BIOFERTILIZERS: FUTURE AND PROSPECTUS IN VEGETABLE CROPS

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Abstract - Bio-fertilizer contains microorganisms which promote the adequate supply of nutrients to the host plants and ensure their proper development of growth and regulation in their physiology. Only those living microorganisms are used which have specific functions to enhance plant growth and reproduction. Biofertilizers have emerged as a highly potent alternative to chemical fertilizers due to their eco-friendly, easy to apply, non-toxic and cost effective nature. They make nutrients that are naturally abundant in soil or atmosphere, usable for plants and act as supplements to agrochemicals. The nitrogen fixing bacteria work under two conditions, symbiotically and as free living. Symbiotic include- Rhizobium and Azolla and non-sybiotic include- Azotobacter, Azospirillum. Some bacteria like Pseudomonas and Bacillus convert insoluble inorganic phosphorus present in soil into soluble form which is utilized by the plants. Biofertilizer being essential components or organic farming play vital role in maintain long term soil fertility and sustainability. Intensive promotional activities need to be undertaken so that farmer develop confidence in the use of bio-fertilizers. Encouragement to private industries, state governments volunteers organizations for production, distribution and marketing of bio-fertilizers. These biofertilizers besides increasing in the growth and yield of different vegetable crops, increases the nutrient uptake and also improve the soil available nutrient status.

Key words - Biofertilizer, nitrogen, phosphate and vegetable crops

I. INTRODUCTION

A bio-fertilizer is a substance which contains living microorganisms which, when applied to soil, seed or plants surfaces, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the availability of primary nutrients to the host plants. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants.

DEFINITION

The term “Bio-fertilizer” or more appropriately a “Microbial inoculants” can generally be defined as preparation of containing live cells of efficient strains of Nitrogen fixing, Phosphate solubilising or cellulolytic microorganisms used for application in seeds, soil or composting areas with the objective of increasing the number of such microorganisms and accelerate those microbial process which augment the availability of nutrients that can be easily assimilated by plants.

OBJECTIVE

- Use of bio-fertilizers is one of the important components of Integrated Nutrient Management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizer for sustainable agriculture
- Use of bio-fertilizers in crop cultivation helps in safeguarding the soil health and also the quality of crop products
- Bio-fertilizer can provide an economically viable support to small and marginal farmers for realizing the ultimate goal of increasing productivity.

TYPES OF BIOFERTILIZERS

Bio-fertilizers are a way to increase crop production by naturally optimizing the nitrogen, phosphorus levels of soil and by enriching the compost waste used as natural fertilizer. Based upon this criteria bio-fertilizer are classified in three different types which are given below:

- Nitrogen Bio-fertilizer
- Phosphorous Bio-fertilizer
- Compost Bio-fertilizer

NITROGEN BIOFERTILIZER

Nitrogen bio-fertilizers help to correct the nitrogen levels of the soil. Different bio-fertilizers have optimum effect on different crops. So the cultivated crop determines that what type of nitrogen bio-fertilizer should be use. The nitrogen fixing bacteria

work under two conditions, symbiotically and as free living bacteria (non-symbiotic).

- The symbiotic bacteria make an association with crop plants through forming nodules in their roots. For example Rhizobium
- The free living bacteria do not form any association but live freely and fix atmospheric nitrogen. For example Azotobacter, Azospirillum.

RHIZOBIUM

- They are symbiotic Nitrogen fixing bacteria forming pink coloured root nodules in leguminous plants, like gram, pea, pigeon pea etc.
- Namewas established by Frank in 1889.
- The estimated Nitrogen fixed by Rhizobium ranges from 50-150 kg/ha/year and increases about 10-15% yield.
- They are remarkable because they can live either in the soil or within the root nodule of host legume.
- The culture of Rhizobium is grown in flasks or fermenters and mixed with a currier material like peat.
- Mainly differentiated into slow growing and fast growing strains

AZOTOBACTER

- It is a free-living bacterium that can fix atmospheric nitrogen into the soil.
- Comprise of bacteria that require the presence of oxygen to grow and reproduce.
- Has several features that allow it to survive in harsh environments of the soil.
- Capable of fixing 15-30 kg/N/ha/year.
- Is used for crops, like wheat, rice, and vegetables.

BENEFITS

- Improves the seed germination and plant growth.
- Tolerant to high salts.
- Thrives even in alkaline soils.
- Can benefit crop by Nitrogen fixation and growth promoting substances.

AZOSPIRILLIUM

- It is a gram-negative free living bacteria.
- Also known as plant growth promoting rhizobacteria (PGPR).
- Several species are able to secrete phytohormones such as Auxin, gibberlins, cytokinins etc.
- Are associated with the roots and rhizosphere of several grasses including sugar-cane, maize and sorghum.

