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## Biofertilizers: boon for fruit production

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### Abstract

India is the 2<sup>nd</sup> largest fruits producer after china. The cultivated land resources is reducing day by day. Green-Revolution gives a direction to developing countries for self-dependency in food production. Plant requirement is macro nutrients and micro nutrients which are required for the crops production. Nutrients is one of crucial element of plant for sustainable agriculture production. The production of crop is largely based on the fertilizer's types used to supplement of nutrients to plants. The behavior of chemical fertilizer, organic manure and bio fertilizers is unique and each of fertilizer has its own advantages and disadvantages in terms of growth, development of plants, soil fertility & productivity. The balanced nutrients application of fertilizers must ensure towards the protection of soil health, the ecological system and least pollution, therefore, a nutrition approach that integrates the use of synthetic, organic manures and bio fertilizers required to be developed for the sustainable agriculture

**Keywords:** Bio fertilizers, growth, fruit yield and quality

### Introduction

Soil micro-organisms plays a critical role to regulating the decomposition of organic matter and availability of plant nutrients. It is bio inoculants of microorganisms which is main approach towards the sustainable agriculture in terms of production. Microbial preparations can be used as an organic inputs to increase yields and the productivity of the crop, organic manures reduces the fertilizer doses and more nutrients may be available for the plant. Bio fertilizers is the formulations of living entities or latent cell of effective strains of microbes that helps to crop nutrients uptake by their co-operation in the root zone (rhizosphere) when it applied via the seed or soil treatment. It enhances the process of activity of microbes of effective strain in the soil which increase of availability of main nutrients in which form is easily taken by the plants. Bio fertilizers is different from the inorganic and organic inputs because they do not applied any kind nutrients to plants directly and formulation of specific kind microbes ie. Bacteria, algae, actinomycetes and fungi. The production of bio fertilizers is quite simple process and their installation cost unit is very cheap as compared to inorganic plants sources (Chen, 2006) [2]. The microbes are not much effective in environment, therefore artificial multiplication of effective strains of microbes play a major role in enhancing the microbial processes in soil environment and make the nutrients availability to the plant.

The main part of integrated nutrient management (INM) is bio fertilizers because they are sustainable source of plant nutrients and cost effective in addition to chemical fertilizers. The microorganisms & their co-operation in relation to plant is being taken advantages in the bio fertilizers production. They can be categories in different ways based on nature and their function.

### Advantages and Disadvantages of fertilizers

This material used widely in agriculture for the crop production is bio fertilizers. On the basis of production system, basically it is separate into three categories]

1. Chemical (inorganic)
2. Organic
3. Bio fertilizer

Fertilizer has its own values in respect to use, merits and demerits to crop and soil health.

### Advantages of inorganic or synthetic-chemical fertilizers

- Nutrients are easy to soluble and readily available nutrients to the plants; hence the effect of these materials is fast and direct.
- They are cheaper in price as compared to the organic which makes it more acceptable and maximum followed by the farmer.
- The nutrient content is very high in chemical fertilizers, less quantity is required to growth and development

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## Disadvantages of chemical fertilizers

- Excessiveness of everything is harmful, in case of chemical fertilizers Over application can give negative effects such as nutrients leaching, water pollution, decline the biodiversity of micro-organisms and biological agents (friendly insects), increase the chance of pest infestation, disease susceptibility to crop, nature of soil (acidification & alkalization) and reduction the soil fertility — hence very big amount of damage to the overall biological system and soil system.
- Excessiveness of N increases the softening of portions of the plant (leaves) resulting in plants that are more susceptibility to insect-pests and diseases
- It reduces colonization of mycorrhizae with plant roots and inhibits symbiotic fixation of nitrogen by *Rhizobium sp.* due to high dose of nitrogen.
- They enhance the decomposition of soil organic matters, which leads to degradation of soil structure.
- Nutrients loss is very readily which leads to reduced fertilizer efficiency.

