickened stipe with deformation of gills (Fig. 1).

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**Fig.1.** Characteristic symptoms of wet bubble disease

## Host range

Though *M. perniciosa* is a major pathogen of *Agaricusbisporus*, however, it is capable of infecting other mushroom species and crops like *A. campestris*, *Pleurotuseryngii* and *P. nebrodensis* and shiitake (*Lentinusedodes*).

## Spread

Spread of *M. perniciosa* occurs mainly through casing soil, air, water or maybe mechanically carried by mites, flies and human errors (Fig. 2). This pathogen can survive from many years in the form of chlamydospores in the spent mushroom substrate and in different cracks or unused areas of the growing rooms and are probably responsible for secondary infection.

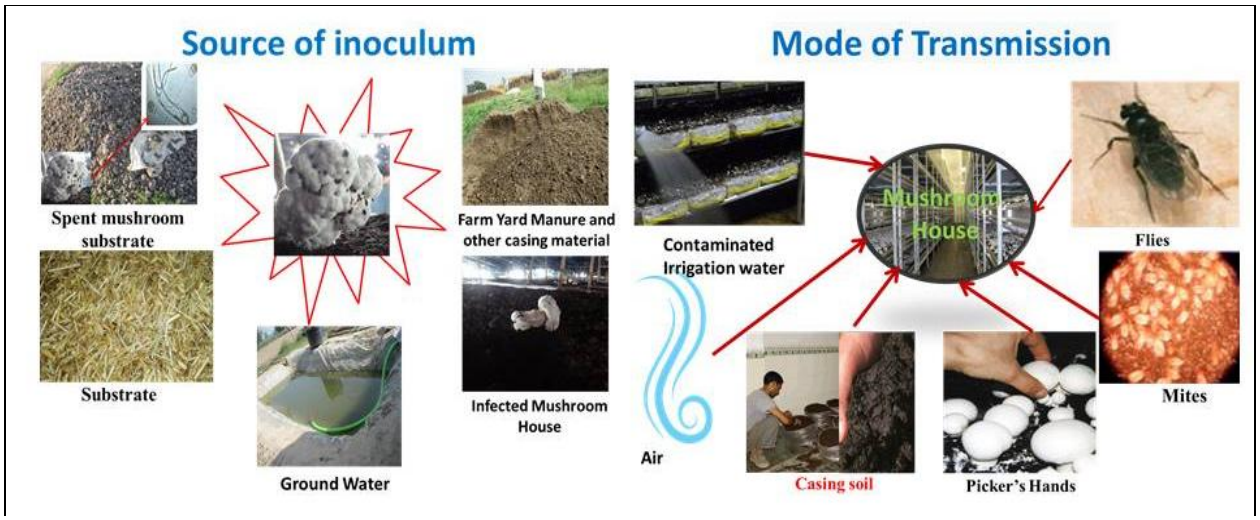


**Fig. 2:** Source of inoculum and different modes of transmission

Generally, *M. perniciosa* may resist the temperature up to $50^0$C. However, the range may be exceeded beyond due to the genetic variability in the pathogen. Infected fruit bodies,

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spent mushroom substrate, farmyard manure, substrate material, groundwater etc. are the major sources of inoculum. *M. perniciosa* can also survive under high moisture conditions because it is also rich in genes encoding hydrophobins. Wet bubble disease spreads at a very fast rate and it therefore advisable to identify and manage the disease at the very early stage of infection i.e. when only 2-3 fruit bodies are infected in a single growing room.

## Biology/physiology

*M. perniciosa* is very sensitive to comparatively high temperature i.e. >50$^0$C. Potato Dextrose Agar (PDA) and Malt Extract Agar (MEA) are considered as the best medium to obtain maximum growth of the pathogen with optimum pH and temperature of 6.0 and 25$^0$C, respectively. Mannose and asparagines are among the important source of carbon and nitrogen required for the growth and development of *M. perniciosa*.

## Management

Quality compost and proper pasteurization or sterilization of casing soil is remained as effective means of management of *M. perniciosa* parasitism in edible fungi. Use standard crop management practices and be the earliest to jump to any disease control strategies. At the time of disease appearance, wear gloves in hands and sprinkles some pinches of common salt on the infected fruit body. Then take a piece of paper/newspaper and wrap up the infected fruit body, pluck it and bury it in a pit somewhere away from the mushroom house, after that sprinkle some common salt at the place from where the infected fruit bodies are removed. Don't add salt to the healthy area otherwise mushroom mycelium is also killed by the salt. Common salt is recommended only for spot treatment of wet bubble disease. For effective management, one spray of Prabal/Derisom/Sheat guard(1-3ml/g/litre water) after casing is done (Prabal contains *Oryzussativus* + *Opuntia*sp, Derisom is the extract of *Pongamiaglabra*/ *Pongamiapinnata* and whereas Sheath guard is a *Pseudomonas fluorescens* based biological fungicide followed by the second spray of Prabal/Derisom/Sheat guard 7 days after first spray (or before pinhead formation). Spray of calcium carbonate (1g/litre water) is done on completion of each harvest followed by a spray of calcium chloride (1g/liter water) after 2 days. After each harvest of the crop pH level of the growing medium goes down to the acid level, which can be corrected back to the desirable level by adding calcium carbonate. Besides this, after first and second harvest, the incidence of bacterial diseases is also increased this is managed by the application of calcium chloride. Calcium chloride is also

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helpful in supporting the mushroom crop in drawing nutrition from the growing medium and resisting the disease pressure. Among chemical control, one spray of chlorothalonil (0.1%) immediately after casing and its second spray after 7 days or before pinhead formation. Besides chlorothalonil, drenching with any permissible fungicides of benzimidazole group (at 0.05% conc.) plus formalin (0.1%) is also effective against wet bubble disease. After completion of crop harvesting, treat the used bags and room with formalin (2%) and keep the door closed for 3 days or adopt post-crop sterilization/cookout technique by keeping the room temperature at $\geq 70^0$C temperature (for 3-4hr). Properly dispose of the spent mushroom substrate is most important to avoid the further spread of the disease. As quoted above in the text that casing soil is the most important source of inoculum for this disease. It is suggested to use 80-90% soil-less material (e.g. coir pith etc.) for the casing preparation and enhance its pH by adding lime (1%) into it and gypsum (2%) to stabilize the soil by reducing the dispersion of large soil aggregates into a smaller size. It is also helpful in maintaining the porosity of casing material and as results in creating continuous evaporation from the growing bags/beds. This whole process supports the fast growth and development of mushroom mycelium and eventually provides strength to resist the attack of a pathogen like *M. perniciosa*.

## Conclusion

Among different parasites of edible fungi, management of mycoparasitism of *M. perniciosa*is very difficult. It is tougher when the parasitism has to be managed curatively. Stage of manifestation of infection in the mushroom house and the time application of protection components (botanicals, microbial and synthetic pesticides) are very important. During the phase of colonization of substrate by the host fungi, application of any management strategy is of no use because of the presence of hydrophobins present on the surface of its hyphal surface. Hydrophobins prevent the attack of major parasite like *M. perniciosa*. However, care is required at the time of primordial formation. At this stage, natural openings are formed on hyphae, which are responsible for the invasion of parasitic fungi. Therefore, to prevent the attack of *M. perniciosa*, casing time and primordial formation stages are very important to apply any management strategy. Application of any antifungal compound can produce best results only when their protective applications are given to the crop and mushrooms are grown under good agricultural practices (GAP).

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## References

Sharma SR, Kumar S, Sharma VP (2007) Diseases and competitor moulds of mushrooms and their management. *Tech Bull NRCM*. 1-81.

Sharma SR, Kumar S (2000) Studies on wet bubble disease of white button mushroom, *A. bisporus* caused by *M. perniciosa*. *Mushroom Sci*15: 569-575.

Sharma VP, Annepu SK, Yogesh Y, Singh M, Kamal S (2017) Status of mushroom production in India. *Mushroom Res* 26: 111-120.

Rakesh KY, Chandrasekhar V, Kumar A. (2020). An automatic multi-threshold image processing technique for mushroom disease segmentation. *International journal of current engineering and scientific research (IJCESR)* 7(6): 110-115.

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# ROLE OF MINERALS IN AQUACULTURE

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Nutrition encloses the chemical and physiological process which provide nutrients for normal functioning of the body and maintaining homeostasis of the animal. Nutrition plays a major role in the increase in growth and survival, immunity, disease resistance, with the increased production in aquaculture stocking density also increasing parallelly to the production. Due to commercialisation in the aquaculture natural resources in the pond are not able to meet the nutritional requirements of culture organisms. In order to meet the nutritional demand of the organism, supplementary feeding is essential. In addition to the other nutrients, minerals play a major role in various functions of the aquatic organisms. Minerals play a pivotal role to establish minimum requirement and maximum tolerance for an element to secure optimal health and growth of living organisms.

## Types of Minerals

Based on the requirement of the animal body minerals are classified into two categories namely

1. **Macrominerals:** These minerals are required in large quantities to the animal body.
2. **Trace minerals:** These minerals are required relatively in small quantities to the animal body

| Macro Minerals | Trace Minerals | |
|---|---|---|
| Calcium | Zinc | Copper |
| Potassium | Iron | Selenium |
| Sodium | Arsenic | Chromium |
| Magnesium | Cobalt | Fluorine |
| Chlorine | Iodine | Manganese |
| Phosphorous | Molybdenum | Nickel |
| Sulphur | Silicon | Tin |
| | Vanadium | Aluminium |

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## General functions of minerals

The general function of minerals and trace elements can be summarised as follows:

- Minerals act as cofactors in catalysts, enzyme activators and in metabolism.
- Minerals are important components of skeletal structures such as bones and teeth.
- soft tissues of the animal body consist of minerals
- Minerals play an important role in the transmission of nerve impulses and muscle contraction.
- Minerals play a vital role in the maintenance of pH of the blood and other body fluids
- Minerals play a key role in the homoeostasis and thus regulate the exchange of water and solutes within the animal body.

## Biological role of minerals and their deficiency symptoms

| Mineral | Biological function |
|---|---|
| **Macrominerals** | |
| Calcium | • Essential for of blood clotting, muscle functions formation of bone, cartilage and exoskeleton of crustacean<br>• Essential for enzymes and plays an important role in enzyme activation<br>• An important role in membrane permeability |
| Phosphorous | • Inorganic phosphate's play an important role in pH balance of animal fluids<br>• An important component of Nucleic acids, Phospholipids and several enzymes<br>• Essential for formation of bone, cartilage, and exoskeleton of crustacean<br>• Key role in metabolism and cell energy |
| Magnesium | • Essential for formation of bone, cartilage, and exoskeleton of crustacean<br>• Key role in enzyme activation, nerve irritability, muscle contraction<br>• Intracellular pH balance |
| Sodium | • Main monovalent ion of intracellular fluids<br>• Essential for osmotic balance and acid-base balance<br>• Absorption of carbohydrate |

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| | |
|---|---|
| Potassium | • Major intracellular cation<br>• Essential for glycogen and protein synthesis<br>• Essential for osmotic balance and acid-base balance<br>• Essential for breakdown of glucose |
| Chlorine | • The major monovalent anion of extracellular fluids<br>• Important role in the carrying of oxygen and carbon dioxide in the blood, and the maintenance of digestive juice pH.<br>• Essential for osmotic balance and acid-base balance |
| Sulphur | • An important component of vitamins like cysteine and methionine<br>• Component of vitamins<br>• Detoxification of aromatic compounds |

**Trace minerals**

| | |
|---|---|
| Iron | • Oxygen and electron transport<br>• Component of respiratory pigments and enzymes essential for tissue oxidation |
| Zinc | • Component of metalloenzymes<br>• Key role in the production and metabolism of RNA<br>• Cofactor of many enzymes<br>• Wound healing |
| Manganese | • Acts as an enzyme activator for the enzymes that mediate phosphate group transfer<br>• Essential for bone formation, regeneration of RBC and reproductive cycle<br>• Component of the enzyme pyruvate carboxylase |
| Copper | • Component of a number of oxide reduction enzymes<br>• Involved in iron metabolism<br>• component of enzyme caeruloplasmin<br>• Mandatory for melanin formation and purity of myelin sheath in nerve fibres |
| Cobalt | • Component of vitamin B12<br>• Necessary for blood cell formation and conservation of nerve fibres |
| Iodine | • Necessary for balancing the metabolic rate of all body processes<br>• Component of enzymes thyroid hormones (Thyroxine and Tri-iodothyronine) |
| Selenium | • An important role in the retention of Vit-E and component of the enzyme glutathione peroxidase<br>• Biosynthesis of coenzyme Q involved in cellular electron transport |