BENEFITS

- The effective strain fixes about 15-20 kg atmospheric nitrogen per hectare.
- Certain growth promoting substances released are useful for increasing seed germination, plant growth and ultimately the yield.
- Also exhibit anti fungal activities and thereby fungal diseases may be controlled.
- About 10 to 15% crop yield can be increased.

PHOSPHATE SOLUBILISING BACTERIA (PSB)

Some bacteria, e.g., Pseudomonas, Bacillus etc. convert insoluble non-available inorganic phosphorus (rock phosphate) present in the soil into soluble form which is utilized by the crop plants. These bacteria also protect the plants from harmful microorganisms by producing siderophores which chelate the iron present in the root zone, thus, iron becomes unavailable for the growth of the harmful microorganisms.

BENEFITS

- The effective strain increase the level of available P_2O_5 in the soil.
- With the increase in available P_2O_5 level, overall plant growth can be increased.
- Also exhibit anti fungal activities and thereby fungal diseases may be controlled indirectly.
- Yield can be increased by 10-15%.

COMPOST ENRICHED BIOFERTILIZERS

Bio fertilizers can also be used to enrich the compost with sufficient nutrients and in bacterial processes of breaking down the compost waste. Suitable bio fertilizers for compost use are Cellulotic fungal culture andPhosphotica.

APPLICATION OF BIO-FERTILIZERS

a) Seed treatment

- ✓ About 200g of Bio-fertilizer is required to treat 10-14 kg of seed.
- ✓ Suspend one packet of 200g in approximately 400ml water and mix it thoroughly.
- ✓ Pour this mixture on seeds and mix with hands to obtain uniform coating on each and every seed.
- ✓ Spread seeds in shade for drying for 10-15 minutes then sow them immediately.

b) Cutting/Set treatment

- Prepare a culture suspension by mixing 1 kg of culture in 50-60 liters of water.
- The cut pieces of planting material required for 1 acre are kept immersed in the suspension for 10-15 minutes.
- Then bring out these cut pieces and allow to dry for sometimes before planting.

- Cut pieces method is applicable for crops like potato.

c) Seedlingtreatment

- Prepare the suspension by mixing 1 kg of culture in 10-15litres of water.
- Get seedling required for 1 acre and make small bundles of seedlings.
- Dip the seedlings in suspension for 15-20 minutes.
- Transplant these immediately.
- Seedling treatment recommended for tomato, chilli, onion etc.

Soil application

- Prepare the mixture of 2-3 kg of bio-fertilizer in 40-60 kg of soil/compost.
- Broadcast mixture in one acre of land either at sowing time or 24 hr before sowing.

DISADVANTAGES

- ✓ The acceptability of bio-fertilizers has been rather low chiefly because they do not produce quick response.
- ✓ Amount of nutrient provided by them is not enough to adequately meet the total needs of crops for high yields.

Case Studies

1) Integrated nutrient management on Cauliflower (Brassica oleracea var. botrytis L.)

S. No.	Treatments	Curd height (cm)	Curd diameter (cm)	Fruit yield (t/ha)
T_1	Recommended NPK	8.1	14.2	16.5
T_2	Azospirillum + $N_{75\%}$ + Full PK	9.6	17.1	18.6
T_3	Azospirillum + Recommended NPK	10.6	18.5	20.1
T_4	*Azotobacter* + $N_{75\%}$ + Full PK	9.5	18.1	19.2
T_5	*Azotobacter* + Recommended NPK	10.4	19.2	20.2
T_6	PSB + $P_{75\%}$ + Full NK	9.5	17.8	18.7
T_7	PSB + Recommended NPK	10.1	19.1	20.0
T_8	VAM + $P_{75\%}$ + Full NK	10.5	20.0	21.0
T_9	VAM + Recommended NPK	11.0	21.3	22.6

CONCLUSION

An experiment on Integrated nutrient management Cauliflower (Brassica oleracea var. botrytis L.) was conducted by Narayanamma et al. (2005)[1] and revealed that the application of bio-fertilizers (Azotobacter, Azospirillum, PSB and VAM) along with inorganic, produced significantly higher yield (18.6 t - 22.6 t ha^{-1}) compared to application of recommended dose of fertilizers (RDF) (16.5 t ha^{-1}). The use of bio- fertilizers also enhanced the nutrient status of available Nitrogen, Phosphorus and Potassium in soil.

