

ROLE OF BIO-FERTILIZERS IN HORTICULTURAL CROPS

Sankara Rao Karri

*Department of Horticulture, Institute of Agricultural Science
University of Calcutta, 35, Ballygunge Circular Road,
Kolkata, India
E-mail:ksrgreenplus@hotmail.com*

Abstract: The term bio-fertilizer is made up of two words “Bio” means living and “Fertilizer” means a product that provides nutrients in usable form. But as a product Bio-fertilizer does not contain any significant quantity of nutrients itself. It contains mainly live bacterial or fungal cells, which on application helps in fixing or solubilizing the nutrients present in air or in soil. These are natural fertilizers.

Keywords : Bio-fertilizers, Horticultural crops

INTRODUCTION

Continuous and unbalanced use of chemical fertilizer is leading to decreases in nutrient up take efficiency of plants resulting in decrease in yield. Frequent use of chemical fertilizers at a high rate also causes problem like soil health, deterioration and ground water pollution.

Types of bio-fertilizers

Some common by used Bio-fertilizers in horticultural crops (Fig.1)

1) Azospirillum

It is a non-symbiotic micro aerophilic bacterium commonly found in association with roots of horticultural crops. Its useful characters include high nitrogen fixation capacity and tolerance to high soil temperature. They fix nitrogen in the range of 10 – 40 kg per hectare. *Azospirillum* inoculation helps the plants in better vegetative growth and also in saving inputs of nitrogenous fertilizers by 20 – 30%. It is also well suited for plants raised through nursery.

2) Azotobacter

It is a free living nitrogen fixing bacteria, fixing N equivalent to 25 – 30 kg N/ha. It also produces hormones like IAA, gibberellins, vitamins etc. Benefits are – enhanced branching of roots, up take of NO₃, production of plant growth hormones.

3) Rhizobium

The largest contribution of biological nitrogen fixation is derived from the symbiosis between legumes and species of *Rhizobium*. It is a symbiotic leguminous N₂ fixer. There is now definite evidence to show that legumes particularly the common bean (*Phaseolus vulgaris*), the most important legume for human consumption, respond positively to the inoculation with rhizobia and contribute to the nutrient status of the soil.

4) Phosphate Solubilizers

The phosphate solubilizers containing bacteria or fungi may convert insoluble form of phosphate to soluble form by producing organic acids, in general about 15 – 25% of insoluble phosphate can be solubilized. These fertilizers play a significant role in solubilizing insoluble phosphate. Around 95 – 99% of the total soil phosphorus are insoluble which are not directly available to the plants. Several soil bacteria; particularly *Pseudomonas* & *Bacillus* and fungi *Penicillium* & *Aspergillus* possess the ability to bring insoluble phosphate in soil into. Soluble forms by secreting organic acids such as acetic formic propionic, lactic, glycolic, fumaric and succinic acids. Their inoculum is available in packets of 200 gr similar to that of *Rhizobium*. They can be mixed with FYM and applied to soil.

5) Mycorrhizal fungi (VAM) Vesicular – Arbuscular Mycorrhizae

Mycorrhiza literally means “Fungus root” coined about a century ago. It is an association of plant roots with certain fungi. It is a symbiotic, which means that both plant and fungus benefit from the relationship. The fungi grows within the cortex of roots and send thread like hyphae out into the soil. This fungi extracts nutrients from the soil. Mycorrhiza is more beneficial when new land is brought under cultivation. Mycorrhiza greatly increases the uptake of nutrients especially P & N from deficient soils. It may also mobilize micro-nutrients such as Copper, Zinc, Iron and also helpful in biological control of root pathogens.

E.g. Papaya, Mango, Citrus, Banana, Grape, Pineapple and all vegetables are benefited by VAM inoculation. The most common method of application in sprinkle powdered inoculant on the roots at transplanting time or to add inoculant to soils just before seedling in transplanted crops. e.g. Onion, Tomato, Chilli, Ornamentals inoculation should be done at sowing time in the mother beds.

Role of bio-fertilizers (table 3)

a) In Vegetable Production (Table 2)

Bio-fertilizers are not alternatives to inorganic fertilizers. But they are useful in increasing yield, quality and production. Bhattacharya & Jain (2000) reported increased yield of many crops by use of P – Solubilizing Bio-fertilizers.

