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# Importance and application of Biofertilizers in Agriculture

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**SUMMARY**

A large amount of chemical fertilizers are used because of intensive agriculture and high yielding varieties. Synthetic fertilizers are expensive and harmful to soil health and nutrition. High dose of chemical fertilizers decrease the soil fertility and soil biodiversity and also add a spill over issue that prompts numerous nutrients downstream. This is conceivably a major challenging ecological issue. Biofertilizers are alternative of chemical fertilizers. Biofertilizers reestablish typical fertility to the soil, make it naturally alive and improve the soil structure and function. Biofertilizers are preparation of living microbial cells that improve the nutritional level of soils. Generally, five biofertilizers viz. Rhizobium, Azotobacter, Azospirillum, Phosphate Solubilizing Bacteria and mycorhiza, which have been consolidated in India's Fertilizer Control Order (FCO), 1985.

## INTRODUCTION

Biofertilizers are preparations of living cells of microbes help the crop plants to uptake of micronutrients from the soil by their interactions in soil when they applied to the soil (Vessey, 2003). Biofertilizers keep the soil condition wealthy in a wide range of nutrients by means of nitrogen fixation, phosphate and potassium solubilisation or mineralization, secretion of phytoharmones, secretion of antibiotics and biodegradation of dead organic matter in the soil. Biofertilizers, when applied to the soil, multiply and take part in nutrient cycling and prompts crop yield. For the most part, 60% to 90% of the absolute applied fertilizers is lost and the staying 10% - 40% is taken up by plants. Consequently biofertilizers can be significant part of intergrated nutrient management system for supporting crop productivity and sustainability (Adesemoye and Kloepper, 2009). Moreover, it presents current advancements in the field of agriculture that uncovers the possibilities of the application biofertilizers as far as expanded nutrient profiles, plant development and efficiency and an improved resistance to ecological pressure.

### Advantages of biofertilizers over the synthetic fertilizers

Synthetic fertilizers are industrially controlled, substances made out of known amounts of nitrogen, phosphorus and potassium, and their abuse causes air and ground water contamination by eutrophication of water bodies (Youssef and Eissa, 2014). In spite of the fact that the act of utilizing synthetic fertilizers and pesticides hastens soil acidification, it additionally represents the danger of contaminating ground water and the environment. It additionally debilitates the underlying plant roots making them prone to various diseases. In the present scenario efforts are required for more sustainable options in crop production, which can be achieved by using products of biological origin instead of agro-chemicals. Organic farming has emerged as an important priority area globally in view of the growing demand for safe and healthy food and long term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals. Organic farming is one of such strategies that not only ensures food safety but also adds to the biodiversity of soil. Biofertilizers are being essential component of organic farming are the preparations containing live or latent cells of efficient strains of nitrogen fixing, phosphate solubilizing or cellulolytic micro-organisms used for application to seed, soil or composting areas with the objective of increasing number of such micro-organisms and accelerate those microbial processes which augment the availability of nutrients that can be easily assimilated by plants (Singh, 2021). Bio-control, a modern approach of disease management can be a significant role of biofertilizer in agriculture. Growth, yield and quality parameters of certain plants significantly increased with biofertilizers containing bacterial nitrogen fixers, phosphate and potassium solubilizing bacteria and microbial strains of some bacteria. Rhizosphere microorganisms are known as the plant's second genome, significantly contributing to soil nutrient cycling and the defense against pathogens. Biofertilizer has been identified as an alternative to chemical fertilizer to increase soil fertility and crop production in sustainable farming. These potential biological fertilizers would play the key role in productivity and sustainability of soil and also protect the environment as eco-friendly and cost effective inputs for the farmers. In nature, there are a number of useful soil microorganisms which can help plants to absorb

nutrients. Their utility can be enhanced with human intervention by selecting efficient organisms, culturing them and adding them to soils directly or through seeds.

**Carrier vs Liquid biofertilizers**

The carrier-based inoculants also suffer with drawback of short shelf life resulting in inconsistent performance under field conditions. The cost of production of carrier-based inoculants is also high, being their production is energy and Labor intensive process. To overcome the problems faced with solid carrier based formulations, new inoculant formulations have been developed which would ensure longer survival, no contamination and ease of applicability. In recent years, many of the formulations of the liquid based inoculants are introduced which have been shown to tolerate adverse environmental conditions in a better way and are free from other problems that are encountered with solid carrier based preparations (Brahmprakash et al., 2007). Liquid inoculants are special formulations of living population of desired microorganisms in an appropriate nutrient medium containing certain cell protecting chemicals. These chemicals promote cell survival during storage and after application to seed and also provide protection to microbial cells under extreme conditions in soil such as high temperature and desiccation. Several biofertilizers units have now started production of liquid bioinoculants. Characteristics of a good liquid inoculant include non toxicity, low cost, readily available uniform materials, adaptable to normal cell culture conditions, amenable to nutrient supplements, rapid release of microorganisms in the soil, supports their growth and survival and is easily manageable in the mixing and packaging operation.