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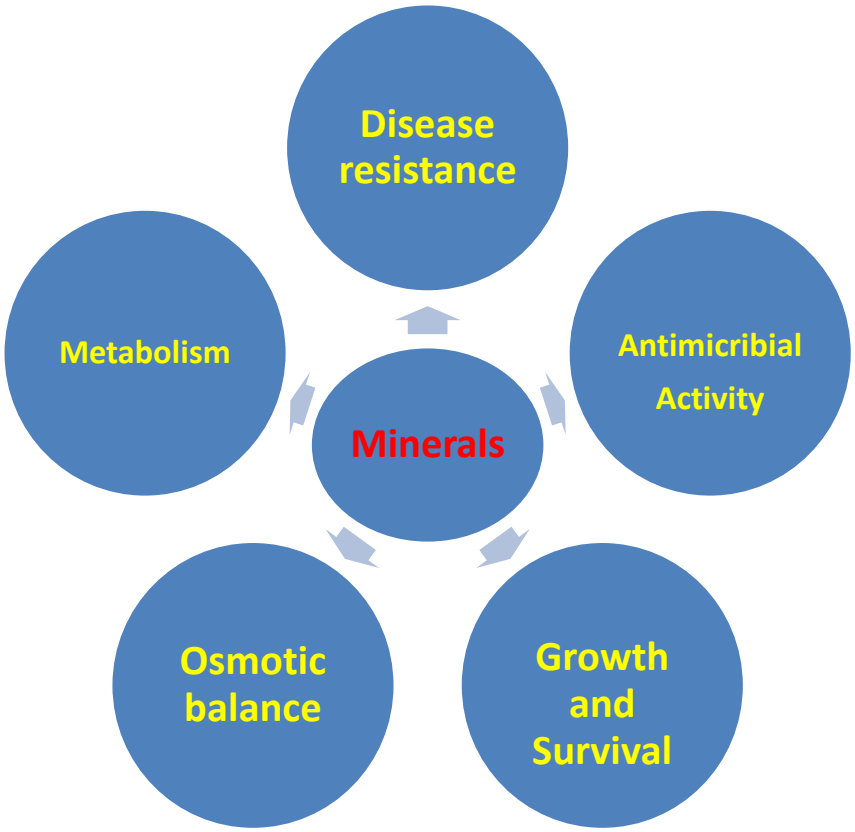
| | |
|---|---|
| | (ubiquinone)<br>• Protect cellular membranes and tissues against oxidative damage |
| Chromium | • Pivotal role in carbohydrate metabolism, cholesterol and amino acid metabolism.<br>• Cofactor for insulin<br>• Crucial role in nutritional and physiological responses on fish. |
| Fluorine | • Fluorine Intoxication<br>• Hardenong of exoskeleton. |

## Common symptoms of mineral deficiencies

- Hard tissue mineralization
- Reduced growth and feeding efficiency
- Softshell problems in crustaceans and skeletal problems in Fishes
- Anaemia, tetany and muscle dystrophy

**Role of minerals in Aquaculture**



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## Some of the Mineral mixtures commercially available in the market





## Conclusion

In Aquaculture, minerals play a more role in the well-being of the cultured species. So, it is necessary to monitor the mineral supplements required for the culture species. The ratio and proportional of the minerals should be known properly. It is also important that the mineral supplements should be given in proper ratio. Failing to do so might affect production efficiency, species health, End production quality.

## References

Banre*et al* (2013), Importance, Optimisation of Trace minerals in Shrimp / Fish nutrition for development of immunity, The Fish Site

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Online ISSN: 2582-368X
www.agriallis.com

CIBA Extension Manual (2016) Application of minerals in shrimp culture systems, Extension Series No:52

FAO (1987),The Nutrition and feeding of farmed fish and shrimp – A training manual, Chapter -6

National Research council of the National Academies (2011), Nutrient requirements of Fish and Shrimp chapter 8 (Pg 163-179)

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# POTASSIUM SOLUBILIZING BACTERIA: A PROMINENT NUTRIENT BOOSTER IN SOIL

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Potassium (K) is the third important plant nutrient after N and P and is a fundamental macronutrient for plant growth (Parmar *et al.*,2013). In soil, K is the most abundant macronutrient and is the 7$^{th}$ most abundant element in the lithosphere (2.6%) (Etesmi*et al.*, 2017). It can be more easily leached in the soil system, and in Indian soil total, K content varies from 0.5 to 3.0%.

## Suitability for adaptation of Potassium Solubilizing Bacteria (KSB)

- K biofertilizers are compatible with biopesticides and other biofertiliers.
- Self-life of this biofertilizer is stable for 1 year from the date of manufacturing.
- It is suitable for application on cereals, millets, pulses, forage crops, spices, medicinal crops, ornamental crops and all other crops.
- K soluble Bacteria are available in different formulations (powder, liquid).

## Strains of Potassium Solubilizing Bacteria (KSB)

It is known that Potassium Solubilizing Bacteria (KSB) can solubilize K bearing minerals and convert the insoluble K to soluble forms of K available to plant uptake. Many Bacteria such as *Acidothiobacillus ferroxidans*, *Paenibacillus* spp, *Bacillusmucilaginosus*, *B.edaphicus*and *B.circulans* have the capacity to solubilize K minerals (Etesami *et al*., 2017).

## Main Mechanisms of Potassium Solubilizing Bacteria (KSB)

Following are the various processes by which KSB helps in solubilizing K bearing minerals and convert the insoluble K to soluble Forms of K.

- **Acidolysis:** Secretion of various enzymes to solubilise essential nutrients.

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- **Chelation:** Bonding of ions and molecules to metal ions. They are mostly organic compounds.
- **Exchange reactions:** It enhances the dissolution of K ions by providing protons from other cations like $Ca^{2+}$.
- **Complexolysis:** Complex formation organic acids and metal ions such as iron, calcium help to solubilise ion. K solubilisation occurs by complex formation between organic acids and metal ions as $Fe^{2+}$, $Al^{3+}$, $Ca^{2+}$ (Koushalya, 2018).
- **Production of Organic Acid:** Acid like citric acid, malic acid, oxalic acid, ferulic acid, syringic acid produced by KSBs (by organic matter decomposition) enhances the K solubility (Setiawati, *et al*., 2016). The product of decomposed organic matter such as acetate, citrate and oxalate can increase mineral dissolution in soil.

**Isolation of KSB:** Potassium solubilizing microorganisms can be isolated by serial dilution methods using Aleksandrov medium.

## Method of Application

- **Seed Treatment:** Mix 10g of biofertilizer with 10g of crude sugar insufficient water to make a slurry and coat 1 kg o seeds.
- **Seedling Treatment:** Mix 100g of biofertilizer with sufficient quantity of water and organic manure to form a slurry. The seedlings are dipped in this slurry for 30 minutes prior to planting get attached to the roots.
- **Soil Application:** Mix 3-5 kg/acre of K biofertilizer with compost and apply to an acre of soil.
- **Drip Irrigation:** Mix 3 kg/ acre of K biofertilizer in drip stream.

## Advantages of Potassium Solubilizing Bacteria (KSB)

- Effectively mobilize unavailable potassium ions and make it available to the plants.
- Natural potassium solubilization improves both plant and soil health and also aids in soil remediation.
- The increase in the beneficial microbe population in soil improves soil health.
- Eco friendly.

## Limitations of Potassium Solubilizing Bacteria (KSB)

- Not easily available in the market and lack of awareness in farmers.

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- Prone to contamination with other chemical fertilizers and pesticides.
- Surplus products may be disposed of in croplands.
- Smoke inhale during application can be harmful.
- Direct incidence may cause irritation, and therefore it is recommended that the operator should use protective gear (gloves, apron, mask, eye mask).

## Conclusion

Using KSBs enhance the use efficiency of K and also mitigate the application of chemical K fertilizers as India is the importer of the potassic fertilizers. It is safe to use along with other biofertilizers. It is an effective component in IPM and INM programs.

## References

Etesami, H., Emami, S.,&Aikhani, H. A. (2017). Potassium solubilizing Bacteria (KSB): Mechanisms, promotion of plant growth and future prospects- A review. *Journal of Soil Science and Plant Nutrition*, 17(4),897-911.

Parmar, P.,&Sindhu, S.S.(2013). Potassium Solubilization by rhizosphere bacteria: influence of nutritional and environmental conditions. *Journal of Microbiology Research*, 3(1), 25-31.

Setiawati, T. C.,&Mutmainnah, L. (2016). Solubilization of Potassium containing mineral by microorganisms from sugarcane rhizosphere. *Agriculture and Agricultural Science Procedia*, 9, 108-117.

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# COVID 19: AGRICULTURE FIGHTS BATTLE

Article Id: AL202095

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The COVID-19 horror is blowing dark waves across the globe; its effect has wreaked havoc in our nation's everyday life. All sectors are struggling to stand their ground, the community of agriculture to confronts the jeopardy. The agrarian pillar is the backbone of the Indian economy which contributes 17.3% to our country's GDP, provides bread and butter to more than 60% of the rural population, and also helps in the growth of manufacturing and industrial infrastructures. India owns the status as one of the top producers, consumers and exporters in the world agriculture. Numerous products seal a top place in the list of export, trading, and commercial activities that supply significant revenue to the government. The COVID-19 impact on agriculture is as serious as feared to be highly tangled and diversified. Even among the different segments, its effect varies widely in various regions, among producers, and agricultural wage labourers. Being the second most populated country with 1.37 billion population, the sector possesses the herculean task to feed the booming population. The agriculture world has always been challenged by vagaries of monsoon, farmer's suicide, and now this pandemic is adding fuel to the fire. This disrupted hit arises a question will the yield convert into foods and serve our stomach, despite bumper production and high market demand the plight of farmers hangs in the balance.

## Multiple constraints amid COVID 19

The major operational activities in agriculture are labour inducive, which is presently challenged by a shortage of available workers and labourers. The Kharif season preparations which are commencing will face the heat equally, as the absence of sufficient labours will distort crop transplanting. The emerging issue has thrown a tough war to workers working in risk-prone areas, with more exposure to health hazards, coupled with a lack of awareness, information and improper social connectivity. India is the abode for more than 75% marginal and small where poverty and destitution are in a state of exponential rise, which wrecks the smooth functioning of the sector and arises a big question on food supply and food security in

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the present hour. The biggest issue is constraints in transportation, on the other hand, workers connected in horticulture & floriculture trade are bearing heavy losses as their products are facing hurdles to reach mandis, with fewer or no buyers to buy. Nearly one in nine people in the world are going hungry, with the coronavirus pandemic exacerbating already worsening trends this year, according to a United Nations report. The lockdown has led to abolish and return of many migrant workers home leaving harvest operations incomplete. Losses to farmers are beyond measures; their earning and feeding are at a sluggish pace. Buyers are not available to buy products; restriction in shipping facilities is making things difficult. The Food and Agriculture Organisation (FAO) warns world "food crisis" if countries do not protect vulnerable people from hunger and malnourishment, and de-clog food supply chains. The graph of nations economy was sinking much prior this pandemic, though the situation is worse now the farming sector will grow by 3 per cent this year despite adverse conditions and it would add at least 0.5 percent to India's GDP growth in 2020-21 as per reports which is a ray of hope in the dark hours. Niti Aayog member Ramesh Chand has pointed to this silver lining in the dark clouds hovering over the Indian economy. In reports, Chand has been quoted as saying, "The farm sector will grow by 3 percent this year despite adverse conditions and it would add at least 0.5 percent to India's GDP growth in 2020-21". This 0.5 percent additional contribution by agriculture may prevent the Indian economy from contracting this fiscal.

## Conclusion

Relaxations for the farming sector in agriculture, special bonus above minimum support price, disburse of funds, food, relief packages, and financial assistance will beat the blazing heat in this critical time aiding the situation to revive back to a normal state. Safe travel and trade corridors should be designed to evade interference's to food supply chains, alongside market chain incentives, guarantees and reassuring messages for all market-chain actors (FAO, 2016). Coordinated policy responses are needed to support agribusiness and the livelihoods and working conditions of millions of agricultural workers in line with relevant international labour standards. Meanwhile, undertaking proper precautions and adopting awareness this crisis has to be converted into an opportunity, we can fight the pandemic ensuring that food gets transferred from the field to kitchen catering the requirement of fellow citizens to have the nutritious food they need. The administration must bridge gaps by facilitating farmers with urban consumers, paying more attention to digital marketing and e-

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NAM. Social distancing induced multiple restraints won't bring a smile in the agriculture arena if such a situation continues for a long run. In need of the hour, the enlisted and enforced management practices by the government are playing a decisive role to ensure that each indispensable piece of information of COVID-19 is disseminated well to the right place at the right time. Safety and Health in Agriculture Convention organization implemented protocols may curb the threat by preventing occupational contamination, the spread of diseases and improve the working farming ambience in continuation. These measures will enable the robust agriculture sector from staring at a dark and bleak future. In this crisis, agriculture could be in the driver's seat for reviving our economy. A universal truth states "the world can stop but agriculture cannot".

## References

International labour organization ILO Sectoral Brief: COVID-19 and the impact on agriculture and food security.

FAO. 2016. Impact of the Ebola virus disease outbreak on market chains and trade of agricultural products in West Africa [online]. Dakar.

World hunger worsening amid coronavirus pandemic; nearly 690 million people hungry: UN report, 2020, Hindustan Times.

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# REMOTE SENSING AND ITS IMPORTANT ROLE IN HORTICULTURE

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As we all know, Horticulture plays an important role in our day-to-day life, which includes crops like fruits, vegetables, medicinal plant, aromatic plants, spices and plantation crops, which leads to us, to our morning tea to clothes and includes all our meals. Due to increasing population and increasing demand, we need more food to feed our population. But due to deficiency of moisture, nutrients or less labour, we are unable to get an excess to these products, which all lead to the more retail price, which a lower-middle-class family cannot afford. So to meet the demand of the population, High-tech farming is a prominent solution. Remote Sensing with other advanced techniques such as Global Positioning System(GPS) and Geographical Information System (GIS). These techniques are playing a major role in the assessment and management of horticultural activities. Accomplished planning along with the advanced technologies for the crops need the application of agricultural meteorology. Agricultural weather and climate data system are essential to accelerate the generation of products, analyses and forecasts that act on horticultural cropping ad management verdict, irrigation scheduling, commodity trading and marketing (Saxena, *et al.*,2017).

