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Biofertilizers in Organic Agriculture

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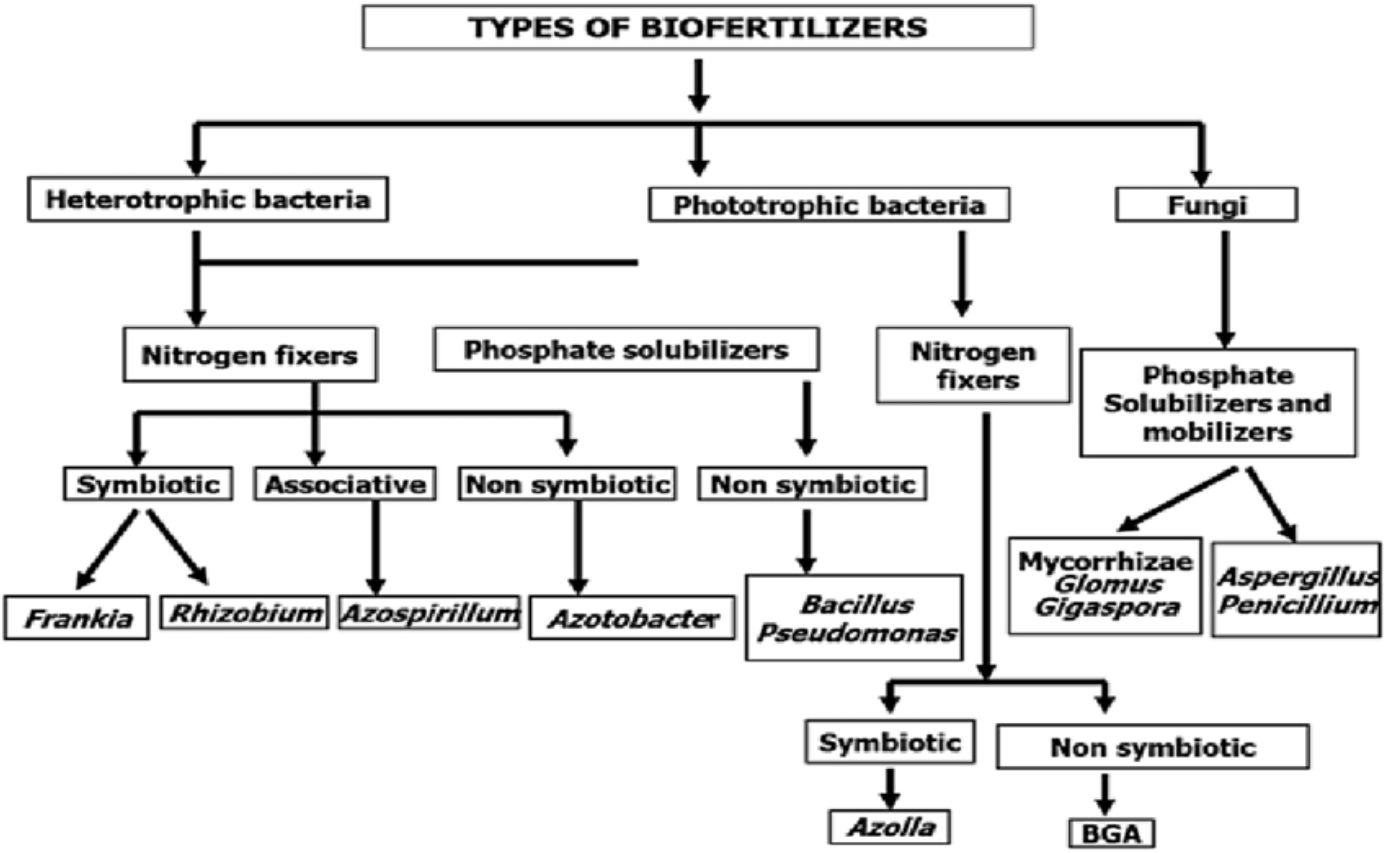
SUMMARY