## Advantages of using organic fertilizers

- Balanced form of nutrient supply which maintain the plant health.
- The biological activity of soil is enhance by which it improves nutrient conversion (mobilization) from organic & inorganic sources and decomposition of toxic substances.
- The colonization of mycorrhizae enhances the P supply.
- They promotes the root growth due to presence of good soil structure.
- The organic matter (OM) content in the soil is increase therefore enhancing the cation exchange capacity of the soil, maximum water holding capacity is increased, decreasing the bulk density, improves the soil aggregates and buffer the soil against different metals.
- The nutrients release capacity is very slow and give contribution to the residual pool of organic N and P in the soil, decreasing nitrogen loss and Phosphorus fixation
- Micronutrients is also supplied by the organic manures
- Organic manures supplies food and promote the growth and development of important microorganisms and earthworms.
- It helps to reduces the susceptibility of; soil-borne diseases, parasites and certain plant diseases

## Disadvantages of using organic fertilizers

- They are comparatively low in nutrient content, so larger volume is needed to provide enough nutrients for crop growth.
- The nutrient release rate is too slow to meet crop requirements in a short time, hence some nutrient deficiency may occur.
- The major plant nutrients may not exist in organic fertilizer in sufficient quantity to sustain maximum crop growth.
- The nutrient composition of compost is highly variable; the cost is high compared to chemical fertilizers.
- Long-term or heavy application to agricultural soils may result in salt, nutrient or heavy metal accumulation and may adversely affect plant growth, soil organisms, water quality and animal and human health.

## Biofertilizers classification

The various types of biofertilizers which help the plant to grow at different levels of its growth are:

## 1. Nitrogen Fixing Biofertilizers

## 2. Phosphate Biofertilizers

- a. Phosphorous Solubilizing Biofertilizers
- b. Phosphorus Mobilizing Biofertilizers

## 3. Biofertilizers for Micro-nutrients

## 4. Plant Growth Promoting Rhizobacteria

## 5. Compost

## 1. Nitrogen Fixing Biofertilizers

| N <sub>2</sub> fixing Biofertilizers |                       |  |
|--------------------------------------|-----------------------|--|
| 1.                                   | Free-living           | <i>Azotobacter, Beijerinckia, Clostridium, Klebsiella, Anabaena, Nostoc,</i> |
| 2.                                   | Symbiotic             | <i>Rhizobium, Frankia, Anabaena azollae</i>                                  |
| 3.                                   | Associative Symbiotic | <i>Azospirillum</i>  |

## 2. Phosphate Biofertilizers

| P Solubilizing Biofertilizers |                        |  |
|-------------------------------|------------------------|--|
| 1.                            | Bacteria               | <i>Bacillus megaterium var. phosphaticum, Bacillus subtilis, Bacillus circulans, Pseudomonas striata</i> |
| 2.                            | Fungi                  | <i>Penicillium sp, Aspergillus awamori</i>   |
| P Mobilizing Biofertilizers   |                        |  |
| 1.                            | Arbuscular mycorrhizae | <i>Glomus sp., Gigaspora sp., Acaulospora sp., Scutellospora sp. and Sclerocystis sp.</i>                |
| 2.                            | Ectomycorrhiza         | <i>Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.</i>  |
| 3.                            | Ericoid mycorrhizae    | <i>Pezizella ericae</i>  |
| 4.                            | Orchid mycorrhizae     | <i>Rhizoctonia solani</i>  |

## a) Phosphorus Solubilizing Biofertilizers

1. Solubilize the insoluble phosphate from organic and inorganic phosphate sources
2. Releases insoluble phosphorus in soil and fix in clay minerals
3. Secrete organic acids and lower the pH to dissolve bound phosphates in soil

## b) Phosphorus Mobilising Bio fertilizers

Transfer phosphorus from the soil to the root cortex

Examples: Arbuscular Mycorrhiza (AM fungi)