## Remote Sensing

It is a process of obtaining information and monitoring about an object, area, and the environment through the analysis of data acquired by a device without being in physical contact or direct touch.

It involves the collecting and storing of spatial data of the environment without physical contact with the object by using EMW (Electromagnetic waves).

- The ability to collect information over large spatial areas.
- The record is unprejudiced one which is stored permanently.

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- It allows for the collection of data over a variety of scales and resolutions,
- It can be used for crop identification, crop area, biomass and yield estimation.

## Geographic Information System (GIS)

It is defined as a powerful set of computerbased tools for collecting, storing, retrieving, transforming, and displaying spatial data from the real world for the particular set of purpose or information.

It involves data gathering, data collecting, data processing, data modelling and visualization in a digital environment.

- Crop mapping and yield estimation.
- Erosion identification and remediation.

## Global Positioning System (GPS)

GPS is a network of satellites, they continuously transmit coded information, which makes it possible precisely identify location on earth by measuring distancing from a satellite.

Determination of position by satellite in digital form.

- Relatively low-cost system, with no user charges.
- Available to users anywhere on the globe.

## Types of Remote Sensing

1. **Active Remote Sensing:** Active Remote Sensing has its own source of energy for illumination. It emits energy in order to scan objects and areas to collect the data.

2. **Passive Remote Sensing:** Passive Remote Sensing has to depend on other sources of energy like Sun, to detect the naturally reflected or emitted EMR (Electromagnetic radiation). When the sun shines, Passive sensor measure this energy and then tend to collect information.

## Applications of Remote Sensing in Horticulture

The first event of using remote sensing technique in India was documented during coconut wilting in 1970.

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**1. Crop Classification:**

The multispectral image of Remote sensing system plays an important role to determine the difference between different horticulture crops (like grasses, herbs, shrubs, trees and climbers) or whether it is a flourishing plant or an infected unhealthy plant/weed (Dakshinamurti *et al*., 1971).

**2. Crop Insurance:**

Due to excess pollution and global warming, we never know how and when the climate will show its destructive effect. But now we can know prior, about weather conditions and take safety measures accordingly with the help of remote sensing.

**3. Crop Area Estimation:**

It helps to get the estimation of a particular crop cultivated in an area to support crop forecasting system at a regional level. Horticultural crops usually face fluctuation both in its production and consumption (Nageswara Rao, *et al.*2004). That's why genuine statistics concerning the area and production of horticulture crops is necessary for market planning and its export.

**4. Yield Monitoring System:**

Remote sensing is an important tool to estimate the yield of all seasonal and non-seasonal crops annually. It also helps us to know that production is enough to meet the needs and demands of the population.

**5. Detecting Pest and Disease:**

Pest and Disease both responsible for the damage of crops and hence, affects the economic importance of horticulture crops. It has been demonstrated that remote sensing helps to identify the pest and disease and its damage stage (Usha *et al*., 2013).

**6. Monitoring Abiotic Stress:**

Remote sensing also helps to detect abiotic stresses like drought, flooding, salinity, temperature fluctuations etc. with its feature of hyperspectral and multispectral imaging.

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**7. Soil Moisture:**

Due to the advanced technology of Multispectral Photography and FTIR Spectroscopy, we are also able to detect the amount of moisture content present in a soil and water table.

**8. Crop Stands:**

Remote sensing helps in the identification and establishment of good crop stand to get maximum and uniform seedling and production.

**9. Crop Canopy Measurement:**

Remote sensing also makes us easy to measure and maintain the canopy of a crop. So that we can apply an accurate amount of fertilizer, pesticide and any other chemical.

**10. Soil Property Sensing:**

To know the qualities and deficiencies of soil moisture, soil nutrients soil texture and soil structure.

## Conclusion

Remote sensing and other geo-informatics technologies are an advanced technique used for precision and high-tech farming these days. It helps to know the accurate condition of a crop and with what all stresses our crops are going through. Remote sensing plays an important role in the forecasting and predicting of drought, flood or any other natural calamities and also includes biotic stress like disease and pest. And how and when fertilizers and pesticides should be applied and at what ratio and amount should be applied to control and manage the situation. Remote sensing has solved most or our problems like collecting data, storing and analyzing etc. It also makes us easy to maintain a record and form a statistical report of all-season crops.

## References

Dakshinamurti, C., Krishnamurthy, B., Summanwar, A. S., Shanta, P. and Pisharoty, P. R. (1971). Remote sensing for coconut wilt. *Proceedings of International Symposium on Remote Sensing of Environment*, vol (1), Ann Arbor, MI: 25-29.

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Nageswara Rao, P. P., Ravishankar, H. M. and Uday Raj, K. N. (2004). Production estimation of horticultural crops using IRS–1d liss–iii data. *J. Indian Soc. Remote Sens*., 32: 393-398.

Saxena, M., Rathore, R.P.S., Gupta, R.P., Bhargav, H. and Thakur, B. (2017). Horticultural Statistics at a Glance. Horticulture Statistics Division Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India (9), 39.

Usha, K. and Singh, B. (2013). Potential applications of remote sensing in horticulture- A review. *Scientia Horticulturae*, 153: 71-83.

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# MARKER-AIDED QTL BREEDING FOR ENHANCEMENT OF SUBMERGENCE STRESS TOLERANCE IN RICE

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Rice (*Oryza sativa* L.) is one of the principal cereal crops growing throughout the world. The global population is expected to reach nearly nine billion by 2050, and therefore about 160 million tons of rice is thought to be produced annually to meet out nutrition as well as food security of this growing population. The changing nature of the climate in this scenario is becoming a serious threat upon sustainable agricultural productivity and creates high yield gap. Although rice (Self-pollinated annual; 2n = 24) is known as a water-loving cereal and can tolerate prolonged submergence up to 8-9 days,severe floods in the major rice growing continents in India damage approximately 12-14 Mha (30%) of rice growing areas leading to loss of average productivity ranges from 0.5-0.8 t $ha^{-1}$ (Muthu et al.2020).

Majority of the rice varieties are susceptible to submergence. Genetic improvement for submergence tolerance through conventional breeding approaches has limited success report due to the complex nature of trait and barriers associated with phenotyping of the trait. Recent advancement in genetics and genotyping techniques facilitates the identification of major quantitative trait loci (QTLs) associated with submergence tolerance *Sub1*. Three related ethylene response factor (ERF) like genes have been identified fromFR13A on the short arm of chromosome 9, i.e. *Sub1A, Sub1B and Sub1C* (Xu and Mackill 1996). Of them, *Sub1A* and *Sub1C* are generally up-regulated by submergence and ethylene. Deployment of the target QTLs through molecular techniques has opened the way for the development of submergence-tolerant popular rice varieties like Swarna and CO 43 by marker-assisted back cross-breeding (MABB).

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## Marker Assisted Backcross Breeding (MABB)

In the present era of scientific development, use of molecular markers in crop improvement programs speed-up the genotyping process as well as precise introgression of novel genes from potential landraces to commercial cultivars by shortening the breeding cycle (Oladosu *et al.*2020).MABB for submergence tolerance is generally based upon three tiers, namely foreground, recombinant and background selection. Foreground selection deals with the selection of the desirable genes, closely linked with *Sub1*, whereas, recombinant selection involves the use of closely associated flanking markers to reduce the donor genomic region carrying the *Sub1*. Background selection describes the utility of molecular markers in accelerating the recovery of the recurrent parent genome (Oladosu *et al.*.2020). Successful introgression of the *Sub1* region of FR13A through marker-assisted backcrossing has been well-documented for the betterment of submergence tolerance in mega-varieties.

## QTL *Sub1*: from landrace to improved cultivar

The FR13A lowland rice variety is much popular among the common landraces tolerant to flesh flooding; but its direct utilization as donor parent is quite limited due to many poor agronomic traits (i.e. short thick grains, long awn, photo-sensitivity and low productivity). It is important to cross landraces (donor parent) with elite cultivars for development of submergence tolerant varieties. The molecular basis of submergence tolerance in rice imparts keen attention to the breeders in introgression of *Sub1* QTL from landrace to improved cultivars for reducing yield losses under submerged milieu (Oladosu et al.2020). The gene *Sub1*has been found responsible for the complete submergence tolerance up to 10-18 days. Marker-assisted backcrossing is mostly preferable in introgression of genomic region carrying *Sub1* into high-yielding varieties, such as BR 11, CR1009, Thadokkam 1 (TDK1), IR64, CO 43, Samba Mahsuri and Swarna (Septiningsih et al.2009).

## General workflow for QTL *Sub1* introgression in Swarna through MABB

Development of improved cultivars showing submergence tolerance involves several steps. First of all, $F_1$ generation is raised by crossing Swarna (recurrent parent) with IR49830-7 (donor parent derived line of FR13A) followed by repeated backcrossing with Swarna to obtain a large $BC_1F_1$ population. From the $BC_1F_1$ generation, individual plants exhibiting heterozygosity at *Sub1* locus to reduce population size for further screening (foreground

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selection). Now from the individual plants having heterozygosity for *Sub1*, selection of lines having homozygosity for the recipient allele at another marker locus distally flanking the *Sub1* locus by RM219 marker (recombinant selection).

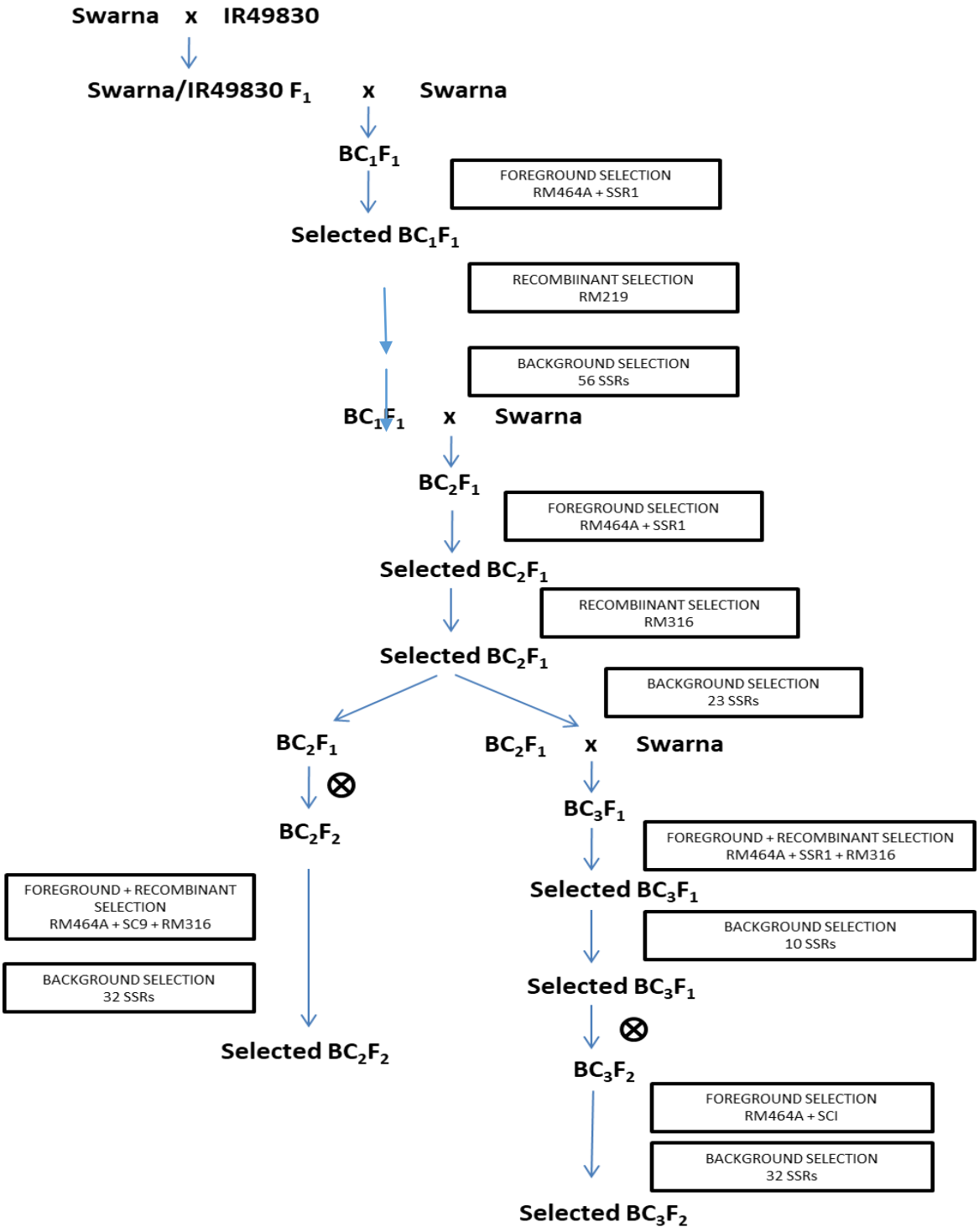


**Figure 1** Development of the submergence-tolerant Swarna-Sub1 through MABB

Source: Neeraja *et al.*2007

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Individuals with very few numbers of markers in the recombinants from the donor genome have critically opted (background selection). In the second backcross generation, the same strategy is followed for isolation of individual plants with desirable allele combination at target loci. Recombinantsof*Sub1* and the nearest proximal marker locus (RM316) with suitable genomic composition at the non-target loci are crossed with recipient parent to develop the next generation in figure 1 (Neeraja *et al.*2007).