2. An Influence of bio-fertilizers on the growth character, yield attributes, yield and quality of tomato.

S. No.	Treatments	Plant height (cm)	No. of branches / plant	No. of fruits / plant	Fruit weight (g)	Fruit yield (t/ha)	TSS
T_1	Recommended NPK	63.2	7.72	31	32.57	41.55	4.37
T_2	Azospirillum + $N_{75\%}$ + Full PK	72.6	8.8	33.7	35.63	43.85	4.45
T_3	Azospirillum + Recommended NPK	70.4	8.59	32.3	34.23	41.53	4.4
T_4	*Azotobacter* + $N_{75\%}$ + Full PK	59.2	7.95	27.1	30.13	35.19	4.36
T_5	*Azotobacter* + Recommended NPK	63.9	7.02	25.8	28.63	31.6	4.41
T_6	PSB + $P_{75\%}$ + Full NK	64.1	7.25	26.8	28.67	31.9	4.35
T_7	PSB + Recommended NPK	70.5	7.43	27.8	30.1	37.08	4.41
T_8	VAM + $P_{75\%}$ + Full NK	64.2	7.17	26	29.43	31.49	4.34
T_9	VAM + Recommended NPK	65.8	7.07	26.9	29.37	33.93	4.41

Conclusion

An Influence of bio-fertilizers on the growth character, yield attributes, yield and quality of tomato was studied by Premsekhar and Rajashree, (2009)[2]. They evaluated three type of bio-fertilizers viz., Azospirillum, PSB and VAM in different combination were tested in comparison with inorganic fertilizer treatment. The result revealed that significantly taller plants, better yield parameter and higher yield was recorded with the application of Azospirillum + 75% N + 100% PK followed by Azospirillum + 100% NPK. The same treatment also recorded the highest (3.76) cost benefit ratio.

3. Effect of inorganic and bio-fertilizers on production of (Brassica oleraceaL. Var. botrytis)

Treatments	Height of plant (cm)		No. of leaves per plant		Gross weight of plant (kg)		Average weight of curd (kg)		Ascorbic acid (mg/100g)		Yield (q/ha)	
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04
T_1 Recommended dose of NPK @120:60:60 Kg/ha	54.33	53.16	19.33	20.55	2.25	2.10	0.95	0.94	52.10	52.00	231.20	236.46
T_2 Azos. + 75% N and Rec. dose of P &K	52.86	56.00	21.55	22.25	2.29	2.68	0.98	0.95	56.65	53.90	251.13	246.80
T_3 Azos + Rec. dose of NPK	63.93	65.10	24.22	24.88	3.50	3.30	1.10	1.09	57.18	56.80	282.60	286.06
T_4 Azot. + 75% N and Rec. dose of P & K	55.20	54.18	21.05	22.23	2.74	2.60	0.96	0.99	55.13	54.10	249.26	243.73
T_5 Azot. + Rec. dose of NPK	59.10	61.70	24.00	24.49	3.05	2.95	1.05	1.06	56.83	55.30	275.60	267.66
T_6 PSB + 75% P and Rec. dose of N & K	53.70	55.10	20.83	21.33	2.60	2.53	0.97	0.94	53.12	53.50	237.00	248.53
T_7 PSB + Rec. dose of NPK	57.96	59.80	22.95	22.44	2.95	2.80	0.99	0.98	53.95	54.20	264.86	266.90
T_8 VAM + 75% P and Rec. dose of N & K	51.16	52.70	22.16	22.40	2.51	2.55	0.88	0.87	54.70	53.20	229.06	230.73
T_9 VAM + Rec. dose of NPK	52.98	54.60	22.15	22.65	2.65	2.48	0.90	0.93	52.95	55.60	245.75	247.64
SEm+	2.30	2.01	0.86	0.83	0.118	0.11	0.030	0.033	2.34	2.17	8.37	9.04
C.D. at 5%	6.89	6.02	2.58	2.50	0.355	0.34	0.090	0.099	NS	NS	25.09	27.12

CONCLUSION

An effect of inorganic and bio-fertilizers on production of (Brassica oleraceaL. Var. botrytis) was studied by Singh and Singh (2005)[4]. They recorded that the application of Azospirillum + recommended dose of NPK i.e. 120:60:60 kg/ha through chemical fertilizers significantly increased plant height, number of leaves/plant, gross weight of plant (without root), average weight of curd and yield of cauliflower. The maximum net income and cost benefits ratio was recorded in same treatment.

REFERENCES

[1] Narayanamma, M., Chiranjeevi, C. H., Reddy, I.P. and Riazuddin Ahmed, S.(2005). Integrated nutrient management Cauliflower (Brassica oleracea var. botrytis L.). Veg. Sci. 32(1): 62-64.

[2] Premsekhar, M. and Rajashree, V. 2009. Influence of bio-fertilizers on the growth character, yield attributes, yield and quality of tomato. American-Eurasian Journal of Sustainable Agriculture, 3(1): 68-70.

[3] Khan, S. and Pariari, A. (2012). Effects of nitrogen fixing bio-fertilizers on growth, yield and quality of chilli(Capsicum annum L.).The Bioscan; 7(3): 481-482.

[4] Singh, V. N. and Singh, S. S. (2005). Effect of inorganic and bio-fertilizers on production of (Brassica oleraceaL. Var. botrytis). Veg. Sci. 32(2) : 146-149.

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