

WELCOME





BIOPESTICIDES AND THEIR USES

INTRODUCTION

- Biopesticide is a formulation made from naturally occurring substances that controls pests by non toxic mechanisms and in ecofriendly manner.
- Biopesticides may be derived from animals (e.g. nematodes), plants (Chrysanthemum, Azadirachta) and micro-organisms (e.g. Bacillus thuringiensis, Trichoderma, nucleopolyhedrosis virus), and include living organisms (natural enemies) etc.
- However, biopesticides are generally less toxic to the user and are non-target organisms, making them desirable and sustainable tools for disease management.

Advantages of biopesticides

- ✓ Inherently less harmful and less environmental load,
- ✓ Designed to affect only one specific pest or, in some cases, a few target organisms,
- ✓ Often effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems .
- ✓ When used as a component of Integrated Pest Management (IPM) programs, biopesticides can contribute greatly.

Types of biopesticides

- Microbial pesticides
- Plant-incorporated-protectants (PIPs)
- Biochemical pesticides
- Botanical pesticides
- Biotic agents (parasitoids and predators)



Microbial Pesticides



- Microbial pesticides are composed of microscopic living organisms (viruses, bacteria, fungi, protozoa, or nematodes) or toxin produced by these organisms
- Applied as conventional insecticidal sprays, dusts, or granules.
- Their greatest strength is their specificity as most are essentially nontoxic and non pathogenic to animals and humans.
- Microbial pesticides includes insecticides, fungicides, herbicides and growth regulators of microbial origin.

Some of the important microbial pesticides

a. *Bacillus thuringiensis*

- Discovered in Japan in early 20th century and first become a commercial product in France in 1938.
- Control lepidopterous pests like American bollworm in cotton and stem borers in rice.
- When ingested by pest larvae, Bt releases toxins which damage the mid gut of the pest, eventually killing it.
- Main sources for the production of Bt preparations are the strains of the subspecies *kurstaki*, *galeriae* and *dendrolimus*

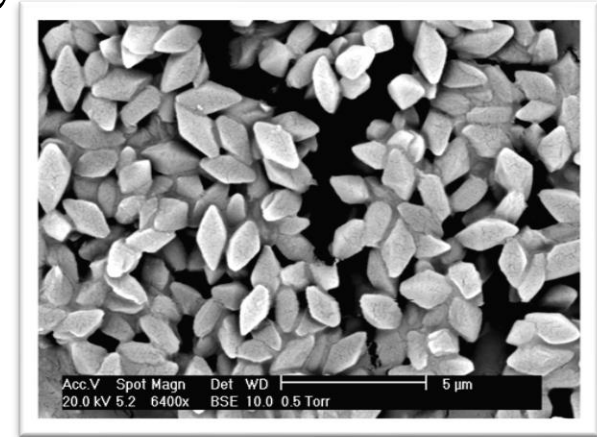
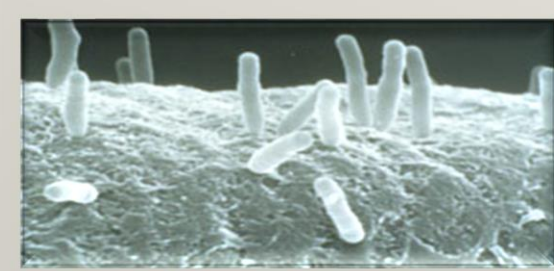


Fig: *Bacillus thuringiensis*

b. *Agrobacterium radiobacter* (Agrocin)



- *Agrobacterium radiobacter* is used to treat roots during transplanting, that checks crown gall.
- Crown gall is a disease in peaches, grapevine, roses and various plants caused by soil borne pathogen *Agrobacterium tumefaciens*.
- The effective strains of *A. radiobacter* possess two important features:
 - ✓ They are able to colonize host roots to a higher population density.
 - ✓ They produce an antibiotic, agrocin, that is toxic to *A. tumefaciens*.

c. *Pseudomonas fluorescens* (Phenazine)

- This bacteria is used to control damping off caused by *Pythium sp.*, *Rhizoctonia solani*, *Gaeumannomyces graminis*.
- It has ability to grow quickly in the rhizosphere