The ultimately developed $BC_2F_2$ generation having submergence tolerance with Swarna type alleles and the isolated $BC_3F_3$ recombinants show homozygosity for all Swarna type alleles.

## Conclusion

The survival mechanism of rice under submerged conditions consists of internal aeration and growth controls (escape strategy). Identification of *Sub1* gene and successful introgression into mega-varieties through MABB has encouraged rapid development and release of new versions of submergence tolerance, maintaining all the desirable traits of the recurrent parent. But the effectiveness of marker-assisted backcrossing depend on the availability of closely linked markers and flanking markers for the target locus, population size, number of backcrosses and position of the markers for background selection. There is a scope to increase rice yield in marginal growing regions, by generating new genotypes with new QTLs for complete submergence tolerance and other environmental stresses altogether.

## References

Muthu V, Abbai R, Nallathambi J, Rahman H, Ramasamy S, Kambale R, Thulasinathan T, Ayyenar B and Muthurajan R. (2020). Pyramiding QTLs controlling tolerance against drought, salinity, and submergence in rice through marker assisted breeding.*PLoS ONE* 15: e0227421.

Neeraja CN, Rodriguez RM, Pamplona A, Heuer S, Collard BCY, Septiningsih EM, Vergara G, Sanchez D, Xu K, Ismail AM and Mackill DJ. (2007). A marker assisted backcrossing approach for development submergence-tolerant rice cultivars.*Theoretical and Applied Genetics* 115: 767-776.

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Oladosu Y, Raffi MY, Arolu F, Chukwa SC, Muhammmad I, Kareem I, Salisu MA and Arolu IW. (2020). Submergence tolerance in rice:review of mechanism, breeding and future prospects. *Sustainability* 12: 1632-1648.

Septiningsih EM, Pamplona AM, Sanchez DL, Neeraja CN, Vergara GV, Heuer S, Ismail AM and Mackill DJ. (2009). Development of submergence tolerant rice cultivars: The Sub1 locus and beyond. *Annals of Botany* 103: 151-160.

Xu K and Mackill DJ. (1996). A major locus for submergence tolerance mapped on rice chromosome 9. *Molecular Breeding* 2:219-224.

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# BACTERIOPHAGE - A POTENTIAL BIO-CONTROL AGENT

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Most of the plant pathogens are of fungal origin, even though bacterial plant pathogens are in minimum numbers, are responsible for severe economic losses in agriculture. Controlling of such bacterial diseases is generally challenging due to lack of efficient bactericides, increased pathogen variability, increasing population of the pathogen under favourable conditions, high transformation rates resulting in pesticide resistance development, high mutation rates also led to bacteria overcoming plant genetic resistance.

## Need for 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 the 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 within 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.

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## Bacteriophage for disease control

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 the 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*. Thereafter 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* |

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## Advantage of Phage therapy

- **Less chance for host to regain viability**: Once infected by an obligatory lytic phage, bacteria will not regain their viability.
- **Self-sustenance**: Phages are self- sustainable, self- replicating and self- limiting. Bacteriophage lives and replicate as long as the host bacterium is present in the environment and degrade quickly in the absence of its host.
- **Host specificity**: Phages are host specific and do not harm other beneficial bacteria or eukaryotes.
- **Less chance for inducing resistance**: Phage resistance occurs in small population size as they have a very narrow host range. Mutations of the bacteria leading to resistance to the phages frequently result in loosing of virulence.

## Challenges in Phage therapy

- **Narrow host range:** phages host range is very narrow. Cannot infect different pathogenic bacterial species or even races
- **Skill needs for production:** Continuous study and improvisation of the phage formulations are needed from time to time.
- **Horizontal gene transfer:** The temperate phages can induce susceptible bacteria to a virulent one by horizontal gene transfer (HGT).
- **Environmental dependency**: Highly depend on the environmental condition for infection and proliferation

## Conclusion

Continuous studies on improvisation of phage therapy, phage formulation development, method of application and managing a favorable environmental condition for phage activity may result in commercialization of phage therapy for controlling bacterial plant diseases in the near future.

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## References

Barua P. and Nath P D., (2018). Bacteriophages: A Potential Next Generation Biocontrol Tool for Plant Disease Management. *International Journal of Current Microbiology and Applied Sciences* . 7(09).

Balogh B., Jones J B., Iriarte F B. and Momol M T., (2010). Phage Therapy for Plant Disease Control. *Current Pharmaceutical Biotechnology*. 11: 48-57.

Jones J B., Vallad G E., Iriarte F B., Obradović A., Wernsing M H., Jackson L E., Balogh B., Hong J C. and Momol M T.,(2012). Considerations for using bacteriophages for plant disease control. *Bacteriophage*. 2(4): 208–214.

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# GENETIC ENGINEERING IS A DRIVING FORCE FOR MODERN AGRICULTURE

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Food insecurity and malnutrition are at the very moment among the most grievous matter of interest for human health, resulting in loss of innumerable lives in developing countries. To be strong and healthy, our regular diet chart must comprise bountiful high-quality foods with most of the essential nutrients, along with the nourishment that provides several health benefits beyond basic nutrition. Even sustaining the quantity of food per capita that we have access at present will be a mounting task in the distant future due to the continuing detrimental situation of arable lands and the prevalence of unfavourable environmental situations consisting drought, salinity, floods, diseases etc. In order to ensure food security for future generations, the world must produce 50% to 100% more food than today in spite of the predicted adverse environmental conditions. Notwithstanding, the traditional plant breeding programme alone can no longer maintain the ever-increasing global food requirements. Therefore, it is the high time to promote sustainable agricultural practices for boosting crop productivity along with the utmost preservation of available natural resources.

Agricultural biotechnology is being accepted as a powerful complement to conventional methods for meeting worldwide demand for quality food and with the help of modern plant biotechnological tools; nowadays we have access to massive gene pools that can be exploited to impart desirable traits in economically important crops. Subsequently, the introduction of genetic engineering involving the transfer of genes from different types of organisms into crops and livestock through hybridization, conjugation and transformation; conveyance of new genes from wild species into cultivated varieties of similar crops to attain desired traits or the substitution of diverse genes into agricultural species, possesses a more productive future and has long been regarded as an auspicious method to guarantee the continued productivity of agriculture and forestry (Beringer *et al.*, 1992) as well as maybe a means to utilize the undiscovered resources of biodiversity in the service of social and

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economic development. With deliberate design and a better apprehension of transgenic organisms, negligible ecological and social disturbances will appear with the development of genetically engineered organisms. Certain distinct property such as disease resistance, stress tolerance and improved nutritional qualities are quite advantageous to the farmers in view of a lot of time is spent on cultivation rather than considering outside interferences. Genetic engineering is expeditiously substituting the conventional plant breeding programs and has become the mainstay of agricultural crop improvement which might facilitate to circumvent the expensive and input-intensive crop production and also convert the traditional agricultural system into low input sustainable practices (Odum, 1989).

## What Is Genetic Engineering?

The entire living community is consisted of cells and strings of DNA molecules retaining the instructions for making genes and forming an exceptional blueprint that determines the growth, development, looks and survival of an organism are present in those cells. Genetic engineering is defined as the straight forward administration of the genetic material/genome by means of manmade interventions to modify the hereditary characteristics of a cell or an organism that comprises the conveyance of definite traits/genes from one to another living cell, involving diversified species and the altered organism through genetic engineering is known as a genetically modified organism or GMO. The application of this widely accepted technology in the agricultural sector is quite different from the conventional cross-breeding methodologies, which have been utilized for a millennium. GMOs generally refer to the gene transfer among various live organisms by using a sequence of laboratory-based techniques for the purpose of duplicating genes; splicing DNA segments altogether as well as for insertion of genes into the cells and conjointly, these mechanisms are termed as recombinant DNA technology. Certain other terminologies are also customarily applied for the GMOs which include genetically engineered, bio-engineered, transgenic etc.

## What are potential GM crops of the future?

Some potential applications of GM crop technology are:

- **Nutritional superiority**: The GM crops are highly nutritious enriched with protein, vitamins, minerals, healthy fatty acids and so on

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- **Stress tolerance**: Those crops are very much tolerant to high and low temperatures, salinity, drought and other adverse conditions

- **Disease resistance**: Genetic Engineering imparts resistance power to the crops/plants to various dreadful diseases or insect pest

- **Biofuels**: The GM crops possessing modified cell constitution are highly efficacious for conversion to ethanol

- **Phytoremediation**: GM plants are also utilized for Phytoremediation by extracting and concentrating contaminants such as harmful heavy metals from the polluted places

## Risks and benefits

Although genetic engineering can improve the control of insect pests, plant pathogens, and weeds, there are certain risks associated with it that are given as follows:

1. The gene for Bt toxin collected from the bacterium *Bacillus thuringiensis*, has been introduced into more than 50 crop species (Beegle and Yamamoto, 1992) and the plants expressing this gene demonstrate effective control of pests such as caterpillars and beetles, besides, the engineered Bt has been approved for use as a conventional insecticide.
2. Few viruses can also be genetically modified for imparting accelerated pathogenicity in order to control insect pests that have negligible persistence in the environment.
3. Employing genetic engineering to increase host plant resistance to pathogenic fungi is another promising goal. Some genes derived from plant RNA viruses confer virus resistance in transgenic crop plants.
4. Weeds possess a major problem in agriculture, and both herbicides and several non-chemical technologies are used to control them. The use of herbicide-resistant crops makes it possible to use the heavy doses of herbicides without damaging the crop. The crops are tolerant to herbicidal chemicals such as Glyphosate, Phosphinothricin, Sulfonylurea, Bromoxynil, and 2,4-D. However, actually, the use of herbicide-resistant crops is likely to increase herbicide use as well as production costs.

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5. It is likely to cause serious environmental hazards, and also the herbicide-resistant crops have been reported to be toxic to some non-target species like beneficial polyphagous predators in soil, such as spiders, predatory mites, carabid and coccinellid beetles, along with detritivores like earthworms and woodlice as well as to aquatic organisms, including fish.
6. These organisms bear alien genes circulating in wild relatives; some concern has been expressed about genetically engineered plants upsetting not only the agro-ecosystem but also other ecosystems.
7. The most serious risks of transgenic crops include simplifying crop systems and promoting genetic erosion, the potential transfer of genes from pesticide-resistant crops to wild vegetation, the generation of new virulent strains of viruses, insect resistance to Bt toxin and the destruction of natural relationships in the ecosystem.
8. If the release of transgenic crops continues, "superweeds" will eventually control the main population of wild and domestic plants, reducing biodiversity. The crops tolerant to diseases can also affect the ecosystem.
9. Although inserting a new gene into an existing genome can be regarded as increasing biodiversity, older plants might not be superior to newly introduced genetically modified organisms. If natural selection prefers transgenic plants, then the natural flora and fauna may be desperately lost.
10. Biotechnology is a key target for solving food production problems in developing countries. Resource-poor farmers are able to use biotechnology in genetic engineering to produce products of low cost and high efficiency against insects, weeds, and diseases. Because of the availability of the products extracted through the means of transferred genes in the market of underdeveloped or developing countries, world hunger and malnutrition can come to the proximity of an end due to less expensive and more adequacy of the crops.
11. Economic concerns are few to none in consideration of genetic engineering in agriculture. Since herbicide and insecticide-resistant crops reduce the number of herbicides, pesticides and other chemicals used, farmers will be spending less money on them that may create a greater profit for the farmer. Food production will be exceedingly amplified because GM food can be produced at a faster rate than normal harvests which determines that food industries can produce more superior quality food with sufficient quantity in the market places.

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## Conclusions

The technical knowledge of genetic engineering holds a phenomenal commitment for improving agricultural productivity and keeping it environmentally or ecologically safe and sound with immanent advantages including higher productivity of crops and livestock, accelerated pest control and declined pesticide usage, reduced fertilizer application because of enhanced biological nitrogen fixation, and improved conservation of soil and water resources. GM strategies are being employed for having the potential to address various constraints regarding agriculture and society that include minimization of yield losses due to various stresses *viz.* biotic and abiotic and are being used extensively for value addition in food crops by enrichment with quality proteins, vitamins, iron, zinc, carotenoids, anthocyanins and many others in addition to the enhancement of shelf life of fruits and vegetables so as to reduce the post-harvest losses of perishable crops significantly. In essence, the release and regulation of genetically engineered organisms into the environment should be similar to the discharge and adjustment of exotic plant and animal species into an unfamiliar environment. Therefore, time and effort must be devoted to laboratory and field testing before releasing these types of organisms. Deprived of circumspection and appropriate regulation, ecological constraints feasibly emanate, and the anticipated advantages of genetic engineering technology are presumably to be imperilled. Consequently, it can be concluded that sustainable integration of conventional agricultural practices with modern biotechnology can enable the achievement of food security for present and future generations. Nevertheless, it is very much essential that the performance of a GM crop should be attentively scrutinized for numerous generations under field levels and gone through rigorous bio-safety assessments on a case-by-case basis, before being released for commercial cultivation. GM crops are going to be a mandatory part of our lives, and the enormous potential of biotechnology must be exploited to the benefit of humankind.