1. Fungus penetrates the cortical cells of the roots.
2. Increase surface area of roots.
3. Displace of absorption equilibrium of phosphate ions which increases the transfer of P ions
4. Stimulate metabolic processes
5. Arbuscles absorb these nutrients into the root system

## 3. Biofertilizers for Micro-nutrients

1. Bacterial species are Silicate and Zinc solubilizers
2. Degrade silicates and aluminium silicates in soil
3. Help in silicate weatherin
4. Eg: *Bacillus sp.*

## 4. Plant Growth Promoting Rhizobacteria (PGPRs)

1. Act as both Biofertilizer & Biopesticides
2. Promote growth by:
  - a) Improved Nutrient Availability (Biofertilizers)
  - b) Suppression of Plant Disease (Bioprotectants)
  - c) Phytohormones Production (Biostimulants) eg: *Pseudomonas fluorescens*

## Sole application of biofertilizers

Kumar *et al.* (2014) [7] reported that the application of AMF and *Azospirillum* recorded highest growth of aonla plant. He recorded the highest no. of leaves and shoot length in same treatment of aonla plants. He resulted that nutrient availability may be increased by the application of the biofertilizers which enhancing the growth of the plant and increase the fruit quality.

The combined treatment of biofertilizer *Azospirillum brasilense* + Arbuscula mycorrhizal fungi gave highest fruit retention and fruit yield *i.e.* 41.3 kg plant<sup>-1</sup> along with highest fruit size (cm), fruit weight (g) and pulp weight (g). The application *Azospirillum brasilense* + AMF is another way to get highest yield in the guava growers concluded Das *et al.*, 2017 [3].

Singh *et al.* (2018) [10] reported the effects of different bio-fertilizers levels as well as plant combinations in *Annona sp.* viz., bio-fertilizer (Harit Vardan), liquid bio-manure (Bioplantomin), organic product (Biovita), polymorphic growth hormones (Farm Bahar) and multi-micronutrients (Plantgro) through soil or foliar spray. He resulted that the foliar application of Bioplantomin recorded m plant height, number of branches, trifoliate leaf, total dry matter accumulation and Protein content 55.0 cm, 4.32, 9.4, 11.66g, 25.70%, respectively compared to control.

Use of bio fertilizers along with chemical or organic fertilizers

The biological activity enhances the supply of nutrient content in sufficient amount to the plant. If the conditions is more favorable for the microorganisms activity due to which convert more organic form to inorganic very effectively and dissolving nutrients and available nutrients to the plants to plants.

Mia *et al.* (2010) revealed that the application of PGPR with reduced levels of Nitrogen gave effective results on the growth of the plant. The inoculum also increased the fixing of nitrogen level as well as yield of Nitrogen which associated with banana roots promote the flower initiation, yield increase and quality parameter of fruit.

Kundu (2011) [8] revealed that the effects of different of inorganic fertilizers levels NPK (100%, 75% and 50%) were supplied alone and in combinations with biofertilizers *ie.* *Azotobacter*, *Azospirillum* and VAM. He resulted that the application inorganic fertilizers along with biofertilizer recorded highest effects on the growth, yield, quality and

leaf mineral as compared to the inorganic alone in cv. Amrapali of mango orchard.

Dwevedi *et al.* (2012) [4] resulted that the biofertilizer Phosphorus solublizers along with Nitrogen sources were found highest effects on physico-chemical paramter of "Red Fleshed" guava fruit as compared to the N-fixers.

Integrated application of chemical, organic and biofertilizers Bhalerao *et al.*, 2009 concluded that treatment in which the Application of cent per cent of RDF of N, P& K with FYM (10kg plant<sup>-1</sup>) and *Azospirillum* and Phosphorus solublizers (25g plant<sup>-1</sup>) recording highest yield and farmers returns. This treatment was followed by RDN of N P K (50%) through farmyard manure + Green manure and NPK through inorganic (50%) and biofertilizers.