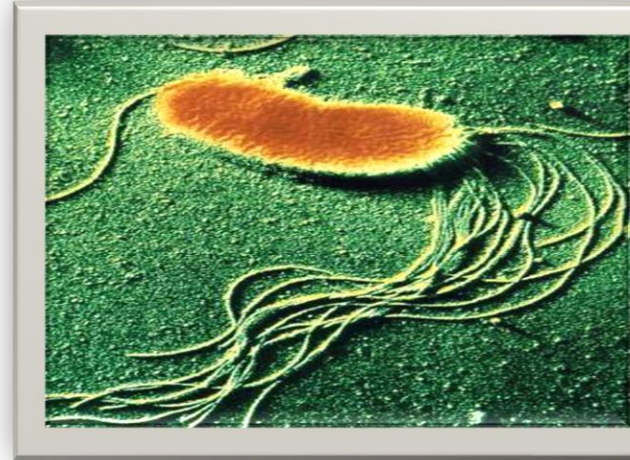


Fig: Pseudomonas

d. *Trichoderma*

- *Trichoderma* is a fungicide effective against soil born diseases such as root rot.
- This is also used against *Necteia galligena*, that causes silver leaf disease of fruit trees by entering through pruning wounds.

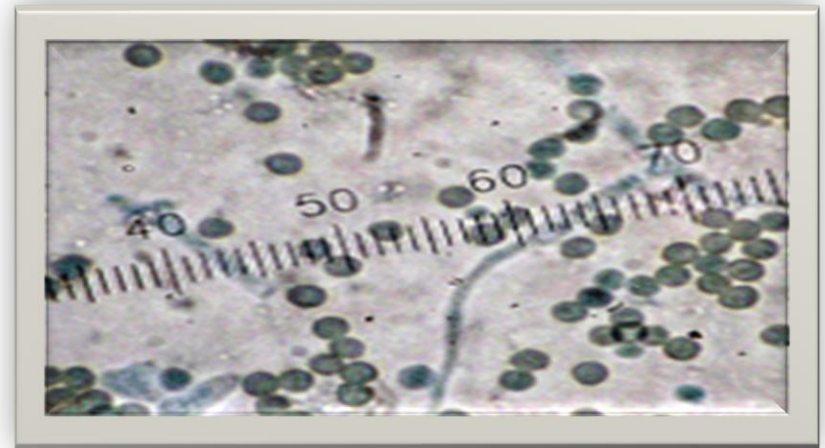


Fig. spores of Trichoderma

e. *Metarizium anisopliae*

- It infects spittlebugs, rhinoceros beetles.

f. *Beauveria bassiana*

- Controls Colorado potato beetle.

g. *Verticillium lecanii*:

- Controls aphids and whiteflies.

h. *Nomuraea riley*:

- Controls soybean caterpillars.



Fig: Metarhizium anisopliae



i. *Baculoviruses (Bvs)*

- Control lepidopterous and hymenopterous pests.
- Rod shaped, circular double stranded super coiled DNA.

Fig: Beauveria

Plant-incorporated-protectants (PIPs)

- Pesticidal substances that plant produce from the genetic material that has been added to the plant.
- As the pest feed on such plants they will eventually die.

Botanical pesticides:

- These are naturally occurring plant material that may be crude preparation of the plant parts ground to produce a dust or powder that can be used in full strength or dilute form in a carrier such as clay, talc or diatomaceous earth.
- “Azadirachtin” effects the reproductive and digestive procees of pest.
- Several plant based insecticides as nicotinoids, natural pyrethrins, rotenoids, neem products etc are used.

