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Biofertilizers in Fruit Crops

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Biofertilizer play a very significant role in improving soil fertility by fixing atmospheric nitrogen both in association with plant roots and without it. It solubilizes insoluble soil phosphate and produces plant growth substances in the soil. They are environment friendly playing a significant role in crop production. The soil lose its biological dynamism owing to repeated and indiscriminate use of the inorganic source of fertilizer. The global mandate (Dorrel and Besson, 1996) today is to use organic sources of plant nutrients to restore soil health. The fertilizers are not only short in supply but costly too and produced at the cost of irreparable loss of non-renewable energy. Biofertilizers are able to fix atmospheric nitrogen in the range of 20 - 200 kg/ha/year, solubilize P in the range of 30 to 50 kg P_2O_5 ha/year and mobilizes P, Zn, Fe, Mo to varying extent. Nitrogen fixing bacteria and phosphate solubilizer are the main biofertilizers for horticultural crops. These micro-organisms are either free living in soil or symbiotic with plants and contribute directly or indirectly towards nitrogen and phosphorus nutrition of the plants.

Definitions

Biofertilizers are using in live formulation of beneficial microorganisms which on application to seed, root or soil, mobilize the availability of nutrients particularly by their biological activity and help to build up the lost microflora and in turn improve the soil health in general. Thus the use of biofertilizers is increasing day by day due an increase in the price of chemical fertilizers, its beneficial effect on soil health and increase in the production of crops.

Nitrogen- fixing bacteria and phosphate solubilizers are the main biofertilizers for horticultural crops. These micro-organisms are either free living in soil or symbiotic with plants and contribute directly or indirectly towards nitrogen and phosphorus nutrition of the plants. Biofertilizer is a cost effective renewable energy source and eco friendly compared to commercial fertilizers and plays a crucial role in reducing the inorganic fertilizer application and at the same time increasing the crop yield besides maintaining soil fertility.

Different types of biological fertilizers

A) Nitrogen fixing bio-fertilizer

i) Azospirillum.(Associative symbiotic)
ii) Rhizobium, Anabaena azollae, Frankia (Symbiotic)
iii) Azotobacter, Nostoc, Klebsiella, Clostridium, Anabaena, Beijerinkia (Free-living)

B) Phosphorus mobilizing bio-fertilizer (PMB)

i) Rhizoctonia solani (Orchid mycorrhiza)
ii) Amanita sp., Boletus sp., Pisolithus sp., Laccaria sp. (Ectomycorrhiza)
iii)Scutellospora sp., Gigaspora sp., Glomus sp., Acaulospora sp. (Arbuscular mycorrhiza)
iv) Pezizellaericae. (Ericoid mycorrhizae)

C) Phosphorus solubilizing bio-fertilizer (PSB)

i) Psuedomonas striata, Bacillus megaterium var. phosphaticum, B. circulans, B. subtilis (Bacteria)
ii) Aspergillus awamori, Penicillium sp. (Fungi)

D) Plant growth promoting bio-fertilizer (PGPB)

i) Psuedomonas fluorescens (Psuedomonas)

E) Bio-fertilizers for Micronutrients

i) Silicate and Zinc solubilizers (Bacillus sp.)

Mechanism of Biofertilizers

The mechanism involved in the plant growth promotion by biological inoculants was given by (Okon, 1985).

i) Increased availability and uptake of nutrients

The root-associated organisms provide agricultural plants with increased plant nutrition availability, solubilization of insoluble phosphates, and biological nitrogen fixation. Increased nitrogen, phosphorous and potassium content of inoculated plants at different stages of crop growth have been found resulting in a significant increase in crop yield.

ii) Production of plant growth promoting substances

Numerous bacteria that colonise roots, such as Pseudomonas spp. that solubilize phosphorus and Azospirillum that fixes nitrogen, are known to release growth hormones, which frequently promote greater growth of roots and shoots. The amounts and ratios of the hormones needed by different plants to sustain healthy growth and development vary. Therefore, it might be expected that at different stages of plants respond differently to invasion by hormone producing bacteria.

iii) Suppression of growth of pathogenic microorganisms

The introduction of specific inoculants results in a decrease in the inoculum density of plant pathogens. It has been proposed that pathogen inhibition may occur through the imported organisms' production of bacteriocins and antibiotics.

