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Research Paper

IISR PGPR Capsule – A Encapsulated Formulation for the Black Pepper growers in Idukki district

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Abstract:
Black pepper cultivation is one of the importance spice crop in western ghats of kerala.
But the area under Black pepper crop is decreasing due to soil acidity leading to nutrient deficiencies of Calcium, Magnesium, pottassium, Zinc, & Boron. A study by KVK revealed that poor nutrient management strategies have resulted in poor nutrient status thus deteriorating the productivity as well as quality of soil. Adoption of technology released by IISR, Kozhikode, use of ***Plant growth promoting rhizobacteria (PGPR)*** *not only increased the production but also the efficiency fertilizer uses in Black pepper crop.*
Key Words*: PGPR, Output, Outcome, Impact*

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I. Introduction

Black pepper (piper nigrum L.) commonly called as "black gold" on account of its economic importance is widely cultivated in Idukki district. Black pepper (piper nigrum L.) is the most important spice of the world refered as 'king of spices'. It is commonly called "Black gold" on account of its economic importance. But in india, especially Idukki the productivity of this spice is low owing to several contracts associated with soil health & management. High rainfall in the black pepper growing area made the soil less productive due to leading and erosion losses of nutrients & has effect on growth of the crop. (Sadanandan,2000). Soil of Black pepper growing areas are low in PH, High Nitrogen, Phosphorus, & medium to low pottassium (Patnaik, 1987). Black pepper requires porous friable soil,having good drainage & adequate water holding capacity, rich in humus & essential plant nutrients. In kerala Black pepper is cultivated in laterate soils, which is acidic,generally low in plant nutrients, low in CEC with weak retention capacity of basis applied as fertilizer. So secondary nutrient &micro nutrient deficiencies are frequent in these soils (Raman*a et al*., 2016).

To tackle this situation among the farmers, ICAR KVK Idukki, adopted the technology of IISR, PGPR technology, during the year 2016 for amending the problems In this context, a case study has been carried out and KVK took the responsibility of technical coordination, technical advice in agricultural aspects, providing the inputs, and ensuring farmers participation in the programme.

Plant growth promoting rhizobacteria (PGPR) have been extensively employed in agriculture for enhanced yield and disease suppression. These PGPR formulations have been found to enhance growth besides being effective replacements for chemical fertilizers/ fungicides. The delivery of PGPR through encapsulation has been a major breakthrough in biofertilizer industry. What makes this technology more exciting is that this encapsulation process can be used to deliver all kinds of agriculturally important microorganisms (Anandaraj*et al.*,2013). Several studies have shown that PGPR not only benefit crops (Kurabachew and Wydra, 2013) but also improve the use efficiency of fertilizers and manures thus allowing reduced application rates (Dinesh *et al.*, 2013). While the beneficial effects of PGPR are widely reported, very little information exists on PGPR for black pepper. Our primary objective was to study the effects of new promising PGPR on black pepper growth promotion and biocontrol of Phytophthora capsici causing foot rot.

II. Situation analysis/ Problem statement

Presently, a successful black pepper crop requires large amounts of chemical inputs that have an adverse effect on soil quality as well as the produce. Hence, efforts are on to devise methods that help in reducing chemical input use. In this context, plant growth promoting rhizobacteria (PGPR) have been found to be successful and have, therefore, been widely employed in many crops.PGPR, root-colonizing bacteria are known to influence plant growth by various direct or indirect mechanisms. Several chemical changes in soil are associated with PGPR. Plant growth-promoting bacteria (PGPB) are reported to influence the growth, yield, and nutrient uptake by an array of mechanisms. Some bacterial strains directly regulate plant physiology by mimicking synthesis of plant hormones, whereas others increase mineral and nitrogen availability in the soil as a way to augment growth. The isolates could exhibit more than two or three PGP traits, which may promote plant growth directly or indirectly or synergistically (Joseph *et al.,* Yasmin *et al.,* 2007). The plant growth stimulating efficiency of bacterial inoculants is affected by soil nutritional condition. The bacterial inoculation has a much better stimulatory effect on plant growth in nutrient deficient soil than in nutrient rich soil Egamberdiyeva D, 2007. The simultaneous screening of rhizobacteria for growth promotion under gnotobiotic conditions and in vitro production of auxins is a useful approach for selecting effective PGPR (Asghar,*et al*., 2004).

2.1.Problems identified

Farmers in Idukki district are spending huge money on fertilizers. It is of great concern that each farmer is spending about 60-70 % of cost of production only on fertilizers and pesticides. KVK has conducted a survey in the district revealed that farmers are applying fertilizers and Pesticides indiscriminately. Majority of farmers are not aware of recommended dosage of fertilizers. The role of PGPR was known to very few farmers.

III. Plan, Implementation of activities and support by KVK.

To overcome this impending problem of farmers, KVK has acquired from IISR, Kozhikode the successful technology called PGPR capsule, a encapsulated formulation which can boost the yield in Black Pepper crops by 20-30%.