Selection of proper biofertilizer and method of application according to crop is importantant factor for successful organic farming. Biofertilizer is an environmentally friendly alternative to artificial fertilisers for sustainable agriculture. The microbial inoculants either directly or indirectly help to growth by fixing nitrogen (N), solubilizing phosphate (P) and potassium (K), secreting siderophores, antibiotics, enzymes, antifungal, and antibacterial compounds, and releasing plant growth-promoting hormones. As a result, production and resistance to biotic and abiotic stressors are increased. When making biofertilizers, a variety of microorganisms are used, including microalgae, arbuscular mycorrhiza fungi (AMF), PSB, Actinomycetes, Paenibacillus, Azotobacter species and Rhizobium species.

INTRODUCTION

Biofertilizers are natural fertilizers that are live microbial inoculants of bacteria, algae, and fungus that supplement the availability of nutrients to plants alone or in combination. The function of biofertilizers in agriculture is becoming increasingly important, especially in light of rising chemical fertilizer costs and their potentially harmful impacts on soil health. A dynamic living system, soil is home to a huge variety of living things. In order to create the best possible natural systems that are socially, environmentally, and economically sustainable, organic agriculture techniques attempt to increase biodiversity, biological cycles, and soil biological activity. In contrast to chemical and organic fertilisers, which directly provide nutrients to crops, biofertilizers are cultures of unique bacteria and fungus. In comparison to conventional fertiliser facilities, the production technique for biofertilizers is rather straightforward, and installation costs are quite inexpensive. Bio-fertilizers are an environmentally acceptable, cost-effective source of plant nutrients that work in conjunction with chemical fertilisers.

Types of Biofertilizers



Biofertilizer	Crops
Rhizobium	Groundnut, Pigeonpea, Soybean, Green gram, Black gram, Lentil, Cowpea
Azotobacter	Cotton, Vegetables, Rice, Wheat, Fruit, Mustard, Safflower, Sunflower, Tobacco, Spices
Azospirillum	Grasses, Sorghum, Bajra, Fooder
Acetobacter	Sugarcane, Coffee
Blue Green Algae	Rice, Banana
Azolla	Rice
Mycorrhiza	Higher plants i.e Tree crops
Phosphate solublizing bacteria	All crops

A) *Rhizobium spp*

Rhizobium is a genus of Gram-negative soil bacteria that fix atmospheric nitrogen and make it available to plant. Rhizobium live in an intimate association with leguminous plants. *Rhizobium* organisms in the soil recognize and invade the root hairs of their specific plant host, enter the plant tissues, and form a root nodule. This process causes the bacteria to lose many of their free-living characteristics. They become dependent upon the carbon supplied by the plant, and, in exchange for carbon, they convert nitrogen gas to ammonia, which is used by the plant for its protein synthesis and growth.

B) *Azotobacter*

Azotobacter species are free-living, nitrogen-fixing bacteria; in contrast to *Rhizobium* species, they normally fix molecular nitrogen from the atmosphere without symbiotic relations with plants, although some *Azotobacte*r species are associated with plants.

C) *Azospirillum*

Azospirillum, as the most important genera of PGPR, are able to colonize the roots of several plant species and increase their growth by the production of different metabolites, including plant hormones. *Azospirillum* are able to fix N under the conditions of microaerophilic. *It* affects plant growth under the stress conditions by the production of different plant hormones including auxins. Salinity and drought stress (osmotic and matrix stresses), acidic conditions, the limitation of carbon resources, and the production of chemical compounds produced by plants under stress conditions. Although auxins are produced at different stages of *Azospirillum* growth, the highest rate of the hormone is produced at the stage of stationary phase. Under acidic conditions the expression of the ipdC gene in *Azospirillum* is activated, especially during the stationary phase, resulting in the increased production of IAA..