Important botanical pesticides



Fig: Neem oil



Fig: Rotenone

Fig: Tobacco suspension

4. Biochemical pesticides

- They are naturally occurring substance to control pest by non-toxic mechanisms.
- Biochemical pesticides include substances as insect sex pheromones, that interfere with mating that attract insect pest to traps.
- The synthetic attractants- are used in one of four ways:
 - i. As a lure in traps used to monitor pest populations;
 - ii. As a lure in traps designed to “trap out” a pest population;
 - iii. As a broadcast signal intended to disrupt insect mating
 - iv. As an attractant in a bait containing an insecticide



Fig:weevil pheromone trap

Biotic agents/Natural enemies

Predators

- They consume several to many prey over the course of their development, they are free living and they are usually as big as or bigger than their prey.
lady beetles, rove beetles, many ground beetles, lacewings, true bugs such as *Podisus* and *Orius*, syrphid fly larvae, mantids, spiders, and mites such as *Phytoseiulus* and *Amblyseius*.



Fig:lady bird beetle



Fig: Lacewings

Parasitoids

- Parasitoids are almost the same size as their hosts, and their development always kills the host insect.
- An adult parasitoid deposits one or more eggs into or onto the body of a host insect or somewhere in the host's habitat.
- The larva that hatches from each egg feeds internally or externally on the host's tissues and body fluids, consuming it slowly.
- Later in development, the host dies and the parasitoid pupates inside or outside of the host's body.
- Bathyplectes, trichogramma, encarsia, muscidifurax etc.



Fig: Trichogramma

Conclusion

- Biopesticides are typically microbial biological pest control that are applied in a manner similar to chemical pesticides.
- Available in different formulations
- Also used to control soil borne and seed borne fungal pathogens
- Disadvantages of them are, high specificity, slow speed of action and their requirement of suitable condition for their survival.
- Eventhough, biopesticides are best for controlling the pests of agriculture then the chemicals
- Therefore there should be more works on production on biopesticides and encourage people to use biopesticides to control the pests.



I ❤️
Organic
Farming

THANK YOU

Introduction

➤ **Biofertilizer** are microorganisms that help plants to grow by increasing the quantity of nutrients.

➤ Biofertilizer are defined as preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants for the uptake of nutrients by their interactions in the rhizosphere.

Azospirillum



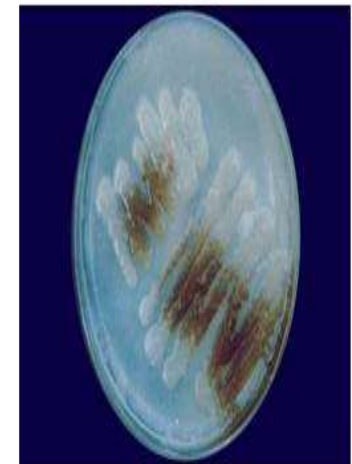
Rhizobium



Phosphobacteria



Azotobacter



Importance of Biofertilizer

➤ Increasing Harvest Yields

- ✓ Average increase crop yields by 20 to 30 percent.
- ✓ Algae-based fertilizers have improved yields in rice at rates ranging between 10 and 45 %.

➤ Improving Soil structure:

- ✓ Use of microbial bio fertilizers improves the soil structure by influencing the aggregation of the soil particles

➤ Better water relation

- Arbuscular mycorrhizal** colonization induces drought tolerance in plants by :
- ✓ improving leaf water and turgor potential,
 - ✓ maintaining stomatal functioning and transpiration
 - ✓ increasing root length and development.

Importance....Contd

➤ Lowering Production Costs

- ✓ Made from easily obtained organic materials such as rice husks, soil, bamboo, and vegetables etc.
- ✓ Reduce the input expenses by replacing the cost of chemical fertilizers.

➤ Fortifying the soil

- ✓ Aquatic cyanobacteria provide natural growth hormone, protein, vitamins and minerals to the soil.
- ✓ Azotobacter infuse the soil with antibiotic pesticide and inhibit the spread of soil-borne diseases like pythium and phytophthora.

➤ Improving Sustainability

- ✓ Biofertilizer strengthen the soil profile,
- ✓ leave water sources untainted and
- ✓ Edify plant growth without detrimental side-effects.

How does Biofertilizer work?

- Fix atmospheric nitrogen in the soil and root nodules of legume crop and make it available to the plants.
- Solubilise the insoluble forms of phosphates like tricalcium, iron and aluminum phosphate into available forms.
- Produce hormones and anti metabolites which promote root growth.
- They scavenge phosphate from soil layers
- Decompose organic matter and help in soil mineralization.

