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# BIOFERTILIZER FOR CROP PRODUCTION AND SOIL FERTILITY

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Biofertilisers are good source for enhancing the nutrient availability in soil and plants. They are ready to use, live formulations of beneficial micro-organisms which are agriculturally useful in terms of N fixation, P solubilization and nutrient mobilization by their biological metabolism to increase the productivity of soil and/or crop on application to seed, root or soil treatment for mobilizing the availability of nutrients.

In India, systematic study on biofertilizers was started by N. V. Joshi in 1920. Rhizobium was the first isolated from various cultivated legumes, and this was followed by vast research by Gangulee, Sarkaria and Madhok on the physiology of the nodule bacteria besides its inoculation for better crop production. Rhizobium and Blue Green Algae (BGA) are considered as the traditional biofertilizers, while Azolla, Azospirillum and Azotobacter are at the middle stage (Rahimi *et al.*, 2014).

**Table1. PGPR and their effect on crop yields (Abd El-Lattief, 2016).**

| Plant growth promoting Rhizobacteria | Crop Parameter |
|---|---|
| *Rhizobium leguminosarum* | Direct the growth promotion of canola and lettuce. |
| *Pseudomonas putida* | Early developments of canola seedlings, growth stimulation in tomato plant. |
| *Azospirillum brasilense and A. irakense* | Growth of wheat and maize plants |
| *P. flurescens* | Growth of pearl millet, enhance growth, leaf nutrient contents and high yield of banana. |
| *Azotobacter* and *Azospirillum* spp. | Growth and productivity of canola. |

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| | |
|---|---|
| *P. alcaligenes*, *Bacillus polymyxa*, and *Mycobacterium phlei* | Improves the uptake of N, P and K by maize crop. |
| *Pseudomonas*, *Azotobacter* and *Azospirillum* spp. | Stimulates growth and increase the yield of chick pea. |
| *R. leguminismarum and Pseudomonas* spp. | Enhances the yield and phosphorus uptake in wheat |
| *P. putida, P. flurescens, A. brasilense* and *A.lipoferum* | Enhances seed germination, seedling growth and yield of maize. |
| *P. putida, P. fluorescens, P. fluorescens, P. putida, A. lipoferum, A. brasilense* | Enhances seed germination, growth parameters of maize seedling in green house and also gain yield on maize. |

Biofertilizers are raised to harvest the naturally available, organic system of nutrient mobilization (Jnawali, 2015). Today. two common types of bio-fertilizers are in use: Nitrogen fixing micro-organism and Phosphorus solubilising micro-organism (Jehangir *et al.*, 2017). Increase in plant growth might be due to the biological nitrogen fixation and by the production of growth promoting substances such as IAA and Gibberellic acid. The bacteria which promote plant growth are known as plant growth promoting rhizobacteria.

**Bio-fertilizer making**

There are several things that need to be considered in making bio-fertilizers, such as microbes growth profile, types and optimum conditions of organism and formulation of inoculum. The formulation of inocula, method of application and storage of the products are all critical to the success of the biological product. In general, six steps are involved in making of biofertilizer. These are: choosing of active microorganisms, isolation and selection of target microbes, selection of method of propagation and carrier material, and phenotype testing, and large scale tests First of all, decision must be made on the active microorganisms to be used. For example, it must be decided whether to use organic acid bacteria or nitrogen fixer or a combination of some organisms, after which target microbes are isolated. Usually organisms are isolated from plant roots by luring it using a decoy such as placing cool rice underground beneath bamboo plants. Next, the isolated organism will be grown on Petri dishes before it is mass produces on flask. It is also important to choose the right carrier material. If the desire is to produce bio-fertilizer in powder form, then apioca flour or peat are the right carrier

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materials to use. Selection of propagation method is mainly to find out the optimum growth condition of organism. This can be achieved by determining growth profile under different parameter and conditions after which the phenotype is tested and selection is made. Lastly, the bio-fertilizer is tested on large scale at different environment to analyze its effectiveness and limitations.

Source: Ritika and Uptal (2014)

| Groups | Examples |
|---|---|
| | **Nitrogen fixing bio-fertilizers** |
| Free-living | *Azotobacter, Bejerinkia, Clostridium, Klebsiella, Anabaena, Nostoc* |
| Symbiotic | *Rhizobium, Frankia, Anabaena, Azollae* |
| Associative symbiotic | *Azospirillum* |
| | **Phosphate solubilizing bio-fertilizer** |
| Bacteria | *Bacillus megaterium var, Phosphaticum, Bacillus subtilis, Bacillus circulans* |
| Fungi | *Penicillum Spp. Aspergillus awamori* |
| | **Phosphate mobilizing bio-fertilizers** |
| *Arbuscular Mycorrhiza* | *Glomus Spp., Gigaspora Spp., Acaulospora Spp. Scutellospora Spp. and Sclerocystis Spp.* |
| *Ectomycorrhiza* | *Laccaria Spp. Pisolithus Spp, Boletus Spp. and Amanita Spp.* |
| *Ericoid Mycorrhiza* | *Pezizella ericae* |
| *Orchid Mycorrhiza* | *Rhizoctonia solani* |
| | **Bio-fertilizers for micronutrients** |
| *Bacillus Spp* | Silicate and zinc solubilizers |
| | **Plant growth promoting Rhizobacteria** |
| *Pseudomonas* | *Pseudomonas fluorescens* |

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## BIOFERTILIZERS IN CROP PRODUCTION

Rhizobium inoculation helps to enhance root nodulation, plant growth and produces higher grain yield by 10-15% under cultivated condition than a crop that has not been inoculated. They are capable of nitrogen fixation, phosphate solubilization, phosphate mobilization, and promotion of rhizobacteria. The preparation includes selective microorganism that may be useful for the soil. The suitability of the packaging is ensured for a longer shelf life and the safety of the environment and the user. Biofertilizers stimulate nutrients that favor the development of biological activities in soils which help in maintaining plant health. This is enhanced by the addition of balanced nutrient, which provide food and growth of microorganisms, and also beneficial soil worms are required. As an outcome of good structure provided to the soil, root growth and organic matter in soil are enhanced. Micorrhizal development is greatly influenced by the application of biofertilizers, which in turn, is responsible for the availability of high phosphorus content in the soil.

## CONCLUSION ON BIOFERTILIZERS

Biofertilizers lead to soil enrichment and are suitable with long-term sustainability. Further, they pose no danger to the environment and can be substituted with chemical fertilizers. The application of bio-fertilizers can minimize the use of chemical fertilizers, decreasing environmental hazards, enhance soil structure and promote agriculture. They play a key role in maintaining long term soil fertility and sustainability by fixing insoluble P in the soil into forms available to plants, thus increasing their effectiveness and availability. In context of both the cost and environmental impact of chemical fertilizers, excessive reliance

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on the chemical fertilizers is not a useful strategy in the long run due to the cost, both in domestic resources and foreign exchange; participate in setting up of fertilizer plants and maintaining the production. Biofertilizers are the alternative sources to meet the nutrient requirement of crops. In Biofertilizers, beneficial bacteria are *Azotobacter, Azospirillium, Rhizobium*, Mycorrhizae which are very essential in crop production. Biofertilizer can also make plant resistant to unfavorable environmental stresses.

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