

BIOFERTILIZER TECHNOLOGY FOR VEGETABLE CROPS



ALL INDIA NETWORK PROJECT ON SOIL BIODIVERSITY-BIOFERTILIZERS

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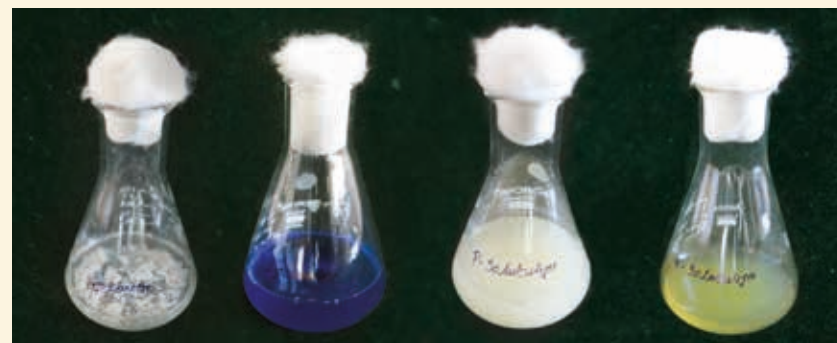
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Background

Most of the biofertilizers are supplied as single inoculant to crops. However, application of single inoculant for different nutrients increases labour and cultivation cost. In this context, microbial consortia are found to be effective in meeting the nutrient requirement as an economically feasible option. ICAR-All India Network project on Soil Biodiversity - Biofertilizers, Vellayani centre Kerala Agricultural University developed a consortium "PGPR Mix - I" for NPK requirement. The consortium consists of *Azotobacter* sp., *Azospirillum* sp., and *Bacillus* spp.

PGPR Mix - I is effective for vegetable crops including brinjal, chillies, tomato, cowpea, cucurbits, onion and cool season vegetables including cauliflower cultivated under irrigated condition. The formulated product increases vegetables yield by 20-25% and saves use of chemical fertilizer up to 25%. The consortium is commercially produced at the biofertilizer production facility and marketed through KVKs (14 no.) and Kerala State Department of Agriculture and Farmer's Welfare. During last 5 years, 120 state agriculture officers were trained and 2060 farmers were benefitted.



PGPR mix -I component cultures

Production of PGPR Mix -I

Efficient N, P and K biofertilizer microorganisms were isolated from Kerala soils. The compatibility of these N, P and K biofertilizer microorganisms were studied and the most compatible organisms were selected. They include two nitrogen fixers (*Azotobacter chroococcum*, *Azospirillum lipoferum*), a phosphate solubilizing bacterium (*Bacillus megaterium*) and a potassium solubilizing bacterium (*Bacillus sporothermodurans*). In order to reduce the cost of production, a new medium (PGPR medium) was developed for the mass multiplication of these microorganisms. The technology for mass multiplication was standardized. Currently talc-based formulation of PGPR Mix – I is being produced for distribution to farmers throughout Kerala. When single inoculant biofertilizer technology give yield increase of 10 percent, PGPR Mix – I is found to give yield increase of 20 - 25 percent depending on the crop. Field studies show that PGPR Mix – I can reduce the use of chemical fertilizers by 25 percent in crops including rice, vegetables and banana. Research



PGPR Mix -I applied



Control

conducted at RRS Moncompu under Kerala Agricultural University showed 50 percent substitution of chemical fertilizers in rice by the application of PGPR Mix – I.

Biofertilizer microorganisms in PGPR Mix – I are maintained on respective agar or nutrient agar slants. Mother culture of each