Classification of Biofertilizers

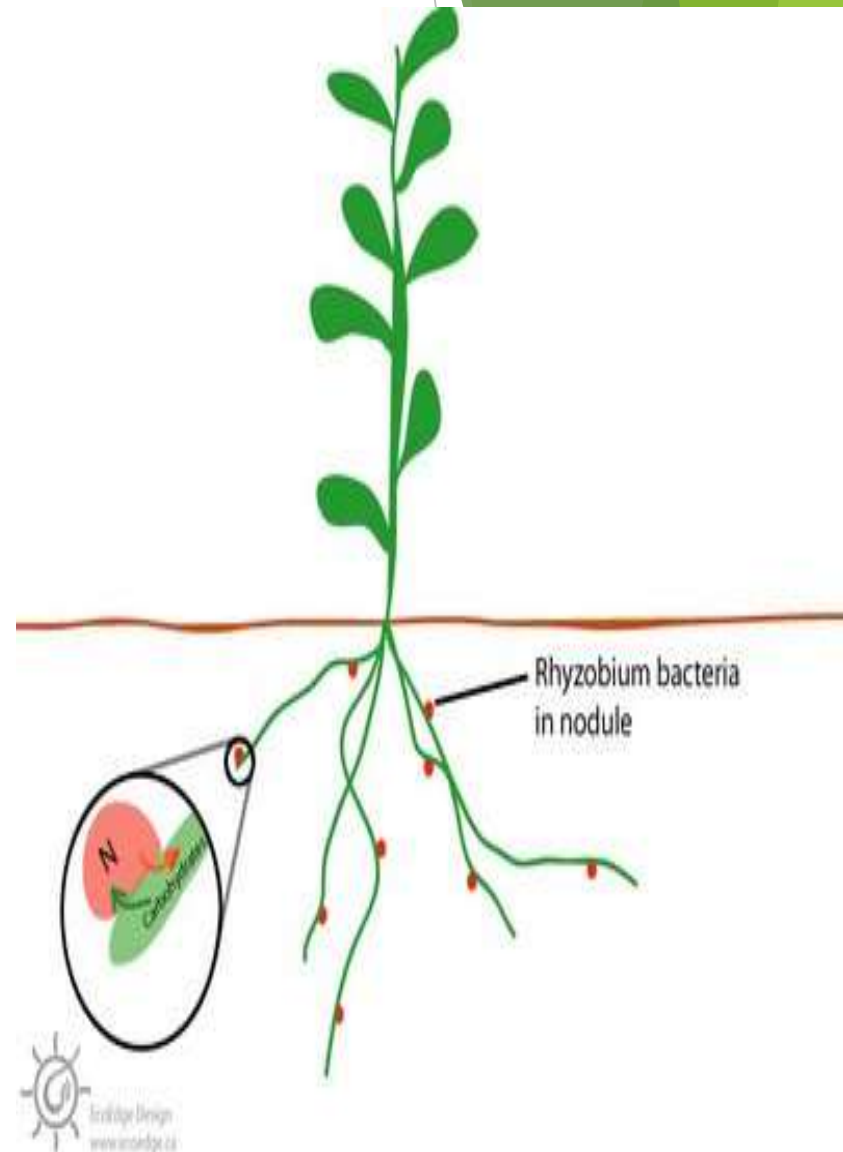
S.N	Groups	examples
A	N₂ fixing Biofertilizer	
	1. Free-living	Azotobacter, Clostridium, Anabaena, Nostoc,
	Symbiotic	Rhizobium, Anabaena azollae
	3. Associative Symbiotic	Azospirillum
B	P Solubilizing Biofertilizer	
	1. Bacteria	<i>Bacillus subtilis</i> , <i>Pseudomonas striata</i>
	2. Fungi	<i>Penicillium sp</i> , <i>Aspergillus awamori</i>
C	P Mobilizing Biofertilizers	
	1. Arbuscular Mycorrhiza	<i>Glomus sp.</i> , <i>Scutellospora sp.</i>
	2. Ectomycorrhiza	<i>Laccaria sp.</i> , <i>Pisolithus sp.</i> , <i>Boletus sp.</i> , <i>Amanita sp.</i>
	3. Ericoid Mycorrhiza	<i>Pezizella ericae</i>
D	Biofertilizer for Micro nutrients	
	1. Silicate and Zinc solubilizers	<i>Bacillus sp.</i>
E	Plant Growth Promoting Rhizobacteria	
	1. Pseudomonas	<i>Pseudomonas fluorescense</i>