Application of Bio-fertilizers viz. *Azospirillum* and Phosphobacteria are known to increase the yield of various vegetable crops like Tomato, Brinjal, Onion, Chillies and Cabbage etc. Thilakavathy and Ramaswamy (1999) reported that application of *Azospirillum* and Phosphotika on the Onion seed bulbs and soil gave an increased yield of 18.3% as well as saved 25% inorganic fertilizers. In another experiment of bio-fertilizers on vegetable and seed yield of cabbage cv. Golden Acre should the best result on vegetable as well as seed yield by application on of 60 kg nitrogen in combination with 50 kg *Azotobacter* culture per hectare (Verma et al. 1997).

The Regional Bio-fertilizer Development Centre, Nagpur conducted experiments at farmer's fields with respect *Azotobacter* and phosphate – solubilizer application on Okra, brinjal, chilli and cauliflower, the application of *Azotobacteres* increased the yield of Okra, brinjal, chilli and cauliflower to the tune of 8.3, 8.9, 15.7, 10.3, 6.2% respectively while the respective response of phosphate solubilizers on brinjal and cauliflower were 10.0 and 7.3%. Significant improvement the growth yield, nutrient uptake, dry matter and vitamin C contents in several vegetable crops were observed on bio-fertilizer application (Table-2).

b) In Fruit Production

Some innovations in this field are as follows :

Banana Suckers are placed directly in the pits filled with the VAM inoculums in FYM base. Application of phosphorus fertilizers was found to be reduced by 25 – 50% depending upon the crop.

Ashok Kumar and Shaumugavelu (1980) conducted an experiment on the effect of *Azotobacter* as Nitrogen fixer on banana. They observed that inoculation of *Azotobacter* and Urea Spray increased the plant height girth and sucker production.

Jeeva *et al.* (1988) found that inoculation of *Azospirillum* in combination with nitrogenous fertilizers increased yield upto 13.1% in banana cv. Poovan and saving upto the extent of 65 kg/ha. of N. Singh (1999) observed that total number of fruits in the mango genotype “MDCH – 1” and guava cv. L – 49 and ‘Allahabad Safeda’ were much higher in plants treated with bio-fertilizers.

Overall Benefits Due to Bio-fertilizer Application

- 1) It helps to increase availability of nutrients, especially Nitrogen and Phosphorus.
- 2) It can replace 20 – 50% of Chemical fertilizers viz. Nitrogenous and Phosphotic fertilizers.

- 3) Increasing farm productivity, generally 10 – 40% in grain yield and 15 – 30% in vegetative growth.
- 4) It helps by decomposition of plant residues and improving C/N ratio of soil, soil texture and structure and water holding capacity.
- 5) Bio-fertilizers are cheaper than the chemical fertilizers.
- 6) It helps in stimulating plant growth in general and roots in particular as they secrete various growth hormones provide better nutrient uptake and increased tolerance towards drought and moisture stress.
- 7) Some organisms also secrete some fungistic and antibiotic like substances that reduces the incidence of certain diseases and increase disease resistance efficiency.
- 8) Mobilize Micronutrients like Zinc and Copper.
- 9) Enhance Chlorophyll content favouring a higher photo-synthesis rate.

Economics of bio – fertilizers

1. Saving of 40 – 50 kg inorganic nitrogen per hectare,
2. 1 ton *Rhizobium* inoculant is equivalent to 100 tonnes of nitrogen.
3. 1 ton of *Azotobacter* & *Azospirillum* each is equivalent of 40 tonnes of N.
4. 1 ton of BGA is equivalent to 2 tonnes of N.
5. 1 ton of Phosphate solubilizers is equivalent to 24 tonnes of phosphorus pentoxide.

Locations of Several National and Regional Bio-fertilizers Production and Development Centres (After DGTD, 1989) (Table 1)

- 1) National Bio-fertilizers Development Centre, Ghaziabad, U.P.
- 2) Regional Bio-fertilizers Development Centre (North), Hissar, Haryana.
- 3) Regional Bio-fertilizers Development Centre (Central), JNKVV, Jabalpur, M.P.
- 4) Regional Bio-fertilizers Development Centre (West), MPKV, Pune, Maharashtra.
- 5) Regional Bio-fertilizers Development Centre (South), USDA, Bangalore, Karnataka.
- 6) Regional Bio-fertilizers Development Centre (East), QUAT, Bhubaneswar, Orissa.
- 7) Regional Bio-fertilizers Development Centre (North East), ICAR, Complex for North-eastern Hill Region, Shillong, Meghalaya

