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Biofertilizers: Definition, Classification and Importance

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Abstract

Fertilizers are used to provide vital plant nutrients such as nitrogen (N), potassium (K), and phosphorous (P) to plants (P). These fertilizers promote crop yield, but they also offer a number of health risks. Consumer preferences are shifting toward the usage of organic food cultivated without the use of any chemicals as a result of a number of health risks. In recent years, biofertilizers have emerged as an important component for biological nitrogen fixation. They provide a cost-effective and environmentally friendly method of nutrient supply to the plant.

Introduction

The term biofertilizer, represent everything from manures to plant extracts. "Biofertilizers" are those substances that contain living microorganisms and they colonize the rhizosphere of the plant and increase the supply or availability of primary nutrient and/or growth stimulus to the target crop. There are numerous species of soil bacteria that colonize mainly in the rhizosphere of plants. These bacteria are collectively known as plant growth promoting rhizobacteria (PGPR). Some PGPR promote the growth by acting as biofertilizer. Microorganisms mainly nitrogen fixer, phosphate solubilizer and mycorrhizae are the main sources of biofertilizer (Ismail *et al.,* 2014).

In general, bio-fertilizers are microbial preparations containing living cells of different microorganisms which have the ability to mobilize plant nutrients in soil from unusable to usable form through biological process. Bio-fertilizers are used in live formulation of beneficial microorganism which on application to seed, root or soil, mobilize the availability of nutrients particularly by their biological activity.

Bio-Fertilizer

Bio-fertilisers are living microorganisms of bacterial, fungal and algal origin. Their mode of action differs and can be applied alone or in combination. By systematic research, efficient strains are identified to suit to given soil and climatic conditions. Such strains have to be mass multiplied in laboratory and distributed to farmers (Boraste e*t al.*, 2009). They are packed in carrier materials like peat, lignite powder in such a way that they will have sufficient shelf life. They can be grouped in different ways based on their nature and function.

Major Advantages of Bio-Fertilizers

• Bio-fertilizers enhance the nutrient availability to crop plants (by processes like fixing atmosphere N or dissolving P present in the soil).

• Impart better health to plants and soil thereby enhancing crop yields in a moderate way.

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Table 1: Different groups of Biofertilizer based on their nature and function

S. No.	Groups	Examples
N_2 fixing Biofertilizers		
1	Free-living	*Azotobacter, Beijerinkia, Clostridium, Klebsiella, Anabaena, Nostoc*
2	Symbiotic	*Rhizobium, Frankia, Anabaena azollae*
3	Associative Symbiotic	*Azospirillum*
P Solubilizing Biofertilizers		
1	Bacteria	*Bacillus megaterium var. phosphaticum, Bacillus subtilis, Bacillus circulans, Pseudomonas striata*
2	Fungi	*Penicillium* sp., *Aspergillus awamori*
P Mobilizing Biofertilizers		
1	Arbuscularmycorrhiza	*Glomus sp., Gigaspora* sp., *Acaulospora* sp., *Scutellospora* sp. and *Sclerocystis sp.*
2	Ectomycorrhiza	*Laccaria* sp., *Pisolithus* sp., *Boletus* sp., *Amanita* sp.
3	Ericoid mycorrhizae	*Pezizella ericae*
4	Orchid mycorrhiza	*Rhizoctonia solani*
Biofertilizers for Micro nutrients		
1	Silicate and Zinc solubilizers	*Bacillus* sp.
Plant Growth Promoting Rhizobacteria		
1	Pseudomonas	*Pseudomonas fluorescens*

- It is a natural method without any problems like salinity and alkalinity, soil erosion *etc*.
- In the vast areas of low input agriculture and oil seeds production, as also in crops like sugarcane, etc, these products will be of much use to give sustainability to production.
- On an average crop yield elevates by 10–20 percent by their use.
- They help in the multiplication and survival of beneficial micro-organisms in the root region (rhizospheric bacteria).
- They control and inhibit pathogenic soil bacteria.
- They enhance soil texture by increasing amount of humus and maintain soil fertility.
- Eco-friendly in nature and pollution free.

Table 2: List of commonly produced bio-fertilizers in India

Name	Crops Suited	Benefits Usually Seen	Remarks
Rhyzobium strains	Legumes like pulses, groundnut, soybean	10-35% yield increase, 50-200 kg N ha^{-1}	Fodders give better results. Leaves residual N in the soil.
Azotobacter	Soil treatment for non-legume crops including dry land crops	10-15% yield increase adds 20-25 kg N ha^{-1}	Also controls certain diseases.
Azospirillum	Non-legumes like maize, barley, oats, sorghum, millet, Sugarcane, rice *etc*.	10-20% yield increase	Fodders give higher/ enrich fodder response produces growth promoting substances. It can be applied to legumes as co-inoculant.
Phosphate Solubilizers* (*there are 2 bacterial and 2 fungal species in this group)	Soil application for all crops	5-30% yield increase	Can be mixed with rock phosphate.
Blue-green algae and Azolla	Rice/wet lands	20 -30 kg N ha^{-1}, Azolla can give biomass up to 40-50 tonnes and fix 30-100 kg N ha^{-1}	Reduces soil alkalinity, can be used for fishes as feed. They have growth promoting hormonal effects. TNAU has developed high yielding Azolla hybrids.
Microhizae (VAM)	Many trees, some crops, and some ornamental plants	30-50% yield increase, enhances uptake of P, Zn, S and Water.	Usually inoculated to seedlings.

Disadvantages of Bio-fertilizers

• Biofertilizers provide lower nutrient density than chemical fertilizers, so more product is often required for the same effect.

• Biofertilizer production requires specific machinery.

• Biofertilizers can be difficult to store and may have a much shorter shelf-life than chemical fertilizers.

• Biofertilizers are often plant specific, what works on the crop does not work on another.

• During the production of microbial fertiliser, strict aseptic precaution is needed. Contamination is a common issue during microbial mass production.

• If exposed for long time in sunlight, microbes get killed as they are light-sensitive.

Conclusion

Biofertilizer help in increasing crop productivity by way of increased biological nitrogen fixation, increased availability or uptake of nutrients through solubilization or increased absorption stimulation of plant growth through hormonal action or antibiosis, or by decomposition of organic residues. Furthermore, biofertilizer as to replace part of the use of chemical fertilizers reduces amount and cost of chemical fertilizers and thus prevents the environment pollution from extensive application of chemical fertilizers. With using the biological and organic fertilizers, a low input system can be carried out, and it can be helped achieving sustainability of farms.

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