About the technology

ICAR-Indian Institute of Spices Research, Kozhikode has successfully developed, field-tested and commercialized encapsulation technology (biocapsules) for smart delivery of agriculturally important microorganisms. The technology involves encapsulation of the microorganisms of interest in a gelatin capsule for delivery to agricultural crops for enhanced soil nutrient solubilization, enhanced growth and yield. The role played by beneficial micro-organisms is very critical in agriculture and they play a vital role in maintaining soil quality, besides enhancing environmental quality. The technical exactness required, time consuming and cumbersome procedures in their method of use are factors which has made the use of beneficial micro-organisms unattractive. There are also concerns about the quality of the commercial formulations available in the market such shelf life, cost of production, ecofriendliness etc. The major attraction for biocapsules are

- smart and precise microbial delivery to crops,
- maintains high microbial population, green technology low production cost
- easy to handle and store
- high shelf life
- production and storage at normal temperature
- does not require sophisticated equipment for manufacture
- can be used to deliver all agriculturally important microorganism

In crop production, beneficial micro-organisms are applied using inert materials such as talc, lignite, etc as carriers. Often such technology is cumbersome and the population of micro-organisms reduces during storage leading to reduced shelf life. Encapsulation technology is a novel technology, one of its kind that ensures smart delivery of agriculturally important micro-organisms (N fixers / P solubizers / mobilisers / Plant Growth Promoting Rhizobacteria (PGPR) / biocontrol agents) through encapsulation in a hard gelatin capsule. It is an easy and reliable technology, Plant Growth Promoting Rhizobacteria (PGPR) are free living bacteria that aggressively colonize and multiply on the roots. The direct effects are through biofertilization, stimulation of root growth and rhizo remediation, while indirect effects are reduction in disease incidence. This improves the use efficiency of fertilizers and manures and thus reduces the application rates. There are three encapsulated strains of PGPR in POWERCAP that promotes growth and increases the resistance towards diseases in black pepper.

Method of application for black pepper

POWERCAP capsule contains 109 propagules. Suspend one POWERCAP capsule in one litre boiled and cooled to to luke warm water and keep it over night with occasional stirring.Next, dilute this one litre solution in 100 litres of clean water and drench the pepper vines @ 1 litre – 3 litre depending on the size of the vine. For ginger, cardamom and other crops, drench depending on the root spread. For nurseries, drench 100 ml of the solution per bag, or mix the solution in digested compost or farmyard manure at the time of bag filling. The same one litre solution can be dissolved in about 8 – 10 litres of clean water and mixed with digested compost on farmyard manure or neem cake and applied to 30 – 50 vines depending on the size. For ginger, cardamom and other crops, apply based on the root spread.KVK has included PGPR as one of the important critical inputs in its mandated activities related to Black Pepper under OFT/FLD, trainings and other extension activities

Interventions Undertaken by the KVK.

The details of the KVK activities undertaken are given hereunder

Table 1. Interventions of the KVK

Activities	**Number of Activities**	**No. of farmers covered**
FLD	10	58
OFT	4	30
Trainings	220	6439
Extension activities	321	4120
Total	**465**	**9404**

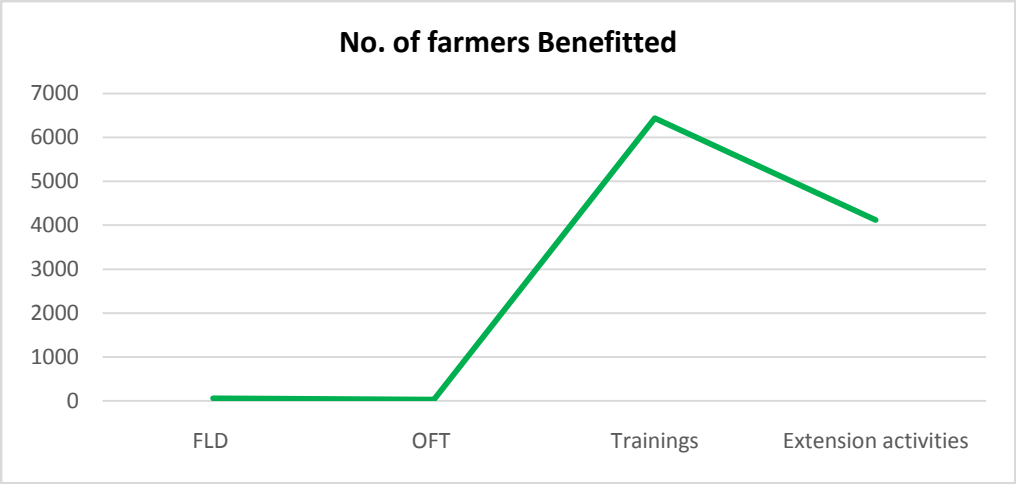


Fig. 1.The number of farmers benefited

Apart from the above mentioned activities, to create awareness among the farmers on PGPR technology, KVK also organized, various in house, off campus and sponsored trainings in collaboration with various agricultural and allied departments, across the district. After obtaining the positive results of the technology, it is being rapidly disseminated to other Black Pepper growers existing in the district.