The major microorganisms used as Biofertilizer are:

A. Nitrogen fixing Biofertilizers

➤ Rhizobium

- ✓ A soil habitat bacterium able to colonize the legume roots
- ✓ Fixes atmospheric elemental nitrogen symbiotically into plant usable form.
- ✓ Fixes 50-100 kg/ha/year of nitrogen, most useful in concern with amount of N_2 fixed.
- ✓ It is especially important for legumes and oilseeds.



➤ **Cyanobacteria**

- ✓ Both free-living as well as symbiotic cyanobacteria (blue green algae) have been harnessed in rice cultivation.
- ✓ The benefits due to algalization could be to the extent of 20-30 kg/ha.
- ✓ Add growth-promoting substances & vitamin B12
- ✓ Improve the soil's aeration, water holding capacity and add to bio mass when decomposed after life cycle

➤ **Azospirillum**

- ✓ Proliferates under both anaerobic and aerobic condition.
- ✓ Nitrogen fixing ability of 20-40 kg/ha
- ✓ PGRs production (IAA), disease resistance and drought tolerance are some of the additional benefits

➤ Azolla

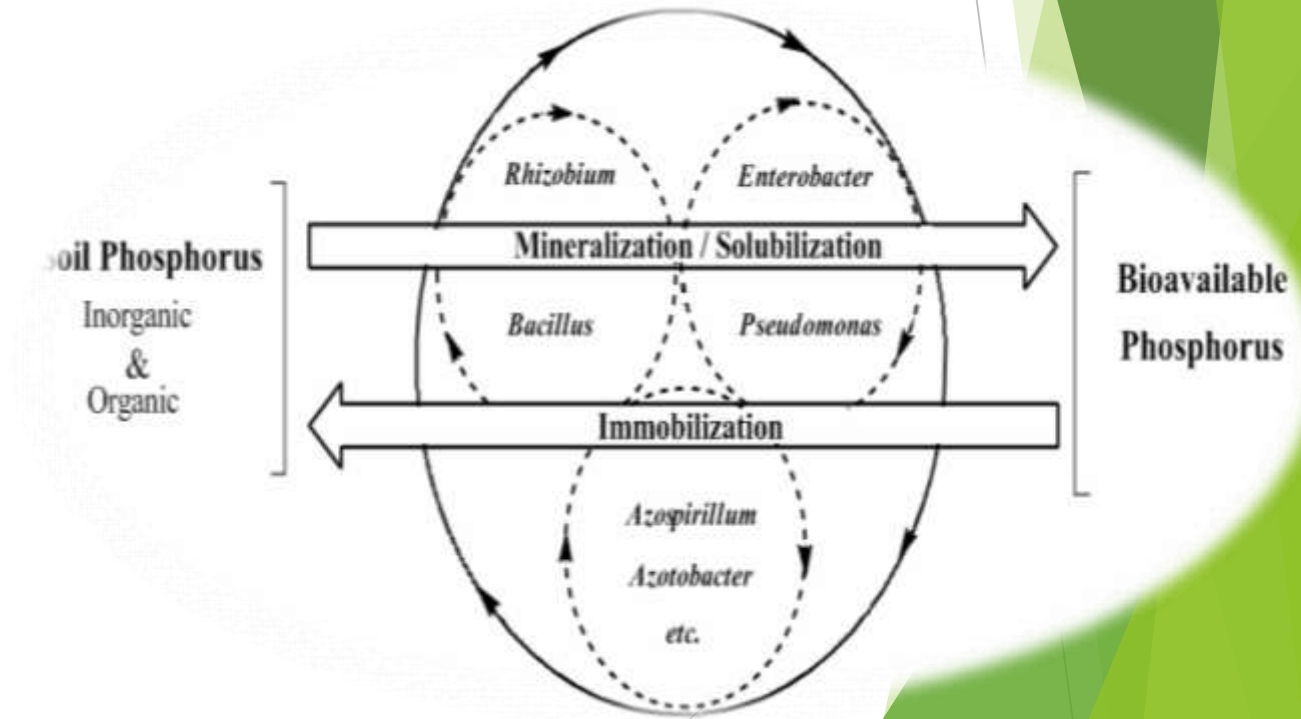
- ✓ A free-floating water fern used as Biofertilizer for wetland rice
- ✓ Fixes atmospheric nitrogen in association with nitrogen fixing blue green algae *Anabaena azollae*
- ✓ Known to contribute 40-60 kg N/ha per rice crop