## References

Beegle, C. C. and Yamamoto, T. (1992). Invitation paper (e. P. Alexander Fund): History of Bacillus thuringiensis Berliner research and development. *Canadian Entomologist*, 124, 587-612.

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Online ISSN: 2582-368X
www.agriallis.com

Beringer, J. E., Bale, M. J., Hayes, P. K. and Lazarus, C. M. (1992). Assessing and monitoring the risks of releasing genetically manipulated plants. *Proceedings of the Royal Society of Edinburgh*, 99(3/4), 134-140.

Odum, E. P. (1989). Ecology and our endangered life support system. Sunderland (MA): Sinauer.

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# LODGING IN WHEAT: ITS CAUSES, ILL EFFECTS AND MANAGEMENT FOR HIGHER PRODUCTIVITY AND PROFITABILITY

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Lodging in wheat is the displacement of stems permanently from their perpendicular position through creation of an angle from the vertical as a result of wind-induced buckling or breakage in stems or roots or both. Lodging causes a drastic reduction in grain yield and quality of wheat, which ultimately leads to lower profitability. Wheat lodging can occur at any time from the booting stage to harvesting stage (*i.e.*, period of 60 days). After lodging, stems of wheat plants create different angles with its base and sometimes stems laid down horizontally on the ground. Tall cultivars, early sowing, excess use of fertilizers and irrigation water for extracting higher yield are some of the main reasons of wheat lodging. Use of lodging resistant cultivars, optimum use of fertilizers and irrigation water, delayed sowing and foliar application of plant growth regulators at certain doses are some important agronomic practices for lodging management.

Cereals are the staple food of the world's population. Wheat (*Triticum aestivum* L.) is one of the leading cereals. India's share in global wheat production was 15.36% in the year 2017-18. In India, wheat is the second most important staple foodgrain after paddy. India took the 2$^{nd}$ top position after China in wheat production during 2017-18 and wheat consumption is oscillating around 50-60 kg per capita per year in our country. Indo-Gangetic plains region (IGPR) extends from the arid and semi-arid zones in Rajasthan and Punjab to the humid and per-humid deltaic plains in West Bengal over a length of about 1600 km and a width of 320 km. Rice-wheat system is the major cropping system in the IGPR covering an area of around 10.5 mha. Lodging affects wheat production seriously. In wheat, lodging occurs more near harvestable maturity. Lodging can reduce grain yield of wheat up to 80% (Piñera-Chavez *et al.*, 2016). In India, the range of grain yield loss in wheat is 12-66% due to lodging (Rajkumara, 2008).

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## Causes of Lodging in Wheat

Early sowing results in high vegetative growth due to long winter spell and ultimately bending of stems at the internodes occurs due to wind gusts. Nitrogen fertility increasing beyond a certain limit enhance the vegetative growth the crop vigorously and resulted in bending of the stems and ultimately decreased the yield attributes and grain yield. Tall varieties of wheat (≥120 cm) are highly susceptible to lodging. Due to wind pressure or high soil moisture, tall plants lodged easily. Heavy irrigation or adverse weather condition (e.g. rainfall, strong winds and hail) at dough stage of wheat also causes lodging. Intensive tillage operation for land preparation and weed management pulverizes the soil, breaks the soil structure and creates a hardpan below the surface soil. Root growth of wheat plants is affected due to this hardpan, and root anchorage of the plants also reduces due to loose soil. This increases root lodging tendency of wheat plants.

## Mechanisms of Wheat Lodging

The nature and extent of lodging are closely related to culm characteristics. There are 2 types of failure mechanism, (i) stem lodging: it occurred when the bending moment of a shoot (shoot leverage) exceeds the failure moment of the stem base (stem strength) and (ii) root lodging: it occurred when the bending moment of a plant (plant leverage) exceeds its anchorage failure moment (anchorage strength). In stem lodging, roots are held firmly in a strong soil where the wind force buckles one of the lower internodes of the shoot. Root lodging is associated with rainfall that weakens plant anchorage combined with the wind-induced force acting on the plant. When lodging happened from the buckling of the stem just below the spike, it is known as necking.

## Angle of Wheat Lodging

No lodging occurs when the angle of lodging is 0° from the vertical. Smaller yield losses have been observed when the angle of lodging is ≤30° from the vertical. Lodging at 45° angle shows one quarter to one half of the grain yield loss incurred from lodging at 80° angle in wheat.

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## Deleterious Effect of Lodging in Wheat

In wheat, lodging increases the chance of pest and disease susceptibility and induces negative impact on crop development. Lodging may limit grain yield improvement by 2 ways: a) directly by reducing photosynthetic capacity due to changes in canopy architecture and b) indirectly by improper partitioning of dry matter into the support structures. Lodging also increases the risk of grain sprouting in spike due to the moist environment and reduces Hagberg falling number (HFN), which is a parameter to measure bread-making quality. HFN of at least 250 s is required to produce good quality bread. Wheat lodging induced during early grain filling reduced grain quality by reducing the HFN from 289 s to 114 s, test weight from 42.2 g to 37.2 g and specific grain weight from 70.3 kg $Hl^{-1}$ to 65.8 kg $Hl^{-1}$ (Weibel and Pendleton, 1964). Lodging after early grain filling stage caused a smaller effect on the grain quality of wheat.

## Critical Growth Stages for Lodging

The effect of lodging on yield losses depends on the growth stages of wheat. A crop that lodges early (*i.e.*, at tillering and jointing) recovers through the development of 'elbow joints' at the lower stem nodes. The cells on the lower side of the node elongate and force the stem to erect. At booting stage, the stem cells mature and are no longer capable of elongation to enable plant recovery. Wheat plants can lodge at any time from booting to harvest (*i.e.*, period of 60 days). The highest lodging-induced reduction in grain yield occurs when wheat is lodged flat (90° angle from vertical) at flowering or early grain filling. Yield reduction in wheat from this type of lodging is up to 80%. Fischer and Stapper (1987) reported that grain yield of wheat was decreased in the range of 7-35% when lodging occurred within the first 20 days after flowering. The lodging score at harvest may be wholly due to a single, late lodging event immediately before harvest and not reflect on the development of lodging through the season. Lodging occurred at the end of the crop cycle imposed lower effect on grain yield than lodging at other growth stages but the yield significantly reduced in case of lodging-prone wheat cultivars.

## Measurement of Lodging

Among the several indicators, lodging score and lodging index are frequently used to measure lodging. Lodging score was calculated by the formula of Fischer and Stapper (1987).

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$$\text{Lodging score} = \frac{(\%\ \text{plot area lodged} \times \text{angle of lodging from the vertical})}{90}$$

where, % plot area lodged = (lodged area/net plot area) × 100; 0° angle from vertical = Main stem standing upright; 90° angle from vertical = Main stem laid down horizontally

The formula of lodging index was given by Wiersma *et al.*(1986). It has been modified.

$$\text{Lodging index} = \frac{\%\ \text{plot area lodged} \times \text{degree of lodging}}{100}$$

where, % plot area lodged = (lodged area/net plot area) × 100; degree of lodging 0 = Main stem standing upright; degree of lodging 100 = Main stem laid down horizontally

The loss of potential yield due to lodging can be calculated by the equation developed by Stapper and Fischer (1990). They showed that approximately 0.5% of potential yield is lost for each % area of wheat lodged averaged over each day of the grain filling period.

$$\text{Yield loss of wheat} = 0.000125\alpha \sum_{T=10}^{50} \%\ \text{plot area lodged}$$

where, the grain filling period (T) lasts from days 10 to 50 (generally 10 days in India) of the 60 days lodging risk period and the potential grain yield of wheat $\alpha$ is taken as 8 t $ha^{-1}$.

**Table 1:** Lodging scores at different growth stages of timely sown, irrigated wheat at Instructional farm, UBKV, West Bengal (pooled data of 2016-17 and 2017-18)

| **Treatments** | ***Lodging score at flowering stage** | ***Lodging score at dough stage** |
|---|---|---|
| ***Fertilizer application*** | | |
| No fertilizer | 0.00 | 0.00 |
| RDF | 0.77 | 1.10 |
| 150% RDF | 2.25 | 3.54 |
| 150% RDF + 15 t $ha^{-1}$ FYM | 3.69 | 5.81 |
| **S.Em (±)** | **0.343** | **0.495** |
| **CD (P=0.05)** | **2.28** | **2.89** |
| ***Growth regulator spraying*** | | |

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| | | |
|---|---|---|
| Water spray | 3.21 | 4.77 |
| Chlormequat chloride (CCC) @0.2% | 1.15 | 1.77 |
| Tebuconazole @0.1% | 1.90 | 2.44 |
| CCC @0.2% + Tebuconazole @0.1% | 0.46 | 1.48 |
| **S.Em (±)** | **0.208** | **0.344** |
| **CD (P=0.05)** | **1.42** | **2.04** |

RDF: Recommended dose of fertilizer; FYM: Farmyard manure; *Angle of lodging was 45°

## Management of Wheat Lodging

Delayed sowing of wheat enhances lodging resistance. Wheat plant does not get enough time to complete its growth stages properly, which causes dwarfing in a plant. This reduces lodging in wheat but grain yield also reduced to some extent. Optimum rate of nitrogen (N), phosphorus (P) and potassium (K) application instead of higher application rate of N alone enhance lodging resistance through better partitioning of photosynthate in all the support structures. Foliar application plant growth regulators (PGRs) such as chlormequat chloride, ethephon, trinexapac-ethyl and tebuconazole etc. at certain rates twice during 1$^{st}$ node and flag leaf stage controls wheat lodging. PGRs reduce the shoot length of wheat plants which is mainly achieved by reducing cell elongation and the rate of cell division. PGRs control wheat lodging by 2 ways: (i) inhibition of gibberellic acid biosynthesis which reduces plant height and subsequently reduces lodging and (ii) release of ethylene which improves root growth, formation and elongation of root hairs and cluster root formation to control root lodging. Application of the recommended rate of N in 3 or 4 splits instead of a single application as basal increases lodging resistance. Semi-dwarf wheat varieties having a stiffer straw, thicker internodes and smaller above-ground biomass than tall varieties should be used for obtaining higher grain yield due to reduction in lodging. To avoid lodging, many farmers in South Asia forego the last irrigation. This may be crucial for grain filling. Light irrigation can be given at dough stage of wheat if required. Conservation agricultural practices such as zero tillage and maintaining crop residues in the field improve soil structure and root anchorage of the wheat plants, which ultimately reduces the risk of lodging.

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## Conclusion

From the above study, it can be concluded that lodging is a serious threat in wheat cultivation. To overcome this problem, some agronomic management practices should be followed. Among these practices, spraying of PGRs at certain rates twice during the 1st node and flag leaf stage of wheat is gaining popularity in India. Grain yield and quality of wheat can be enhanced through adoption of the above-mentioned lodging management practices which ultimately increases the net return and benefit-cost ratio.

## References

Fisher, R. A. and Stapper, M. (1987). Lodging effects on high-yielding crops of irrigated semi dwarf wheat. *Field Crops Research*, 17, 245-258.

Piñera-Chavez, F. J. P., Berry, P. M., Foulkes, M. J., Jesson, M. A. and Reynolds, M. P. (2016). Avoiding lodging in irrigated spring wheat. I. Stem and root structural requirements. *Field Crops Research*, 196, 325-336.

Rajkumara, S. (2008). Lodging in Cereals - A Review. *Agricultural Reviews*, 29(1), 55-60.

Stapper, M., Fischer, R. A. (1990). Genotype, sowing date and plant spacing influence on high-yielding irrigated wheat in southern new South Wales. II. Growth, yield and nitrogen use. *Australian Journal Agricultural Research*, 41, 1021–1041.

Weibel, R. O., Pendleton, J. W. (1964). Effect of artificial lodging on winter wheat grain yield and quality. *Agronomy Journal*, 56, 487-488.

Wiersma, D. W., Oplinger, E. S. and Guy, S. O. (1986). Environment and cultivar effects on winter wheat response to ethephon plant growth regulator. *Agronomy Journal*, 78, 761-764.

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# PROMOTING THE CULTIVATION OF MEDICINAL AND AROMATIC PLANTS FOR ENHANCEMENT OF RURAL LIVELIHOOD IN INDIA

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India, being an agrarian country and agriculture contributing approximately 16 percent to its GDP, has huge potential in cultivating medicinal and aromatic plants. Since ancient times, Indian culture has been promoting medicinal and aromatic plants for curing several diseases. The Ministry of Environment and Forests has identified and documented over 9500 plants species with several economic importance. Cultivating these plants can serve the purpose of doubling the farmer's income, enhancing rural livelihood and promoting the entrepreneurial behaviour in rural youth. Cultivation of medicinal and aromatic plants will also assure purity, authenticity and sustainable supply of raw materials that are required for herbal drugs. These medicinal and aromatic plants also have huge demand globally, thus promoting global trade. Despite having several opportunities, they also face several challenges like any other groundbreaking concepts. Thus, this article delivers a brief outline of the present scenario, the importance and scope of cultivating medicinal and aromatic plants.