D) Blue Green Algae

Blue-green algae are actually types of bacteria known as Cyanobacteria. They normally look green and sometimes may turn bluish when scums are dying. BGA are oxygen-evolving, nitrogen-fixing prokaryotes that use sunshine as a source of energy. The frequency of occurrence is dependent on climate and soil conditions. Rice fields are abundant with it.. *Anabaena, Nostoc, Calothrix, Aulosira, Aphanothece,* and *Gloeotrichia* are the most common genera. When the combined nitrogen level in the ecosystem goes below 40 ppm, cyanobacterial nitrogen fixation activates, allowing algal biomass to create more biologically fixed nitrogen as soon as the nitrogen fertiliser level is lowered in the ecosystem due to loss and usage. The removal of algae from rice field water was found to significantly diminish in situ nitrogen fixing. Farmers may save around 40-60 kg urea by using BGA, since the typical use of BGA is determined to be 20-30 kg N/ha/season.

E) Azolla

Azolla is generally inoculated and grown as a cover crop for incorporating into the soil as a top-dressing in rice cultivation. *Azolla* in symbiosis with the cyanobacterium Anabaena azollae, under optimum conditions, can

fix substantial amounts of N_2 through BNF, and release as much as 70% of the fixed N to the rice crop upon incorporation.

F) Mycorrhiza

Arbuscular mycorrhizal fungi (AMF) facilitate host plants to grow vigorously under stressful conditions by mediating a series of complex communication events between the plant and the fungus leading to enhanced photosynthetic rate and other gas exchange-related traits, as well as increased water uptake. Numerous reports describe improved resistance to a variety of stresses including drought, salinity, herbivory, temperature, metals, and diseases due to fungal symbiosis

G) Phosphate solubilizing bacteria (PSB)

Phosphate solubilizing bacteria (PSB) are beneficial bacteria capable of solubilizing inorganic phosphorus from insoluble compounds.[1] P-solubilization ability of rhizosphere microorganisms is considered to be one of the most important traits associated with plant phosphate nutrition. It is generally accepted that the mechanism of mineral phosphate solubilization by PSB strains is associated with the release of low molecular weight organic acids, through which their hydroxyl and carboxyl groups chelate the cations bound to phosphate, thereby converting it into soluble forms. PSB have been introduced to the Agricultural community as phosphate Biofertilizer. Phosphorus (P) is one of the major essential macronutrients for plants and is applied to soil in the form of phosphate fertilizers. However, a large portion of soluble inorganic phosphate which is applied to the soil as chemical fertilizer is immobilized rapidly and becomes unavailable to plants.

Methods of application of biofertilizers

a) Seed Treatment: Seed treatments include Rhizobium, Azospirillum, Azotobacter, and Phosphobacteria @ 200 g/Kg seeds.

b) Seedling root dip: This method is used for transplanted crops recommended biofertilizers are mixed in this water and the roots of seedlings are dipped for 5- 10 minute and transplanted.

c) Soil Treatment: 4 kg each of the recommended biofertilizers is mixed in 200 kg of compost and kept overnight. This mixture is incorporated in the soil at the time of sowing or planting.

Advantage of Biofertilizers

- Biofertilizer contains microorganisms that encourage appropriate nutrient supply to the host plants and maintain optimal growth and physiological regulation.
- The release of growth-promoting hormones by biofertilizers improves root proliferation.
- They are eco friendly and available in low cost.
- It improve soil fertility and productivity.
- Though they may not produce instant benefits, the long-term results are amazing.
- They boost the phosphorous content of the soil by solubilizing and releasing inaccessible phosphorus, and they do so by harnessing atmospheric nitrogen and making it directly available to the plants.

CONCLUSION

By enhancing the delivery of vital nutrients to the plants, biofertilizers, which are substances containing microorganisms, aid in stimulating the development of plants and trees. It is ecofriendly and helps to reclaim soil as well as improve soil productivity and fertility.

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