➤ Azotobacter

- ✓ A free living bacteria mostly found in neutral to alkaline soils.
- ✓ Fixes the atmospheric nitrogen by converting into ammonia
- ✓ Produces abundant slime which helps in soil aggregation.
- ✓ Fix biologically active PGRs like IAA and gibberellins.

➤ Phosphate solubilizing Biofertilizer:

- ✓ Group of beneficial bacteria capable of hydrolyzing organic and inorganic phosphorus from insoluble compounds
- ✓ Pseudomonas, Bacillus and Rhizobium are among the most powerful
- ✓ Seed inoculation of PSB- 30 kg P_2O_5 /ha



➤ Phosphate mobilizing Biofertilizer (Mycorrhiza)

- ✓ A symbiotic generally mutualistic association between a fungus and the roots of a vascular plant.
- ✓ The fungus colonizes the host plant's roots, either intracellularly or extracellularly.
- ✓ This association provides the fungus with access to carbohydrates
- ✓ In return, the plant gains the benefits of the mycelium's higher absorptive capacity for water and mineral

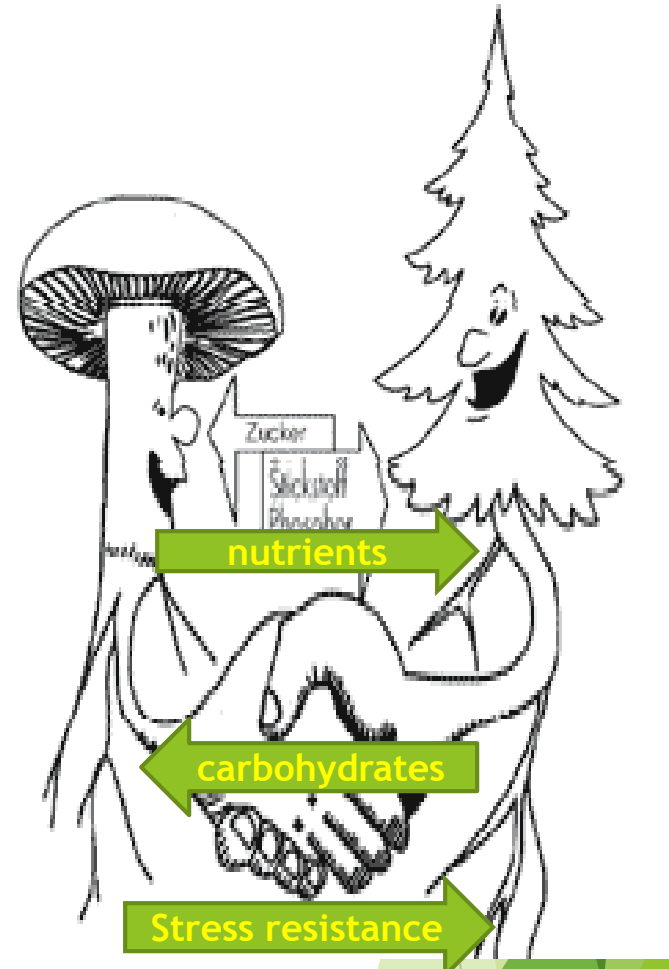


✓ Plant roots alone may be incapable of taking up phosphate ions that are demineralized in soils with a basic pH

✓ The mycelium of the mycorrhizal fungus can make them available to the plants they colonize.