Chilli plants -PGPR Mix -I applied and control

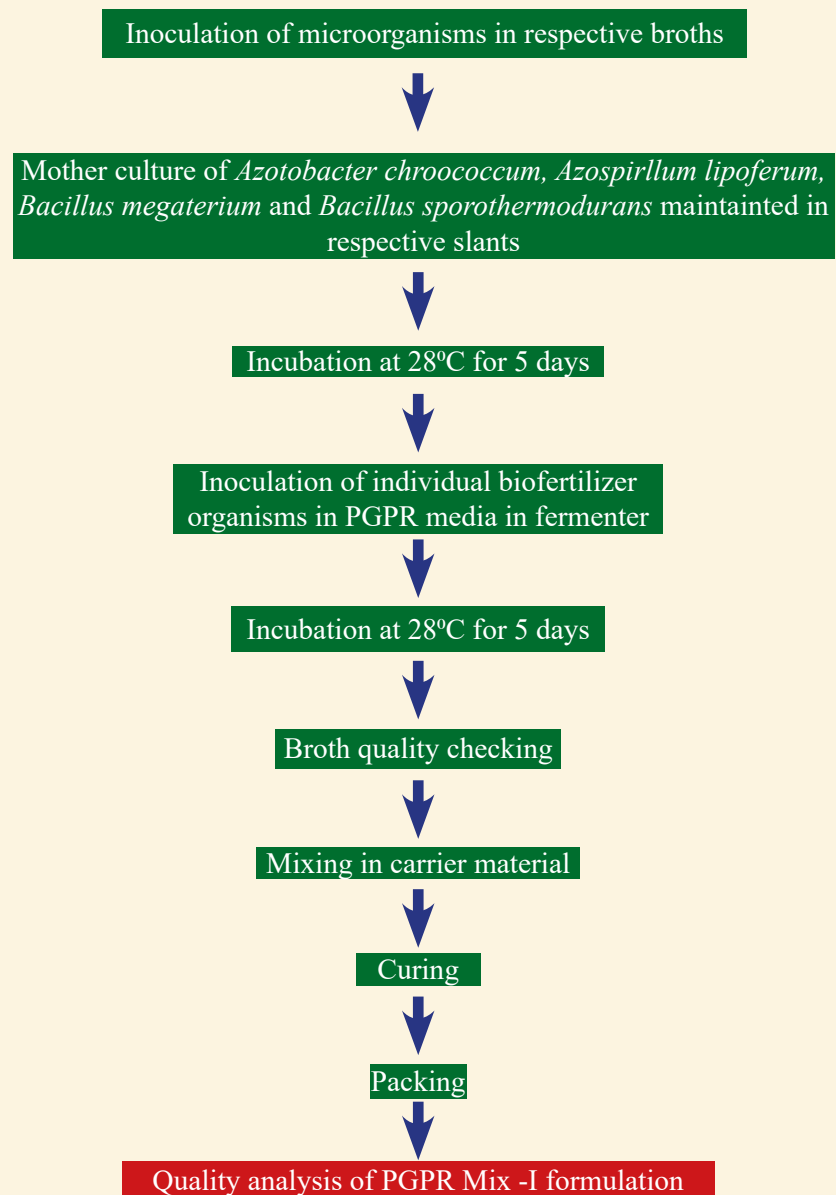
microorganism is inoculated individually in respective broth to prepare stock culture. One litre stock culture is prepared for each constituent biofertilizer organism and inoculated in sterile PGPR medium in a 100 L fermenter. It is incubated at 28°C for 5 days. Each batch is analyzed for microbial population of different component

organisms and the presence of contaminants. After quality analysis the culture consortium is mixed properly with carrier material (talc), cured, moisture content adjusted to optimum and packing done. Microbial quality analysis of random samples from each batch of the packed product is also carried out.



Fermenter for mass production

Mass Production of PGPR Mix - I



Method of application of PGPR Mix – I

Carrier based formulation of PGPR Mix – I is applied along with organic manure. Well decomposed farmyard manure, powdered cow dung, compost etc. can be used. Recommended dose of organic manure for the vegetable crop is mixed well with PGPR Mix – I at the rate of 2 percent (20g per kg of organic manure) and moistened by

sprinkling adequate amount of water. This mixture is applied to the root zone. Irrigation must be given for the establishment of the bioinoculant in soil. This treatment should be repeated 2-3 times at monthly intervals. Adequate moisture must be maintained in the field at the time of biofertilizer application.



Application method

Precautions

1. The instructions given on the packet should be strictly followed.
2. Wear mask and gloves while handling the microbial consortium.
3. Store PGPR Mix – I in the original packet in cool dry place. Do not store along with food and feed materials, and other chemicals like fertilizers and pesticides.
4. Use the product before expiry date to get the desired result.
5. Maintain an interval of 10 days between the application of PGPR Mix – I and any chemical fertilizers or pesticides, wood ash, poultry manure, etc.
6. Apply recommended quantity of organic manure for better establishment of the NPK microbial consortium.
7. Care should be taken to maintain adequate moisture in soil.