Fig. 1. Types of bio-fertilizers

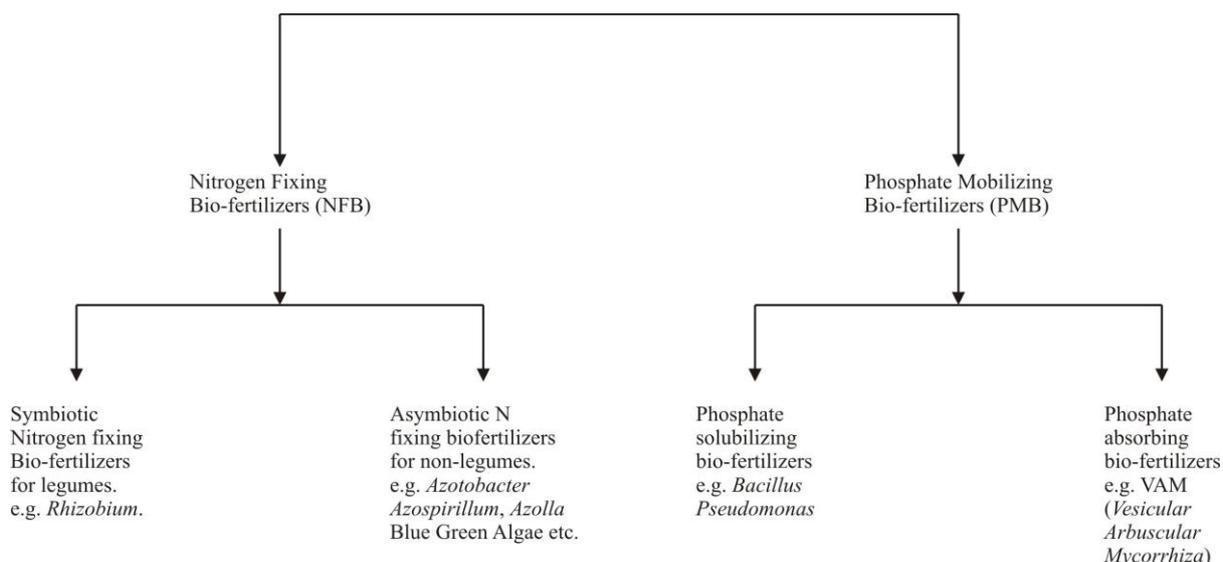


Table 1. Number of Bio-fertilizer Production Units Located in different States/Union Territory.

Sl. No.	Name of the State/ Union Territory	Total No. of BFPU	Total BFP capacity Tons/Yr./State	Distributed Pattern of BFPU.
01	Andhra Pradesh	4	165	SG(1) + AU(1) + P(1) + FI(1).
02	Assam	2	90	AI(1) + AU(1)
03	Bihar	2	20	AU (2)
04	Delhi	1	75	IARI
05	Gujarat	3	300	FI(2) + MFD(1)
06	Haryana	2	125	GI(1) + AU(1)
07	Himachal Pradesh	1	10	SG (1)
08	Karnataka	6	150	AU(2) + SG(1) + GI(1) + P(2).
09	Madhya Pradesh	4	450	GI(1) + AI(1) + MFD(1) + SG(1)
10	Maharashtra	5	250	GI(1) + AI(2) + AU(1) + P(1).
11	Manipur	1	50	GI (1)
12	Orissa	2	125	GI(1) + AI(1)
13	Punjab	1	75	GI(1) + AI(1)
14	Rajasthan	2	100	AI(1) + AU(1)
15	Tamil Naidu	9	450	SG(4) + AU(1) + FI(3) + P(1).
16	Uttar Pradesh	13	300	GI(1)+SG(10)+AU(2)
17	West Bengal	4	150	AU(1) + P(3)
	T o t a l	62	2885	

Abbreviations : AU = Agriculture University, AI = Agriculture Industries, BFPU = Bio-fertilizer Production Unit, BFP = Bio-fertilizer Production, FI = Fertilizer Industries, GI = Government of India, MFD = Marketing Federation, P = Private, SG = State Government.
 Source : Singh (1993)

Table 2. Doses of Bio-fertilizers for Vegetables.