Mycorrhizal and non mycorrhizal barley plants after colonization with *Cochliobolus sativus* (Kogel, Giessen)



Benefit for both partners

➤ **Silicate and Zinc solubilizing Biofertilizer**

- ✓ Microorganisms are capable of degrading silicates and aluminum silicates
- ✓ *Bacillus sp* can be used as bio-fertilizer for zinc or aluminum silicates because these organisms solubilize the zinc present in the soil and make it available to the plants.

➤ **Plant Growth Promoting Rhizobacteria (PGPR)**

- ✓ Species of *Pseudomonas* and *Bacillus* can produce phytohormones or growth promoters.
- ✓ They produce include indole-acetic acid, cytokinins, gibberellins and inhibitors of ethylene production

Role of Biofertilizers in soil fertility and Agriculture

1. They supplement chemical fertilizers for meeting the integrated nutrient demand of the crops.
2. They can add 20-200 kg N/ha year (eg. *Rhizobium sp* 50-100 kg N/ha year ; *Azospirillum*, *Azotobacter* : 20-40 kg N/ha /yr; *Azolla* : 40-80 kg N/ha; BGA :20-30 kg N/ha) under optimum soil conditions and thereby increases 15-25 percent of total crop yield.
3. They can at best minimize the use of chemical fertilizers not exceeding 40-50 kg N/ha under ideal agronomic and pest-free conditions.
4. Application of Biofertilizers results in increased mineral and water uptake, root development, vegetative growth and nitrogen fixation.
5. Some Biofertilizers (eg, *Rhizobium BGA*, *Azotobacter sp*) stimulate production of growth promoting substance like vitamin-B complex, Indole acetic acid (IAA) and Gibberellic acids etc.

6. Phosphate mobilizing or phosphorus solubilizing Biofertilizers / microorganisms (bacteria, fungi, mycorrhiza etc.) converts insoluble soil phosphate into soluble forms by secreting several organic acids and under optimum conditions they can solubilize / mobilize about 30-50 kg P₂O₅/ha due to which crop yield may increase by 10 to 20%.

7. Mycorrhiza or VA-mycorrhiza (VAM fungi) when used as Biofertilizers enhance uptake of P, Zn, S and water, leading to uniform crop growth and increased yield and also enhance resistance to root diseases and improve hardiness of transplant stock. They liberate growth promoting substances and vitamins and help to maintain soil fertility.

8. They act as antagonists and suppress the incidence of soil borne plant pathogens and thus, help in the bio-control of diseases.

9. Nitrogen fixing, phosphate mobilizing and cellulolytic microorganisms in bio-fertilizer enhance the availability of plant nutrients in the soil and thus, sustain the agricultural production and farming system.

10.They are cheaper, pollution free and renewable energy sources.

11.They improve physical properties of soil, soil tilth and soil health in general.

12.They improve soil fertility and soil productivity.

13.Blue green algae like *Nostoc*, *Anabaena*, and *Scytonema* are often employed in the reclamation of alkaline soils.

14.Bio-inoculants containing cellulolytic and lignolytic microorganisms enhance the degradation/ decomposition of organic matter in soil, as well as enhance the rate of decomposition in compost pit.

15. BGA plays a vital role in the nitrogen economy of rice fields in tropical regions. Azotobacter inoculants when applied to many non-leguminous crop plants, promote seed germination and initial vigor of plants by producing growth promoting substances.

16. Azolla-Anabaena grows profusely as a floating plant in the flooded rice fields and can fix 100-150 kg N/ha /year in approximately 40-60 tones of biomass produced, Plays important role in the recycling of plant nutrients.

Conclusion

- ✓ Biofertilizer have great role in increasing the crop production
- ✓ They improve the soil health status and provide different growth promoting hormones and phytohormones to the plant
- ✓ Also do not leave the residual effects like that of the chemical fertilizers.
- ✓ Hence the use of Biofertilizer could be the proper option for sustainable agriculture.

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THANK YOU