Since ancient times, medicinal and aromatic plants have been used in curing several diseases and with the increasing population and less availability of healthcare systems to the underprivileged sections of the society, these plants are gaining importance widely all across the world. The Tropical Rain Forests are known to be the World's largest pharmacy as 25% of the vegetation is covered with medicinal plants. Similarly, India has been considered as a treasure house of valuable medicinal and aromatic plant species as it is endowed with various agro-ecological regions that are blessed with the precious genetic diversity of these species. The Ministry of Environment and Forests has identified and documented over 9500 plant species which have immense importance in pharmaceutical industries. The total area and

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production of medicinal and aromatic plants in India in 2019-20 have come out to be 6, 28,000 hectares and 7, 98,000 metric tonnes (Anonymous, 2019) respectively. Estimates by the Export-Import Bank of India has put international trade related to medicinal plants at US$ 60 billion per year and still growing at a rate of 7% annually (Maiti, 2004).

In the present scenario of "back to nature" health care, it has become important that these plant species should not only be preserved but also be cultivated to such an extent that it can meet the demand of people as well as the domestic industries to exploit the bright prospect for export. The shift from collection to the cultivation of medicinal and aromatic plants will also assure purity, authenticity and sustainable supply of raw materials that are required for herbal drugs. Due to the unorganized marketing structure, this sector has not been exploited to its full potential. In view of the insufficient recognition to the useful medicinal and aromatic plant wealth of India, the emphasis has to be given on identifying new sources of drugs, enhancing their productivity and yield, promoting their cultivation among the rural sectors of the country and dissemination of information for research and utilization of these plant species.

## International Scenario

The impulsion for initiating action to realize the objective of international recognition and acceptance of indigenous medicine system in the long-run has been provided by the World Health Organization (WHO), the Food and Agricultural Organization (FAO) and the United Nations Industrial Development Organization (UNIDO) which have emphasized that:

- More than 90% of the World's rural population is exclusively dependent on herbalists and traditional medicines for maintaining a reasonable level of health.
- There is an urgent requirement for consolidating and protecting this valuable heritage.
- It should be improved.

## Economic Importance

Traditional medicaments, derived from plants for thousands of years, are now yielding their secrets and gaining importance in modern medicine. About 8000 herbal remedies have been coded in the Ayurveda, which is used as human remedies even now. The curative properties of drugs are due to the complex chemical substances of various compositions

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present as secondary metabolites in one or more parts of the plants. Agronomic practices for growing Poppy, Isabgol, Ghritkumari, Mandukaparni, Brahmi, Guggul, Mulethi, Senna, Cinchona and a few others have been developed, and there is now localized cultivation of these plants commercially.

The aromatic plants possess odoriferous and volatile substances that occur as essential oils, gum exudate, balsam and oleo-resin in one or more parts like root, wood, bark and foliage. A large quantity of aromatic material of botanical origin is used in cosmetics, toiletries and allied industries.

- Herbs such as Black pepper, Cinnamon, Aloe, Sandalwood, Red Clover are known to heal wounds, sores and boils.
- Tulsi, Fennel, Apple Mint, Golden Oregano, Rosemary can be planted easily in the kitchen garden and many of them act as magnets for bees and butterflies.
- Many medicinal plants are used as blood purifiers and eliminate metabolic toxins; some have antibiotic properties. Turmeric is used in growth inhibition of germs and harmful microbes.
- Some antipyretic herbs like Chirayta, Black pepper, Sandalwood, Safflower are recommended to reduce fever and production of heat caused by this condition.
- Apart from being aromatic, Sandalwood and Cinnamon are great astringents.
- Ginger and Cloves are used in certain cough syrups..
- Few aromatic plants like Barberry, Aloe, Golden Seal are used as mild tonics that reduce toxins in the blood.
- Mint has been viewed as an excellent source to ease an upset stomach and alleviating indigestion, Sarpagandha can be used for curing mental disorders like schizophrenia and high blood pressure.
- Tulsi relieves arthritis, regulates blood pressure.
- Ashwagandha has anti-cancer properties and may reduce symptoms of depression, Mandukaparni is a potent memory enhancer, imparts anti-convulsant, anti-depressant, wound healer and an anti-oxidant.

And not to forget, in the present scenario of this Covid-19 pandemic, Giloy is proving to be very useful as an immunity booster. Many traditional medical practitioners have suggested that it can cure the disease in about 15 days and does not have any side effects in the human body.

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## Some Notable Examples

Assam is one of the notable homes to a rich and diverse collection of medicinal and aromatic plants. Cottage industries here manage the production of MAP products which have an ever-growing demand especially in the rural areas. The Government Ayurvedic College, Assam Small Scale Industries and SKM Ayurvedic Institute, all three based in Guwahati, Assam are making continued efforts in the processing of MAPs, collecting information about the indigenous knowledge based on these MAPs and creating entrepreneurial opportunities for the rural youth.

Jharkhand has its fair share of indigenous knowledge and an unemployment rate of 8.8% as in July, 2020 (Source: Centre for Monitoring Indian Economy). This combination can be used to trap the indigenous knowledge and provide the unemployed, rural youth with a source of income and livelihood. Bishunpur in Jharkhand has had a fair share of glory since it made an appearance in our prime minister's 'Mann ki baat' speech where the PM clearly appreciated the people for cultivating lemongrass. Bishunpur's success can be turned into a major stepping stone in encouraging MAP cultivation, harvest and processing.

## Future Prospects

China beats India as the largest exporter of herbal medicines. China has its Traditional Chinese Medicine (TCM) while India has Ayurveda, Yoga, Unani, Siddha and Homeopathy (AYUSH). In the wake the Corona pandemic, the world is changing, and so is the outlook of people. People want to change their lifestyles to have better health and better immunity. This changing scenario provides ample opportunity for India to grow its MAP market.

MAP products as medicines and health boosters are actually being used throughout the country. But this sector is highly unorganized. In addition to this lack of organization, there is also a lack of scientific research. To become a part of the national and global market, MAP products and medicines need a systematic marketing strategy with regular research findings published.

The western medicines or allopathic medicines, though are the most popular, have side effects. People, even in the western countries want alternatives and India, through AYUSH

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can create a niche for itself not only in the world of medicines but also in the unexplored area lifestyle change.

Phyto-pharmaceutical industries, Patanjali being one of the many, need to be encouraged in order to provide employment and generate livelihood among people. Farmers can be encouraged to take up contract farming of MAP.

The Indian Himalayan region is also an abode to diverse MAP species. The harnessing of their potentials can be a major income generator among people of this region. Similar is the case with regions of western and Eastern Ghats and Nanda Devi region to name a few.

## Conclusion

With the on-going campaign of ‘vocal for local' stretching out through the length and breadth of the country, it is high time that we recognize the ancient Indian medical solutions and lifestyle. This will not only promote something which is native to India but will also generate employment. The use of MAP also denotes a shift towards more natural and eco-friendly products.

## References

Anonymous (2019). Second Advanced Estimate, Ministry of Agriculture and Farmers Welfare.

https://unemploymentinindia.cmie.com/

Maiti, S. (2004). Inventory, documentation and status of medicinal plants research in India. *Medicinal PlantsResearch in Asia*, 1: 79-103.

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# AGRITOURISM IN INDIA: A VIRGIN MARKET

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Agriculture serves as the backbone of the Indian economy with a contribution of nearly 16.5 percent in India's GVA (Gross Value Added) in the year 2019-20. But unfortunately, due to several reasons, it has become a most critical industry, resulting in economic distress on the part of the farmers. Thus, agritourism, an enterprise set up on a commercial basis on a functional farm for the educational or recreational purpose of visitors, can be seen as a secondary and stable source of income for the farmers. Also, India is counted amongst the top 10 tourist destinations in the world (Conde Nast Traveller "A leading European Travel Magazine). It serves as a home for the diverse culture and agro-climatic conditions, providing scope for the growth of this business. Thus, there lies a lot of opportunities for agritourism in India, including an increasing preference for non-urban tourist spots.

Travel centred around farming, small-scale production, animal husbandry, etc. can be termed as agritourism or agrotourism.It is fundamentally an association between tourism and agriculture that serves as a key component of an ecologically and socially accountable tourism. Agritourism is a recent concept in the tourism sector that provides a chance mainly to the urbanites, to reconnect with the land, to gain an insight into the lifestyle of the farmers, to experience rural life, to taste the local food and to get hands-on experience with various farming activities.

Pandurang Taware, considered as the Father of agrotourism in India, founded the Agri-Tourism Development Corporation (ATDC) in 2005 at Pune (Maharashtra) with the following objectives:

- To develop and promote Agritourism with the aim of diversifying and stabilising the rural economy;

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- To provide an opportunity for generating employment, enhancing income and offering a wider market base for local business;
- To promote small tourism industries by attracting tourists to rural areas;
- To provide training and infrastructural support to farmers for growth of the concept;

## Need and Importance of Agritourism

About two-thirds of the Indian population being dependent on agriculture as their source of income, the farmers form the backbone of the country. But due to rapid urbanization, people are getting detached from nature and the "land". Thanks to technology, the only source of viewing and enjoying nature nowadays is via television, internet, VR, etc. Thus, agritourism provides them with an escape from the daily hectic and mechanical lifestyle and enjoy the tranquillity of rural area in a peaceful environment. Agriculture, these days, has taken the form of the business, compared to the subsistent nature earlier. As a result of that, the majority of the small and marginal farmers cannot afford it, and they need a supplementary source of income to support their families.

## Benefits of Agritourism

### For Farmers:

- Acts as a secondary source of income for farmers, improving their living standards.
- Helps in making the tourists or visitors aware of the lifestyle of the rural people and gain insight into the locally produced agricultural goods.
- Helps in creation of employment in rural areas.
- A spirit of entrepreneurial behaviour can be inculcated in rural youth.

### For Community:

- Generating employment opportunities will strengthen the rural economy.
- Locally produced agricultural goods and services can be promoted.
- Provides opportunities to the communities to enhance their local tax bases.
- Traditional knowledge and wisdom of India can be preserved and promoted.
- An improvement would be there, in terms of protection and aesthetic value, in the sites which are supposed to serve as agritourism areas for attracting the tourists.

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### For Tourism Operators:

- Tourism market can be strengthened in the rural areas.
- It will provide an opportunity for the flow of non-local currency in the rural economy.

### For Tourists/Visitors

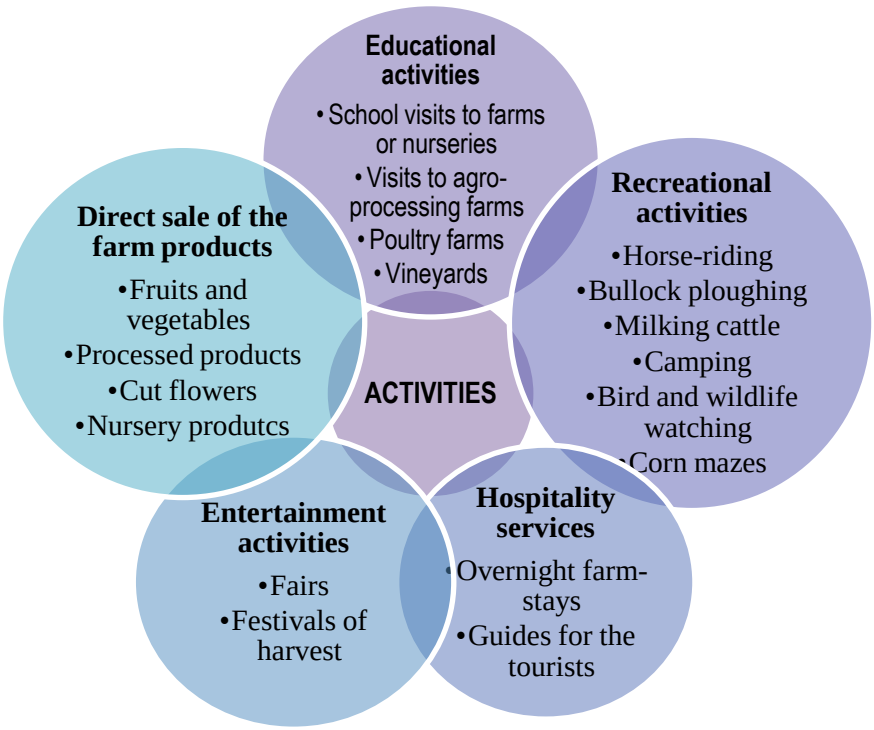
- It will provide a first-hand experience about the various farming activities carried on in a farm.
- It will also provide an opportunity to the visitors to interact directly with the nature and know about the importance of the environment in which they are living.

### Principles of Agritourism

- To have something for the visitors to see, in the form of natural resources, tradition, culture and values of rural people, fairs and festivals, etc.
- To have something for the visitors to do, in which they can participate and enjoy, like horse-riding, milking cattle, picking fruits, etc.
- To have something for the visitors to buy, like on-farm agricultural products, rural crafts, etc.

### Activities/ Services Provided in Agritourism

Chase *et al.*(2018) has categorised agritourism activities into various types like direct-to-



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consumer sales, educational activities, recreational activities, hospitality services, etc.