Goswami *et al.* (2012) [6] revealed the effects of FYM, inorganic fertilizers and biofertilizers on 5 years old orchard of cv. Pant Parbhat guava. He concluded that the half dose of N:P:K (250g:195g:150g) + FYM (50 kg tree<sup>-1</sup>) + *Azospirillum*(250 g tree<sup>-1</sup> year<sup>-1</sup>) produced highest plant height 0.24m and 0.25m, plant spread 0.58m and 0.66 m, trunk diameter 2.68cm and 2.71 cm and tree volume 0.055m<sup>3</sup> and 0.041 m<sup>3</sup> during 2007-08 and 2008-09, respectively.

Godage *et al.* (2013) [5] revealed the effects of inorganic and biofertilizers on cv. sardar of guava orchard. He found that the treatment combination of N:P:K (75:75:100)+ *Azotobacter* (5 ml tree<sup>-1</sup>) + Phosphorus Solublizer (5 ml tree<sup>-1</sup>) gave highest fruit diameter fruit weight pulp weight tree height, East-West tree spread and North-South tree spread recording 10.07cm, 215.06g, 193.44g, 3.80m, 5.20 m and 5.13m respectively, at harvesting stage,.

Devi *et al.* (2014) reported the effect organic as well as biofertilizer on cultivar "Bombai" litchi. He applied the different treatment in which the treatment with FYM + *Azotobacter* + P solubilizers + K mobilizers give highest TSS content and total sugars content (17.79°Brix) and (17.57%), recording respectively but highest (53.48 mg/100 g pulp) ascorbic acid content was found in treatment combination of *Azospirillum*, neem cake, P solubilizers + K mobilizers. Farm waste manures and biofertilizers have a mutual relation towards nitrogen fixation, phyto hormone production and promoting nutrients uptake leads to improvement of fruit quality characteristics. These combinations also improve the physic-chemical properties and biological properties of the soil. The highest microbial population in soil make available of nutrients. Thus increased yield and enhancing fruit quality of the crop.

**Table 1:** Effect of bio-fertilizers on fruit retention and yield parameters of guava cv. L-49 (Das *et al.*, 2017) [3]

| Treatments                                    | Fruit retention (%) | Yield /plant (Kg) | Yield/ha (t) |
|---|---------------------|-------------------|--------------|
| <i>A. chroococcum</i>                         | 51.00               | 36.15             | 10.04        |
| <i>A. brasilense</i>                          | 52.10               | 36.72             | 10.20        |
| <i>B. megatherium</i>                         | 50.12               | 37.00             | 10.28        |
| AMF ( <i>Glomus mosseae</i> )                 | 53.14               | 37.35             | 9.54         |
| <i>A. chroococcum</i> + <i>B. megatherium</i> | 54.15               | 37.14             | 10.32        |
| <i>A. chroococcum</i> + AMF                   | 56.00               | 38.12             | 10.59        |
| <i>A. brasilense</i> + <i>B. megatherium</i>  | 56.10               | 40.11             | 11.15        |
| <i>A. brasilense</i> + AMF                    | 56.30               | 41.37             | 11.50        |
| N, P & K (260:320:260 g/plant/year)           | 51.20               | 32.40             | 9.00         |
| Control                                       | 45.20               | 25.20             | 7.00         |
| SEm±  | 0.678               | 1.385             | 0.548        |
| CD(p=0.05)                                    | 2.015               | 4.114             | 1.64         |

## Conclusion

The population is increasing day by day. Due to the increasing the population the demands of quality and quantity

product is increased. Now days Food security is a serious global concern due to which we have to use the different techniques that leads to increasing the yield as well as

improve the quality of the plant the use of conventional farming is not only the solution to increase the yield. We have to need to adopt the technique which helped to increase the farmer income as well as provide more profit. The use of bio fertilizers with organic and inorganic farming is beneficial kinds because they are help to provides the nutrients and protect to the plant from various kind of attacks.

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