4. Impact

KVK decided to work on "IISR PGPR capsule" promotion since this is one of the important program for supplying quality inputs for farmers in time.

4.1. Output of the programme

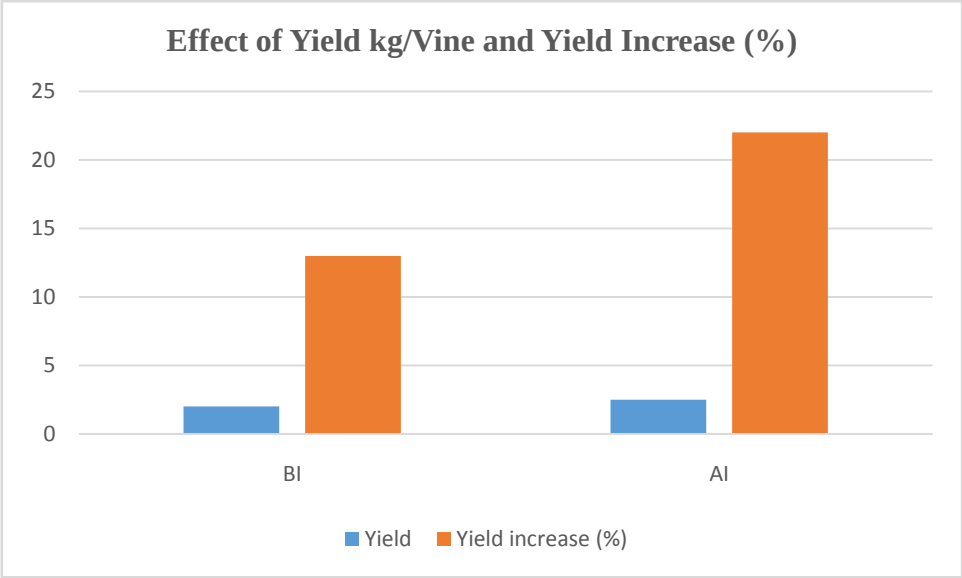
Farmers who have undergone trainings and those who have adopted the technology reported that they attained an increased yield of 19 – 25% inyield .Application of PGPR increased the yield parameter like number of spikes/vine (35.65) , spike yield (160.2g/vine), berries per spike (138.7), 100berry weight (5.20 g), & berry yield (138.7 g) The most relieving benefit, the farmers have experienced as a result of its adoption, is the decrease in

the cost of fertilizers. they could reduce the cost of fertilizers by about 15 percent through this technology. The technology also proved that it gives more resistance to crop against pest and diseases.
Table No. 2. provides information of results of yield parametersbefore and after the intervention. The data gives a clear picture, on how this technology has benefitted the farmers, by giving them higher yield and income.

Table No. 2. Results of yield parameters

	Number of spikes/vine	**Spike length (cm)**	**Number of berry/spike**	**100 berry weight**	**Spike yield (g/vine)dry)**	**Berry yield (g/vine)dry)**	**Yield Kg/vine**	**Yield increase (%)**	**Net Income (Rs)**	**BCR**
BI	31.32	1.04	90.43	5.05	127.4	111.5	2.0	13	109250	2.20
AI	35.65	10.88	113.7	5.20	160.2	138.7	2.5	22	147185	2.63

*** BI**: Before Implementation *** AI:** After Implementation



4.2. Outcome of the programme
Due to the consistent interventions, and efforts, KVK has been successful in reaching a wider farmer population. The IISR PGPR technology has spread over an area of258.4 ha in Idukki district, with more than 2000 farmers adopting this technology. They have also attained more than 20% yield increase as a result of the adoption of the technology.
Consistent efforts taken by KVK in collaboration with State Department of Agriculture has proved to be successful and it is expected to reach all the vegetable growing area of the district very soon.

4.3. Impact of the programme
The impact, or programme effect, refers to a change in the target population that has been brought about by the programme – that is, a change that would not have occurred if the programme had not happened. In this case, there has been a constant increase in the area and productivity of Black Pepper in Idukki district. Adoption of IISR PGPR technology has directly contributed to the increase in average yield by 22%. Presently, the district is also witnessing an increase in demand for IISR PGPR technology not only from the local farmers but also from neighbouring districts.

5. Inference
The overall observation on the impact of IISR PGPR technology among the farmers of Idukki district revealed that, majority of the farmers who have adopted this technology obtained increased yield, Less spike shedding etc. They also revealed that, due to regular usage of the IISR PGPR technology, Soil health also increased.

6. Conclusion
IISR PGPR technology, released by IISR, Kozhikode, has proved to be a real boon for the farmers in terms of increased yield, better soil fertility status and more spike yield in black pepper. It is indeed a cost effective technology to the farming community to enhance their production potential if used in appropriate time as recommended**.**

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Way forward

Witnessing the extent of adoption IISR PGPR technology *among the farmers, KVK Idukki has a plan to educate the farmers of of the district regarding the technology and motivate them to take up the technology for increasing the yield of Black Pepper.*

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