Vegetable	Bio-fertilizers for N & P	Method of application	Quantity of N Bio-fert. Required/ha.
Potato	<i>Azotobacter</i> + P.S.M.	Soil/seed treatment.	4.0 – 5.0 kg.
Raddish Spinach, Okra.	"	"	0.4 – 0.06 kg.
Turnip, Carrot	"	"	0.02 kg.
Onion, brinjal, Cauliflower, cabbage, Tomato, Chilli.	"	Seedling treatment.	1.5 – 2.0 kg.

PSM – Phosphate – Solubilizing Bacteria.

Yield increase in Vegetables at Farmers fields at different locations.

The Regional Bio-fertilizer Development Centre, Nagpur, conducted

Experiments of farmers fields during 1997 – 98.

Place	Treatment	Crops	Yield		Increase in yield over un-
			Control (q/ha)	Treated (q/ha) treated (%)	
Umri Nagpur	<i>Azotobacter</i>	Okra	24.8	26.0	8.3
Ambada, Narkhed	P.S.M.	Brinjal	125.0	137.5	10.0
Tivara, <i>Azotobacter</i>	"	"	190.0	220.0	15.8
Amarvati, Nagpur	"	Chilli	14.5	16.0	10.3
Sweagram, Bopapur,	P.S.M.	Cauliflower	34.0	36.5	7.35
Chikhali, Katol Parshivani	"	Okra	23.4	25.5	8.97

Source : RBDC, VCA Complex Nagpur (1997 – 98)

Table 3. Bio-fertilizers for Horticultural Crops.

Vegetable/Fruit	Microorganisms	Method of Application
Legumes :		
Beans, Green pea, Dolichos and Cowpea.	<i>Rhizobium leguminosarum</i> , bv. <i>Phaseoli</i> <i>Rhizobium</i> spp.	Seed treatment, broad casting.
Non – legumes :		
Tomato, Brinjal, Chilli, Capsicum, Okra.	<i>Azospirillum</i> , <i>Azotobacter</i> , <i>Bacillus</i> spp, Phosphate solubilizing bacteria.	Seed treatment, nursery application and Seedling dipping.
Fruit Crops :		
Mango, Citrus, Papaya, Banana, Grape and Pomegranate.	VAM Fungi, <i>Glomus mosseae</i> , <i>Azospirillum</i> and Phosphate – Solubilizing bacteria.	Nursery application and to be applied in pits while transforming

Nutrients Fixed/Made Available by DIF Microorganisms.

Microorganism	Associated with	Dose (kg/ha/year)
<i>Rhizobium</i> -N-Fixing	Leguminous Vegetables	30 – 180
<i>Azospirillum</i> and <i>Azotobacter</i> -N-Fixing	Non – leguminous Vegetables.	30 – 80
Phosphate-Solubilizing Microorganisms.	Transplantable Vegetables and Fruits.	Solubilizes 40–100 Of Fixed P.
<i>Mycorrhiza</i> .	All Vegetable and Fruit Crops.	

CONCLUSION

The population pressure, water loss, soil erosion, floods, saline and alkaline soils, weed and pest damage are considered to be the main indicators of unsustainability. Hence, supply and judicious use of production factors play a decisive role in the sustainable growth of agricultural production. We have discussed on Bio fertilizers and can conclude that it is an economic, ecofriendly system, which attempts to provide a balanced environment, maintains soil fertility, control diseases and produce safer and qualitative food stuff. However technologies like organic farming or integrated management systems need to be assessed to their location, specific applicability and adaptability to bring about better sustainability. Over all organically grown food may not put more nutrients into once body but will surely optimize the health and production of inter-dependent communities of soil

life, plants, animals and people. When one buys certified organic food and products, the money you spent cast a vote for a healthier planet.

REFERENCES

- Kumar, Ashok, A. R. and Shanmugavelu, K.G.** (1980). Studies on the Effect of Azotobacter and Nitrogen on Banana. Proc. Nat. Sem. On Banana Product. Tech. pp. 121 – 124.
- Bhattacharyya et al.** (2003). Bio-fertilizers for Vegetables. *Ind. Hort.* (July – Sept.) : 12 – 13.
- Jeeva, S., Kulasekaran, M., Shanmugavelu, K.G., Oblisami, G.** (1988). Effect of Azospirillum on growth and development of banana cv.poovan (AAB). *Southindian Hortic.* **36**,1-4
- Verma, T.S., Thakur, P.C. and Ajeet, S.** (1997). Effect of bio-fertilizers on vegetable and seed yield of cabbage sci.,**24**:1-3.