Some advantages of liquid bio-fertilizer over conventional carrier based bio-fertilizers are:

- Longer shelf-life (about 12-24 months).
- Lower chances of contamination.
- No loss of properties due to storage up to 45ºC.
- Higher potentials to fight with indigenous population.
- Easy identification by typical fermented smell.
- Better survival on seeds and soil.
- Easy applicability by farmers.
- High commercial revenues.
- Higher export potential

**Application of carrier based biofertilizers**

There are three basic methods of carrier based biofertilizers application (**(**Aksh, 2015**).**

- Seed treatment or seed inoculation
- Seedling root dip
- Main field application

**Seed treatment:**

Each packet (200g) of biofertilizers is blended with 200 ml of gur slurry. The seeds required are blended in the slurry to have uniform covering of the inoculants over the seeds and afterward dried for 30 minutes in shade. The treated seeds ought to be utilized within 24 hours. One packet of inoculants is adequate to treat to 10 kg seeds. *Rhizobium*, *Azospirillum*, *Azotobacter* and *Phosphobacteria* are applied as seed treatment (table 1)

**Seedling root dipping:**

This strategy is utilized for transplanted crops. Two packet of the bio-inoculant are blended in 40 liters of water. The root part of the seedlings required for a section of land is plunged in the blend for 5 to 10 minutes and afterward transplanted (table 1).

**Soil treatment:** Four packets of the biofertilizers is blended in with 20 kg of dried and powdered homestead yard fertilizer and afterward broadcasted in one acre before transplanting (table 1).

**Table 1. Application of Carrier based biofertilizers**

| Recommended Biofertilizers | Crop | Application method | Recommended Dose | Benefits |
|---|---|---|---|---|
| **Rhizobium inoculant** | Pea, Lentil, Lathyrus, Chickpea, Pigeonpea, Soybean, Bean, Clover, Alfaalfa | Seed treatment | ➢ Soybean, Groundnut and Bengalgram= 5 packets per ha<br>➢ Cowpea, Greengram and Redgram= 3 packets per ha<br>➢ 1 packets= 200g | Rhizobium fix about 50-100 kg N/hac per year |
| **Azospirillum inoculant** | Rice and Cereal crops | > In the transplanted crops, *Azospirillum* is inoculated through seed, seedling root dip and soil application methods.<br>> For direct sown crops, Azospirillum is applied through seed treatment and soil application. | 1 packets (200g) per Acre. | *Azospirillum* fix about 20-25 kg N/hac per year |
| **Azotobacter inoculant** | Cereals crops, Horticultural crops | | 1 packet (200g) per Acre. | *Azotobacter* fix about 15-20 kg N/hac per year |
| **Blue Green Algae** | Rice | Soil treatment | 10 kg/ha | BGA fix about 25-30 kg N/hac per year |
| **Phosphate solubilizing inoculant** | All types of crops | Seed treatment | 1 packet (200g) per Acre. | Phosphate solubilizing bacteria can be decreased the application of chemical phosphorus fertilizers by 40%. |
| **Mycorhiza** | Horticultural crops | Soil treatment | ➢ Bulk inoculums of 100gm is sufficient for one meter square area.<br>➢ Seedlings raised in the polythene bags need 5-10 g of bulk inoculums for each bag.<br>➢ At the time of planting of saplings, VAM inoculums is to be applied at the rate of 20g /seedling in each spot. | Mycorhiza can be decreased the application of chemical phosphorus fertilizers by 40-60%. |

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| | | | ➢ In the existing tree, inoculums of 200g is required for each tree. | |
| **Azolla** | Rice | Soil treatment | ➢ Green manure: 6.25-10.0 t/ha and incorporated before transplanting of rice.<br>➢ Dual crop: Azolla is applied 1.25t/ha, one to three days after transplanting of rice. | Azolla input about 40-60 kg N/hac/year in rice field. |

**Application of liquid biofertilizers**

There are three ways of using Liquid Bio-fertilizers (table 2)

1. Seed treatment
2. Root dipping
3. Soil application

**Table 2. Recommended Liquid biofertilizers and their application methods.**

| Crop | Recommended Biofertilizers | Application method | Recommended Dose |
|---|---|---|---|
| Chickpea, pea, Groundnut, soybean, beans, Lentil, lucern, Berseem, Green gram, Black gram, Cowpea and pigeon pea | *Rhizobium* | Seed treatment | 200 mL/ Acre |
| Wheat, Barley, Oat, Maize, Sorghum, Pearlmillet | *Azotobacter/ Azospirillum* | Seed treatment | 200 mL/ Acre |
| Rice | *Azospirillum* | Seed treatment | 200 mL/ Acre |
| Mustard, Seasum, Sunflower, Linseeds | *Azotobacter* | Seed treatment | 200 mL/ Acre |
| Bermuda grass, Sudan grass, Napier Grass , ParaGrass | *Azotobacter* | Seed treatment | 200 mL/ Acre |
| Rice | *Azospirillum* | Seedling treatment | 500 mL/Acre |
| Tobacco | *Azotobacter* | Seedling treatment | 500 mL/ Acre |
| Tea, coffee | *Azotobacter* | Soil treatment | 400 mL/ Acre |
| Fruit trees | *Azotobacter* | Soil treatment | 2-3 mL/plant |

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