PGPR Mix – I inoculated chilli plot

Rate of application of PGPR Mix – I in vegetable crops

Crop	Spacing	Quantity of PGPR Mix – I	Basal dose of FYM or compost
Brinjal	60 cm x 60 cm	1 kg / 100 m ² nursery 2.5 kg ha ⁻¹	25 t ha ⁻¹
Chilli	45 cm x 45 cm	1 kg / 100 m ² nursery 2.5 kg ha ⁻¹	25 t ha ⁻¹
Tomato	60 cm x 60 cm	1 kg / 100 m ² nursery 2.5 kg ha ⁻¹	25 t ha ⁻¹
Amaranthus	30 cm x 20 cm	2.5 kg ha ⁻¹	25 t ha ⁻¹
Bhindi	60 cm x 30 cm	2.0 - 2.5 kg ha ⁻¹	20 t ha ⁻¹
Cowpea	2 m x 2 m	2.0 - 2.5 kg ha ⁻¹	20 t ha ⁻¹
Cucurbits	2 m x 2 m	2.5 kg ha ⁻¹	12.5 kg pit ⁻¹ Additional dose of 12.5 kg pit ⁻¹ at time of vine formation
Cauliflower	60 cm x 60 cm	2.5 kg ha ⁻¹	25 t ha ⁻¹

Economics of production

The initial cost of establishment of biofertilizer production unit is high but the recurring expenditure is very low. The cost of production of PGPR Mix – I is worked out as ₹ 65000 per ton.

Cost – benefit analysis in chilli

PARTICULARS	AMOUNT (₹)
COST INCURRED	
Land preparation	
Hired machinery (@ ₹ 5000)	5,000
Labour (10 no. @ ₹ 700)	7,000
Inputs	
Seeds (2 kg @ 2000/kg)	4,000
Organic manure (25 t @ ₹ 3000/ton)	75,000
Fertilizers and chemicals	40,000
PGPR Mix -I (2.5 kg @ ₹ 85/kg)	213
Irrigation	8,000
Harvesting (labour 20 no. @ ₹700)	14,000
Miscellaneous	2,000
TOTAL COST	1,55,213
RETURNS	
Yield (2400 kg @ ₹ 100/kg)	2,40,000
BENEFIT COST RATIO	1.546

Additional cost incurred per hectare by the use of PGPR Mix – I is approximately ₹ 225. When yield increase of 20 percent is realized, the average gain in income is ₹ 10,000 to 30,000.

Availability

The NPK biofertilizer consortium PGPR Mix – I is available at Department of Agricultural Microbiology, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala.
Price ₹ 80/kg.

Technology Transfer

Year	Training (number of beneficiaries)		Distribution of PGPR Mix – I (in tons)
	Farmers	Extension officers	
2015-16	312	54	11.897
2016-17	352	54	5.340
2017-18	600	27	8.691
2018-19	325	25	4.029
2019-20	470	-	5.860
TOTAL	2059	160	35.817

Regular trainings are conducted in collaboration with the Krishi Bhavans under Kerala State Department of Agriculture and Farmer's Welfare. The technology of PGPR Mix – I is made available to farmers through Krishi Vigyan Kendras and Regional Research Stations under Kerala Agricultural University, Vegetable and Fruit Promotion Council, Kerala, Coconut Development Board and different Krishi Bhavans under State Department of Agriculture.

Stakeholders

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CPCRI, Kayamkulam	Central Plantation Crops Research Institute (Regional Station), Krishnapuram.P.O, Kayamkulam, Kerala 690533, Phone No: +91-479 244 9268
Eco shop, Kudappanakunnu	Eco shop, MLA road, Kudappanakunnu, Chenkallur, Thiruvananthapuram, Kerala 695044
Mitranikethan, Vellanad	Mitranikethan KVK, Vellanad, Thiruvananthapuram, Kerala 695 543, Phone No: 8281114479, 9061628822, trivandrumkvk@yahoo.co.in kvk.trivandrum@icar.gov.in
State Agriculture Department	Krishi bhavans, State Department of Agriculture, Kerala.

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കേരള കാർഷിക സർവ്വകലാശാല മിത്ര സൂക്ഷ്മാണു ഉത്പന്നം

പി.ജി.പി.ആർ. മിക്സ്-I

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