## Scope of Agritourism in India

- A cost-effective gateway- The current concept of tourism is limited to urban and elite people, constituting only a small portion of the population. However, agritourism has the potential to widen the tourist base due to its cost-effectiveness as the cost of food, accommodation and recreation is minimum.
- Agritourism provides scope to satisfy the curiosity about the farming community as it centres around the lifestyle of rural people, their tradition and culture.
- A break from the hectic daily routine- The lifestyle of people has become so mechanical these days, that all they want is an escape from such routine and finding solace to make life more peaceful. Being closer to the nature, peace and tranquillity are two in-built factors in agritourism.
- Due to urbanization, rural people are migrating to urban areas in search of jobs. Thus cities and growing at the cost of villages and yesterday's villagers are today's urbanites. But deep down in their hearts, lies love and respect for their villages. Thus, agritourism provides an opportunity to satisfy such desires.

## Agritourism Destinations in India

Agritourism has not yet popularised across the Indian states, except the western belt of Maharashtra. Being the pioneer state to introduce the concept, Maharashtra did not have a specific action plan regarding it in the tourism policy of 2006. But in the recent years, the Government of Maharashtra has taken the initiative and provided action plan in the tourism policy of 2016, which includes a mandatory educational tour for students from classes V to X. However, the concept is gradually taking momentum in other states like Uttarakhand, Punjab, Rajasthan, Karnataka, etc. Some successful agritourism destinations and farm stays are mentioned hereunder:

- **Maharashtra**- Baramati Agritourism Centre, Palshiwadi (Pune);Dirgayu Agritourism Centre (Thane);AnandKrushiParyatan Kendra (Satara);
- **Karnataka**- Green Dreams Farm(Coorg);
- **Kerala**- Dewalokam Farm Stay; Vanilla County (Kottyam);Mepra: The Hidden Roots (Kuttanad);

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- **Goa**- Dudhsagar Plantation and Farm Stay;
- **Tamil Nadu**- Destiny Farm stay (Ooty); Acres Wild Cheese-making Farm Stay (Coonoor);
- **West Bengal**- Tathagata Farms (Darjeeling);
- **Uttarakhand**- The Goat Village (Garwahal);
- **Rajasthan**- The Country Retreat (Pali);

## Conclusion

To overcome problems like lack of social recognition and respect, lack of adequate incentives, etc. the youth, nowadays, are not willing to take up agriculture as a profession. Even a large portion of farmers are resorting to suicide every year due to several reasons like cut-throat indebtedness, crop failure, lack of proper irrigation facilities, etc. According to the NCRB reports, nearly 3.5 lakh farmers have committed suicide since 1995 to 2018. Thus, the time has come for the policy-makers to successfully harness the potential of agritourism to boost up the rural economy of the nation. However, just like any other new concept, agritourism is also not without challenges, the major ones being lack of proper credit facilities, lower literacy rate and lack of proper market orientation on the part of the farmers, lack of awareness about the concept, fragmented and small land-holdings and lack of Government support. Thus, initiatives on the part of the Government along with promoting and making the people aware about this virgin concept is the need of the hour to harness the immense potential that lies in it.

## References

Agri Tourism Development Corporation India (ATDC), official website: http://www.agritourism.in

Chase, L. C., Stewart, M., Schilling, B., Smith, B., Walk, M. (2018). "Agritourism: Toward a Conceptual Framework for Industry Analysis". *Journal of Agriculture, Food Systems, and Community Development*. 8 (1): 13-19.

Shembekar, P. and Joshi, M. (2016). A study on growth and future scope of Agri-tourism projects in Nagpur District. *GE-International Journal of Management Research.* 4(4): 78-82.

Shembekar, P.S. (2017). Scope and challenges of agritourism- Literature review. *Journal of Advances in Business Management*. 3(2): 52-56.

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# ARBUSCULAR MYCORRHIZAL FUNGI (AMF): BIOPROTECTANT OF PLANT HERBIVORE INFESTATION

Article Id: AL202103

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Changing climatic pattern and modern agricultural practices leads increasing the pest and insect attack of important agricultural crops. Arbuscular mycorrhizal fungi (AMF) have a symbiotic association with the plants which improves the plant by nutrient mobilization and priming the Defense against various environmental stresses. AMF changes the morphology (trichome density, tissue hardness) and physiology (antioxidant enzymes, primary and secondary metabolites) of the plant which enhanced defense during herbivory. In this article, we reviewed the importance of AMF defense priming upon herbivore attack.

Agriculture is one of the important sectors of growing food demand globally. Controlling the insect pest attack in agriculture crops is important for healthy crop cultivation and maximum production. In India pest attack alone causes crop losses of 15.7% annually. Arthropod pest alone destroys 18-20% of annual production worldwide (Sharma et al.2017). Changing climatic pattern and modern agricultural practices lead to increasing the insect pest attack. Deutsch and Tewksbury(2018) reported crop losses increased to 10-25% because of the temperature increase. About 30-35% of annual crop yield in India get lost because of the pest according to P.K. Chakrabarty, Assistant director-general, Indian council for agricultural research. Control the insect pest with the use of chemicals leads to environmental problems. In this case, using biological methods to control/reduce insect pest is eco-friendly.

## Importance of AMF in Agricultural Ecosystem

AMF is a ubiquitous soil fungi belonging to phylum Glomeromycota, which have a symbiotic association with more than 80% of terrestrial plant species (Meier et al.2018). These biotrophic fungi alter plant root system and improve the uptake of nutrients, primarily phosphate and some micronutrients from the soil (Jung *et al.*2012). The mycorrhizal

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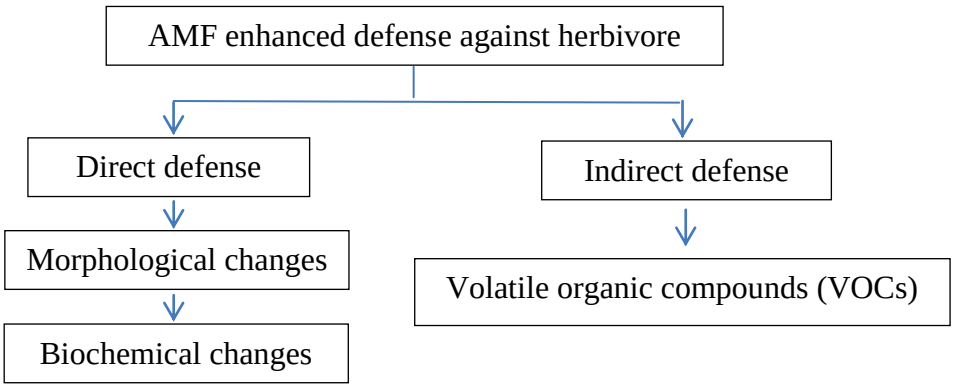
association also increases the photosynthetic activity of plant and AM fungi hyphal network helps to absorb the soil moisture (Kumar et al.2020). However, changing agricultural cultivation pattern and modern agricultural practices reduce the mycorrhizal inoculum in the field. Additionally, mycorrhiza had less attention for high input agricultural crops because of little benefits to heavily fertilize agricultural ecosystem. In spite of this, mycorrhiza has a huge attractive role. AMF colonization alters the plant physiology and gene expressions. This leads to acquiring resistance/tolerance against various biotic and abiotic stresses by crops (Montesinos - Navarro *et al.*2019).

## Mycorrhiza Priming Defense in Plant upon Herbivory

Plants undergo various biotic stresses, including herbivore attack. Upon herbivore, attack plant develops both constitutive and induced Defense against herbivore. Mycorrhiza not only improves the plant growth by nutritional mode, but it also increases the Defense of plant by non-nutritional mode. AMF improves the plant resistance against insect by improving nutrient uptake, altering the plant morphology, physiology and by producing volatile organic compounds (VOCs) (Jung et al.2012).




## Direct Defense

## Morphological Changes

The modified structure of the plant is the first line of Defense against insect pest. Plant special structures like thorns, stings, sticky resins and trichomes provide physical Defense against insect (Taggar & Gill, 2012). Trichomes are an important physical barrier against insect, which is increased in mycorrhizal colonized plants. Glandular trichomes are other types of trichomes which secrete secondary metabolites like alkaloids, flavonoids,

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terpenoids which are poison and repellent to the insect pest. Tissue hardness is other types of Defense. Hardening of leaves reduces the palatability of insect pest. Enhance the leaf hardness by lignin, cellulose, suberin and callose, small organic molecules (phenolics) provide mechanical Defense against insect feeding and penetration (War *et al.*2018).

## Biochemical Changes

Upon herbivore attack, mycorrhizal plant produces enhanced levels of antioxidant enzymes like lipoxygenases, polyphenol oxidases, and peroxidases and phenylalanine ammonia-lyase. Reallocation of food resource is another important method of Defense against the insect. Apart from this mycorrhizal plant produce improved level of secondary metabolites, hormones (jasmonic acid) and anti-nutritional protein upon insect attack (Jung *et al.*2012).

## Indirect Defense

During environmental stress, the plant has produced divers VOCs for plant protection and signalling molecules to communicate among nearby plants. It is an indirect method of plant Defense against biotic stress, which attract the natural enemies of insect. This defensive volatiles attract the parasitic and predatory insects that are natural enemies for the herbivore (Chen, 2008).

## Conclusion

Arbuscular mycorrhiza is one of the key bioagents for controlling insect pest and also improves the plant by nutritional mode. Priming Defense of mycorrhizal plants upon herbivore reduces the infestation percentage. But the level of Defense and positively or negatively regulation of Defense, depends on the type of insect and mycorrhizal species.

## References

Chen, M. S. (2008). Inducible direct plant defense against insect herbivores: a review. *Insect science*, *15*(2), 101-114.

Deutsch, C. A., Tewksbury, J. J., Tigchelaar, M., Battisti, D. S., Merrill, S. C., Huey, R. B., & Naylor, R. L. (2018). Increase in crop losses to insect pests in a warming climate. *Science*, *361*(6405), 916-919.

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www.agriallis.com

Jung, S. C., Martinez-Medina, A., Lopez-Raez, J. A., & Pozo, M. J. (2012). Mycorrhiza-induced resistance and priming of plant defenses. *Journal of chemical ecology*, *38*(6), 651-664.

Kumar, A., Phillips, R. P., Scheibe, A., Klink, S., & Pausch, J. (2020). Organic matter priming by invasive plants depends on dominant mycorrhizal association. *Soil Biology and Biochemistry*, *140*, 107645.

Meier, A. R., & Hunter, M. D. (2018). Mycorrhizae alter toxin sequestration and performance of two specialist herbivores. *Frontiers in Ecology and Evolution*, *6*: 33.

Montesinos-Navarro, A., Valiente-Banuet, A., & Verdú, M. (2019). Processes underlying the effect of mycorrhizal symbiosis on plant-plant interactions. *Fungal Ecology*, *40*, 98-106.

Sharma, S., Kooner, R., & Arora, R. (2017). Insect pests and crop losses. In *breeding insect resistant crops for sustainable agriculture*, 45-66.

Taggar, G. K., & Gill, R. S. (2012). Preference of whitefly, *Bemisia tabaci*, towards black gram genotypes: Role of morphological leaf characteristics. *Phytoparasitica*, *40*(5), 461-474.

War, A. R., Taggar, G. K., Hussain, B., Taggar, M. S., Nair, R. M., & Sharma, H. C. (2018). Plant defense against herbivory and insect adaptations. *AoB Plants*, *10*(4), 037

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# WATERSHED APPROACH FOR SUSTAINING NATURAL RESOURCES IN INDIA

Article Id: AL202104

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Agriculture is considered as a very complex system because it involves numerous components or enterprises including crops, trees, livestock, fisheries, bee keeping and many more. These all modules are inter-reliant and subsidies to each other. Similar to any other enterprise, agriculture also depends on several internal and external factors. These factors include environment (atmosphere largely), soil (depth, fertility, physical fitness and drainage) and water resources (monsoon, surface flow and sub- surface flow and run off). In the present scenario environment is in bad shape due to increased $CO_2$ level, ozone layer depletion, global warming, melting of glaciers, increase in temperature and rising of sea level while the soil is also contaminated due to heavy metal pollution, increased salinity and sodicity, degradation through erosion, waterlogging and shifting cultivation. On the other hand, water resources are not in their best serving phase because of the salinity of water and poor quality of water. To overcome all these problems, different approaches can be adopted, which include the individualistic approach and holistic approach. The individualistic approach comprises front line demonstration and single critical based interventions which have voluminous advantages and disadvantage like lack of linkage with other input, no concern about supporting system and easy to manage and follow. Conversely, a holistic approach which involves watershed management results in linkage with all the other inputs and consideration with life supporting system. The watershed approach aims at alleviating habitat and inhabitant impoverishment through a holistic & participatory approach of conservation & sustainable exploitation of natural& human resources. Watershed is the area that drains into a lake or river via streams and ditches directly over the ground surface or through the ground.