Role of Biofertlllzer in Fruit Crops

The use of biofertilizer even though not spread up on a wide scale for all crops, however, there is a growing awareness among the farmers that production can be increased by the use of biofertilizers in case of cereals, pulses, oil seed and some cash crop like vegetable and sugarcane (Verma and Bhattacharyya, 1994).

Biofertilizer is a recent concept in horticultural crop. Generally fruit crops have now received more attention than vegetables and ornamental crops. *Glomus fasciculatum, Glomus mosseae, AzospirilJum, Azotobacter* and PSB are found useful for different horticultural crops. Use of biofertilizer particularly inoculation with *Azotobacte could* substitute 50% nitrogen requirement of banana and produce higher yield over full doses of nitrogen application (Tiwary *et al.*, 1999).

The absorption of mobile nutrients like nitrogen also increases in association with *VAM* fungi (George *et al.*, 1992). Beneficial response of *Azotobacter and Azospirillum* in enhancing the productivity of banana was also reported by Dibut Alvorez (1996) and Mohandas (1996). *VAM* fungi are responsible for more than two fold increased acquisition of the less mobile nutrient elements like P, Ca, S, Zn, Mg and Cu from the rhizosphere (Clark, 1997). The high efficiency of *AzospiriIlum* for fixing nitrogen and better mobilization of fixed phosphorus by VAM even at high temperature can make these highly suited for mosambi (Manjunath *et al., 1983).*The per cent of wilting in VAM treated trees of guava was recorded to be lower as compared to untreated trees (Srivastava *et al., 2001).*

1. Effect of biofertilizer on growth character

Singh and Singh (2004), reported that VAM significantly increase growth of plants compared to non-mycorrhizal control and was also effective in increasing nutrient uptake by the plants.

VAM influenced growth attributing character and yield attributing component. About 50% saving of phosphorus was achieved through the use of VAM. Manjunath et *aJ.* (2001) reported that VAM fungi (Glomus *fasciclatum)* was found to be effective in papaya in increasing the plant height, stem girth, petiole length and number of leaves. Rupnawar and Navale (2000) conducted an experiment on pomegranate and observed that mycorrhizal treatment were superior over non-mycorrhizal treatment in pomegranate.

2. Effect of biofertilizers on yield.

The beneficial effect of *Azotobacter* inoculation in fruit and vegetable crops was well discussed by Asokan *et a* (2000). Sharma (2002) in Assam revealed significant increase in the bunch weight and yield of banana with *Azotobacter* and organic manures supplements over 100% fertilizer. *Azotobacter* also enhanced shooting and shortened crop duration. Wang in 1996 reported that with the application of *Azospirillum* + 150 kg N/ha can increase the yield in strawberry by 54%, the number of fruit per plant and clump weight were also highest compared to a treatment 150 kg N alone.

3. Effect of biofertilizers on soil character

The plants inoculated with *Azotobacter* and *Azospirillum* derive positive benefit in terms of enhancement in uptake of $N0_3^-$, NH_4^+, $H_2P0_4^-$, K^+ and Fe_2^+ increased nitrate reductase activity in plants and production of antibacterial and antifungal compounds (Wani, 1990). Gogoi (2003) reported that the combined application of inorganic fertilizer and biofertilizers in banana cv. 'Barjahaji' significantly increased the available NPK status, organic C and microbial biomass and dehydrogenase activity in soil after harvest.

4. Effect of biofertilizers on quality parameter

Singh *et al.* (2000) reported that the treatment combination of 3/4 % P + VAM + N was the best treatment for producing better growth and yield of high quality fruit in Mosambi. This treatment also influence plant height, trunk diameter, canopy volume, root growth and biomass production as compared to control.

Conclusion

Generally the effect of biofertilizers on plant and yield is not as striking as that of chemical fertilizers. Since it is a living system, thus the influence is subject to environmental, biological and nutritional stresses. Moreover, the performance of the microbial inoculant depends on the quality of the inoculant and accurate specification is required to avoid poor performance of the inoculants. To become successful, this biofertilizer technology must reach to the hands of the farmers.

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