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Biofertilizer: A Boon for Sustainable Fruit Production

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SUMMARY

Sustainable crop production is the need of hour, and for optimum plant growth and development and higher productivity, availability of nutrients should be balanced and sufficient. Now a days, among resource-poor farmers, soil infertility is the most important constraint for higher fruit yield. In order to maintain soil fertility and higher crop production, use of synthetic fertilizers has been used widely. However, incessant use of fertilizers causes decline of soil quality as well as productivity. Continuous use of nitrogen and phosphorus fertilizers leads to soil acidity and enrichment of P in vegetable production. Improvement in soil fertility could be restored efficiently through adaption of integrated soil fertility management like biological nitrogen fixation (BNF) for increasing efficiency of inputs and higher productivity of fruit crops.

INTRODUCTION

In recent years, biofertilizers have emerged as an important component for biological nitrogen fixation. They offer an economically attractive and ecologically sound route for providing nutrient to the plant. Biofertilizers are low-cost renewable source of nutrient that supplements the chemical fertilizer. Biofertilizers gained importance due to its low cost amongst small and marginal farmer. Sustainable crop production is proving as one of the toughest job nowadays. In crop production there is no uniformity in agricultural practices throughout the world, but one thing is common more or less which is use of fertilizers. For optimum plant growth and development, availability of nutrients should be balance and sufficient (Chen 2006). Among the resource-poor farmers in developing countries, soil infertility is the most important constraint for limited crop yield (Mohammadi and Sohrabi 2012). To maintain the soil fertility and crop production, use of synthetic fertilizers has been accepted widely. But the incessant use of these fertilizers causes the decline of soil quality as well as productivity (Yang 2006). Continuous use of nitrogen and phosphorus fertilizers leads to soil acidity and enrichment of P in vegetable production (Liang *et al.*, 2013). To restore the fertility in these regions, farmers have to get improved varieties and productive cultural practices. The improvement in soil fertility could be restored efficiently through adaption of integrated soil fertility management including an approach for nutrients management based on natural resource preservation by biological nitrogen fixation (BNF) though increasing the efficiency of inputs (Vlek and Vielhauer 1994).

Why Biofertilizers

Farmers haphazardly use various chemical fertilizers for enhancing growth and productivity of different crops to meet the emerging demand of food supply. These actions have led to toxifying and highly affecting the soil health, microbial activity and friendly insects. However, excess use of chemical fertilizers as a result made the crops more susceptible to diseases and fertility of soil (Aktar *et al.*, 2009). In the year of 2020, the world population will be 8 billion. To feed this population, a target of 32.1 million tons of grain food will be required, and the nutrient requirement will be 28.8 million tons. Therefore, the availability of nutrients will be 21.6 million tons hence creating a deficit of about 7.2 million tons from the required

nutrients (Arun, 2007). Generally, among the applied chemical fertilizers, only 10–40% is taken up by the plants and the remaining applied fertilizer lost. So, to overcome the deficit amount of nutrients, the production of agriculture needs to improve, and that should be sustainable and environment-friendly. Therefore, it is compulsorily required to reconsider most of the existing agricultural practices which include fertilizers, fungicides, insecticides, herbicides and pesticides (Pretty and Bharucha 2015). In view of these harmful effects of chemical fertilizers, the safe alternative of chemical inputs is biofertilizers which are thought to do minimum ecological disruption to a great level. Biofertilizers are cheap and ecofriendly in nature, and their long-term use improved soil fertility considerably (Mehdi *et al*., 2010). Biofertilizers can enhance the crop yield about 10–40% by increasing protein contents, vitamins, essential amino acids and nitrogen contents (Bhardwaj *et al*., 2014).

Classification of Biofertilizers

Sr. No.	Group		Examples
A	**N_2 Fixing Biofertilizers**		
	1.	Free living	Azotobacter, Clostridium, Klebsiella, Anabaena, Nostoc
	2.	Symbiotic	Rhizobium, Anabaena and Azollae
	3.	Associative symbiotic	Azospirillum
B	**P Solubilizing Biofertilizers**		
	1.	Bacteria	Bacillus subtilis, Bacillus circulans, Pseudomonas striata
	2.	Fungi	Penicillium sp, Aspergillus awamori
C	**P Mobilizing Biofertilizers**		
	1.	Arbuscular mycorrhiza	Glomus sp.,Gigaspora sp.,Acaulospora sp.,
	2.	Ectomycorrhiza	Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.
	3.	Ericoid mycorrhizae	Pezizella ericae
D	**Biofertilizers for Micro nutrients**		
	1.	Silicate and Zinc solubilizers	Bacillus sp.
E	**Plant Growth Promoting Rhizobacteria**		
	1.	Pseudomonas	Pseudomonas fluorescence

Biofertilizers in Fruit Crops

Biofertilizer is a recent concept in horticultural crop. Generally fruit crops have now received more attention than vegetables and ornamental crops. Use of biofertilizer particularly inoculation with Azotobacter could substitute 50% nitrogen requirement of banana and produce higher yield over full doses of nitrogen application. The absorption of mobile nutrients like nitrogen also increases in association with VAM fungi. Beneficial response of Azotobacter and Azospirillum in enhancing the' productivity of bnnana was also reported by many workers. 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. 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).

Effect of Biofertilizers on Growth Characteristics

- Greatest percentage increase has been found in seedling height of mango, seedling diameter and number of leaves by treatment with 49 g N, Azotobacter + 48 g N, 32 g N or Azotobacter alone as compared to control.
- Both soil and foliar application of nitrogen in combination with Azotobacter increase the plant height, plant girth, the number of hands, bunches and the number of fingers/hand significantly in banana cv. 'Robusta'.
- VAM fungi have been found to be effective in papaya in increasing the plant height, stem girth, petiole length and number of leaves.
- Mycorrhizal treatment is superior to non-mycorrhizal treatment in pomegranate.

Effect of Biofertilizers on Yield

- Significant increase in the bunch weight and yield of banana has been achieved with Azotobacter and organic manures supplements over 100% fertilizer.
- Azotobacter also enhances shooting and shortens crop duration.
- The application of Azospirillum + 150 kg/ha of N can increase the yield in strawberry by 54%, the number of fruits per plant and the clump weight compared to treatment with 150 kg N alone.
- The microbial inoculants in combination with inorganic manures have been shown to augment the yield and nutrient uptake in several crops.

Effect of Biofertilizers on Quality Parameters

- A fairly high TSS and reducing sugar content have been reported in fruits harvested from Azotobacter-inoculated banana plant cv. 'Giant Governor'.
- The plant growth, yield and fruit quality of strawberry are significantly increased with the application of biofertilizers and nitrogenous fertilizers.
- Maximum TSS content has been observed with Azotobacter inoculation along with 80 kg/ha of N. Inoculation of fruit plants has proved the possibility of curtailing about 50% P fertilizers without reducing the crop yield.
- The effect of inoculation with Azospirillum and phosphobacteria on the fruit quality of banana (Musa MA) cv. 'Giant Governor'.

CONCLUSION

Our dependency on chemical fertilization has encouraged the flourishing of industries that are producing and marketing the dangerous chemicals which are life-threatening. These chemical fertilizers are not only harmful to human but also damaging the ecological balance. However now farmers are motivated on large scale to shift from chemical fertilization to organic fertilization due to destructive effects on human health when consumed. Use of biofertilizers can be helpful in solving these problems of food need and ever-increasing global population. So, there is dire need to understand the beneficial aspects of biofertilizers to apply it in advanced agricultural practices. The use of biofertilizers can promote the fruit productivity in larger scale and could play a key role in soil sustainability by protecting the environment.

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