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## Watershed management

Watershed remunerates natural resources of a particular area and helps in benefiting the surrounding ecosystem that is why considered as a holistic approach. Generally, it works on objectives framed as "Power" which means

- **P**= Production of food, fiber and fodder, pollution control and prevention by flood
- **O**= Over exploitation of natural resources to be limited, operational practicability of all on-farm operations
- **W**=Water storage, wild and indigenous animals, plants conservation
- **E**= Erosion control, eco-system safety, economic stability and employment generation
- **R**= Recharge of ground water, reduction of drought hazards and reduction in siltation in multipurpose reservoir

During watershed management, these objectives are considered as important for the inclusive development of the total area. Watershed generally contains three major portions *i.e.*catchment area (receiving water), storage and command area (distribution area). For the development of catchment, various potentials of that specific area in different aspects should be considered like type and nature of vegetation, slope, size, quantity and distribution of rainfall, expected runoff, generation of runoff, safe channelization of harvested water, silt load reduction and fragmented land holding etc. In the same way storage area should be evaluated on the basis of location, stability and type of storing structures(concrete, earthen, poly film line), size, water availability period and duration, siltation, evaporation loss prevention, operation and maintenance practicability, total expense and expected life of storing area. Command area must be decided according to nature and duration of crop in that particular area, water conveyance system, adopted irrigation system, water availability and total water demand, proper utilization of water in command area distributed from the catchment area. The whole watershed management not only results in injudicious consumption of natural resources like water, land and microclimate of a particular area but also helps in improving the way of life of people residing inside the boundaries of the watershed.

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## Watershed approaches implemented for sustaining natural resources

For the optimum utilization of natural resources, various mechanical and biological measures are employed**:**

### Mechanical measures

- Prevention from soil erosion through bunding, trenching, terracing, vegetation barriers, grass water ways.
- Harvesting of rainfall water through farm pond, low earthen dams, and percolation tanks.
- Drainage line treatment measures like check dam, gully control structures, spill ways and grass outlets.

### Biological measures

- Agronomic practices like contour farming, strip cropping, cover cropping, mulching, crop rotation, mixed farming and tillage
- Cultivation of grasses
- Agroforestry
- Crop diversification and intensification
- Integrated pest and nutrient management
- Use of multiple resources like dairy, goatry, piggery, poultry, apiculture etc.

All these executed measures improve usage of natural resources of watershed area which promotes better returns from different enterprises and uplifted lifestyle of residents.

### Success story of several watersheds across India

- **Integrated model watershed at Kokriguda:** This watershed is situated in Orissa's district Koraput at the altitude of 880- 1329 meters with the total watershed area of 317 hectares. Before the watershed development, the whole area was affected by severe erosion through high wind velocity and water resources, denuded hillocks, causing almost nil agricultural accomplishments and other related enterprises. These activities resulted in malnourished livestock and impoverished human population. The situation transformed in a better picture after the watershed development in the particular district.

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The participatory rural appraisal was conducted by the government during watershed planning, along with social and resource mapping: improved total irrigation area, net cultivated area and total cropping intensity of watershed in twenty years. In the initial years of 1997 total irrigation area was 3.50 ha, net cropped area was 127.25 ha, and cropping intensity was 77.97% which was estimated to increased up to 93.80 ha, 167.70ha and 155.93% respectively in 2017.

- **Integrated watershed in Konkan Zone of Goa:** Barcem watershed was planned and executed in Konkanzone of Goa state.The geographical area of the watershed is 1625 ha. Land use in the watershed is comprised of 37% net cultivated and 27% barren and uncultivated land. Various activities like crescent shape trenches, sunken ponds, live fencing and check dams were constructed by farmers during the initial development of watershed. Due to increased rainfall harvesting, adequate water-storing reservoirs groundwater recharge takes place rapidly and improved crop intensity. Cashew is the major crop of this particular watershed area which results in high benefits return. Watershed encouraged better utilization of natural resources like land and water, enhanced sustainable agriculture, supported the whole ecosystem in an advantageous manner (Chand et al. 2007).

## Conclusion

The degradation of land and wastage of water resources forces to plan a holistic approach for a better future in agriculture. Watershed protects fertile soil from high wind and water erosion through many mechanical and agronomical practices. These practices convert low inputs to high output. Optimum utilization of natural resources enhances agricultural productivity and reduces malnutrition in human as well as livestock. Watershed improves other enterprises like poultry, fisheries, apiculture, sericulture, agroforestry and other allied business of agriculture resulting in the upliftment of families of the farmer.

## References

Chand,S.,Korikanthimath,V.S. and Manivannan,S.2007. Impact of soil and water conservation structures on productivity and ground water table in Barcem watershed of Goa.*Indian Journal of Soil Conservation.* 35(2): 172-173.

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# LIQUID BIOFERTILIZERS BOON FOR FARMERS

Article Id: AL202105

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India is an agrarian country where 60-70% population depends on agriculture. As all know that agriculture is the index of economic growth of any country. Therefore, good and healthy agriculture is necessary for each country. There are many hurdles in front of good agriculture practices but, one which influences agriculture more is consistently reducing land holding. According to a rural survey carried out by NABARD, the average landholding size of a household shrunk marginally to 1.1 hectare (ha) in 2015-16 from 1.16 ha three years ago (The Hindu, 2018). The main reason behind decreasing land holding is the ever-increasing population.

India is the 2nd largest country after China in population. Indian population increasing very fast, it is estimated that the population of India reached at 1.412 billion in 2025 and to 1.475 billion in 2030 (Rani *et al*., 2018). To feed ever-growing populations, it is necessary to increase production efficiency. If farmers want to increase production, then they have to increase productivity because productivity is the basis of higher production. Many components contribute to increasing productivity, one of which is nutrient management. Among various nutrient management components, liquid biofertilizer is one of the important components which influence productivity. It is also inexpensive than other nutrient sources.

## Liquid Biofertilizers

Liquid biofertilizers are the microbial formulation containing beneficial microorganisms which are capable of fixing, mobilizing or solubilizing the important plant nutrients by their biological activity. Liquid biofertilizers are classified in 3 broad groups-

### 1. Nitrogen fixers

Microbes which fix nitrogen symbiotically and non-symbiotically.Ex-*Rhizobium, Azotobacter, Azospirillum.*

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**2. Phosphorus solubilizers or mobilizers**

Microbes which solubilize or mobilize important plant nutrients such as P, Zn, Cu, Mo etc.examples of some important solubilizers or mobilizers are *Pseudomonas striata, Bacillus polymyxa, Aspergillusniger, Penicilliumdigitatum, Glomus, Gigaspora*and *AM.*

**3. Potash mobilizer**

Microbes which mobilize elementarily or a mixture of potassium in the soil. Use of potash mobilizing bacteria (KMB) would not only reduce the high cost of manufacturing potassium fertilizers but would also mobilize insoluble potassium in soils and fertilizer to which they are applied. Ex. *Frateuriaaurentia*

## Basic concept of liquid Biofertilizers

The basic concept of liquid biofertilizers as follows-

1. **Stabilization-** Stabilize the microbes during production, distribution and storage.
2. **Application-** Prepared formulation should be delivered easily to the field in the most effective manner.
3. **Persistence-** High persistence, to protect the microbes from harmful environmental factors at the field.
4. **Activity-** Increase the activity, reproduction, contact and interaction with target crops, to enhance the microbial activity at the field.

## Roles of liquid Biofertilizers

1. Minimize the use of nitrogen, phosphorus and potassium fertilizers.
2. Increases the seed quality of the crops.
3. Improve soil health and enhance soil fertility.
4. Economically profitable.
5. Crop yield increased.
6. Reduced pest and disease occurrence.
7. Produce growth hormones which help to increase productivity.
8. It provides benefits to subsequent crop due to residual effect.
9. Improve nutrient use efficiency.

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## Benefits of Liquid Biofertilizers

1. Easy to use.
2. Require minimum dose for application.
3. Shelf life 12-24 months.
4. Resistant to high temperature.
5. Storage quality is good.
6. Microbe's population can be maintained more than $10^9$ cells $ml^{-1}$ up to 12 -24 months.
7. Cost effective.
8. Better survival on seeds and soil.
9. Very high enzymatic activity.
10. Contamination is nil.

## Impact of liquid biofertilizers on Crop Yield and Soil Health

| S.No. | Findings | References |
|---|---|---|
| 1. | Application of 75% RDK along with soil application of KMB(*Frateuriaaurentia*) @ 1 litre in 80 kg FYM $ha^{-1}$ resulted higher potato tuber yield. | Chaudhary *et al*., 2019 |
| 2. | In green gram crop combined inoculation of liquid biofertilizers such as Rhizobium & PSB could increase the morphological characters such as height of the plant, Root length, number of nodules $plant^{-1}$ , nodule dry weight g $plant^{-1}$ , and Dry matter production. | Shravani et al., 2019 |
| 3. | Combined inoculation of liquid biofertilizers such as Rhizobium, Azospirillum and Azotobacter could enhance the morphological parameters as well as biochemical constituents such as Chlorophyll, Carbohydrate, Protein Carotenoids in *Vigna mungo.* | Maheswari and Elakkiya, 2014 |

## Application Methodology

There are 3 ways of using liquid biofertilizers

### 1. Seed treatment

i. Use plastic bag having size 21"X10" for small quantity seed treatment.
ii. Put 2 kg seed in a bag and shut the mouth of the bag in such a way to trap the air as much as possible.
iii. Twist the bag until all the seed were uniformly wetted.

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**iv.** When a uniform layer of culture coated on each and every seed shaking should be stopped.

**v.** Open the bag and spread the seed under shade for 20-30 minutes.

**vi.** The seed treatment can be done with any of two or more bacteria.

**vii.** The important things have to be kept in mind that the seeds must be coated first with *Rhizobium* or *Azotobacter* or *Azospirillum* than use phosphorus solubilizing bacteria and potassium mobilizing bacteria.

**viii.** This method is very effective.

### 2. Root Dipping

i. This method is used for paddy transplanting/ vegetable crops.

ii. The required quantity of inoculums has to be mixed with 5-10 ltr of water.

iii. Dip the plant roots for a minimum ½ an hour before sowing.

### 3. Soil Application

i. Phosphorus solubilizing bacteria and potassium mobilizing bacteria used in this method.

ii. Mix PSM and KMB inoculants with 400 to 600 kg of cow dung FYM.

iii. Kept the mixture under the shade for overnight and maintained 50% moisture.

iv. Use the mixture as a soil application in rows or during levelling of soil.

### Dosage of liquid biofertilizers

| **Crop** | **Recommended Biofertilizer** | **Quantity to be applied (approx.)** |
|---|---|---|
| Pulses | *Rhizobium* | 500ml/ha |
| Wheat, Oat, Barley | *Azotobacter/Azospirillum* | 500ml/ha |
| Rice | *Azospirillum* | 500ml/ha |
| Oilseed crops | *Azotobacter* | 500ml/ha |
| Pearl millets, Finger millets | *Azotobacter* | 500ml/ha |
| Maize and Sorghum | *Azospirillum* | 500ml/ha |
| Fruit and Flowers | *Azotobacter* | 1-2ml/plant |

### Precautions

1. Store liquid biofertilizer bottle in a cool and dry place.
2. Do not mix biofertilizer with any agrochemicals.

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3. Keep agrochemicals away from biofertilizers bottle.
4. Do not use biofertilizer after the expiry period.

## Conclusion

It can be concluded that liquid biofertilizer is the key component of nutrient management. It has a long shelf life and very effective rather than solid base biofertilizer. It enhances soil fertility as well as crop productivity. It is environment friendly because it reduces pollution which is caused by chemical fertilizers. It is very cost-effective and easy to use for farmers.

## References

Chandra K, Greep S, Ravindranath P, Srivathsa RSH. (2005). Liquid Biofertilizers, Ministry of agriculture department of agriculture & co-operation, Government of India.

Chandra, K. and Singh, T. (1999). Past and present scenario of RBDC.Pages 1-7 edts Chandra K., Rath, S. and Singh, T. 1999- Biofertilizer situation in Orissa.National institute for sustainable tropical agriculture and human action, (NISTHAA) Chintamaniswar, Bubaneswar.

Chandra, K. Ingle, S.R. and Bihari, K, (2002). Biofertilizers and its impact on different crops. Page no 18-19. National seminar on biotechnology.'Microbes to Man'.School of life science.Utkaluniversity, Bhubaneswar.

Chandra, K., Ingle, S.R., Bihari, K. and Srivathsa, RSH (2001). Future Inoculum-Biofertilizers in todays agriculture. Pages 63-67.National seminar on plant resources management for sustainable development. Department of Botany. Utkaluniversity, Bhubaneswar.

Chandra, K., Singh, T. and Srivathsa, H. (1999).Potash mobilizing microorganism-In biofertilizer ready recokner.Pages 12-14 Regional biofertilizer Dev. Bhubaneswar, Orissa.

Chaudhary, S.F., Patel, B.T., Chaudhary, N.G. andGohil, N.B. (2019) Effect of potassium mobilizing bacteria on growth and yield of potato (*Solanumtuberosum* L.) Inloamy sand *International Journal of Chemical Studies* ; 7(2): 998-1001.

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Online ISSN: 2582-368X
www.agriallis.com

Maheswari, N.U. and Elakkiya, T. (2014). Effect of Liquid Biofertilizer on Growth and yield of Vigna mungo L. Int. J. Pharm. *Sci. Rev. Res*. 29(2): 42-45.

Rani, P., Rai, S., Kumar, M. and Kumari, S. (2018). Biochar: A boon for agriculture. *International Journal of Chemical Studies.* SP4:86-93

Shravani, K.,Triveni, S.,Latha, P.C. and Ramulu, V. (2019). Biofertilizers formulations and their effect on morphological characters in greengram (*Vignaradiata* L.) *Journal of Pharmacognosy and Phytochemistry* ; 8(3): 2460-2465.

The Hindu (2018).Average farm landholding size shrinks to 1.1 ha.Agri business, The Hindu news paper published on 17 Aug. 2018.