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RESEARCH ARTICLE

CONSTRAINTS IN BLACK PEPPER (*piper nigrum* L.) PRODUCTION USING MICROBIAL INOCULANTS IN IDUKKI DISTRICT OF KERALA

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ABSTRACT

Farmers in Kerala extensively used bio inoculants for the management of diseases and for promotion of growth in black pepper, vanilla, cardamom, betel vine, ginger, rice and vegetables. The study entitled "Constraints in black pepper (*Piper nigrum* L.) production using microbial inoculants in Idukki district of Kerala" is worth due to the role of microbial inoculants in sustainable agriculture presumes special significance. The present study which is an attempt to understand the challenges of MI application in black pepper production in Idukki district. The major constraints in the adoption of MI are lack of awareness about practical utility and lack of technical expertise on MI. Farmers in the study area are incognizant about all types of MI. The narrow knowledge about this technology was the major challenge which has led to the adoption of only few types of bio inoculants.

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INTRODUCTION

Spices have played a conspicuous role in all the civilization of antiquity in ancient India and China and have promoted international relations amongst the various countries all over the world. Aroma and flavour have been a part of the sorcerous rites and have been put into use for various purification ceremonies. Black pepper renowned as the 'King of Spices' and also termed as 'Black gold' is one of the most important spices contributing to commerce and trade in India since pre-historic period. Kerala accounts for 80-90% of the total black pepper production in the country. Idukki and Wayanad are the two major pepper producing districts in Kerala. Karimunda is the most appealing cultivar of Kerala. The other major cultivars include Kottanadan, Narayakodi. Aimperian, Neelamundi, Kuthiravally, Balankotta, Kalluvally and Panniyur -1 to 8, Sreekara, Subhakara, Panchami, Pournami, PLD-2, Sakthi, Thevam, Girimunda and Malabar are the improved varieties released for cultivation. The continued and indiscriminate use of chemical fertilizers and pesticides for enhanced soil fertility and crop productivity resulted in unexpected harmful environmental effects. In order to maintain agricultural productivity along with sustainable ecosystem, integrated management for nutrients, diseases and pests can be advocated.

The advent of intensive farming and its prevalence in Kerala for the past 50 years have resulted in the decline of beneficial micro-organism, loss of soil fertility and vitality, collapse of the sustainable agricultural system, soaring of cost of cultivation, health hazards and challenged food security and food safety (GOK, 2008). Recently the farmers of Idukki district are switching in favour of organic pepper production. This intensified the need of microbial inoculants (MI) as a substitute of chemical plant protectants. Microbial inoculants(MI) such as *Trichoderma viridae*, *Pseudomonas flourescens, Rhizobium* sp., *Beauveria bassiana, Lecanicilliumlecanii, Azetobacter, Azospirillum,* VAM, Phosphorous solubilizing bacteria, *Paecilomyces lilacinus*, PGPRs etc. in terms of soil, plant and human health. The importance of organic farming and residue free commodities would certainly warrant increased adoption of the microbial inoculants. Under these circumstances, this study pointing finger to the constraints and threats experienced by the microbial inoculants using pepper farmers. The study was conducted in Idukki district which is the major producer of black pepper. Two development blocks in the district Kattappana and Nedumkandam with maximum area under pepper cultivation were selected for the study.

Review of literature: According to Giriappa (1990) non-availability of quality vines, poor genetic base of the existing strains, old and senile plantations, non-adoption of scientific management like nutritional and plant protection strategies were some of the reasons for low productivity in black pepper. Since the scope of increase in the area was limited the only option was to increase the productivity of black pepper. Jerome (1991) analyzed that the growth performance of area under black pepper in Kerala was characterized by swinging and stagnations. Lack of institutional support, traditional methods of cultivation, pests and disease attacks were the core reasons for the stagnant yield. Analysis pointed out trends in farm, wholesale and export prices of pepper showed high degree of instability and year-to-year fluctuations. The study stressed the importance of intensive cultivation of pepper in future rather than extensive one. The very fluctuating price of pepper in the international market led the small and marginal pepper farmers to switch over other high valued crops like vanilla and cardamom. India was suffering from lack of good quality planting materials, poor cultivation practices, less fertile soil and the outbreaks of diseases, resulted in yield (267 kg/ha) of pepper in India far less than the yield in other countries like Vietnam or China (2000 kg/ha) (Madan, 2000).

Thomas (2009) reported that the major constraints of black pepper cultivation in Kerala were lack of finance and indebtedness of pepper growers, non-availability of healthy and disease resistant varieties, inadequate efforts on value addition and inadequate assistance from the developmental agencies like Spices Board and Krishi Bhavans. According to Sajitha (2012) black pepper was intensively cultivated in Wayanad district as compared to Idukki district. This study also reported that field in Wayanad was more prone to risk than Idukki. Standards of black pepper were destroyed in Wayanad during 2000 due to the incidence of gall wasp attack on *Erythrina* sp. After this incidence pepper growers in wayanad were facing the problem of lack of proper standards to grow the pepper vines. Idukki has got an advantage of more strong standards which allowed the growers to cultivate more black pepper in their small plot of land.

The performance of pepper production showed a decline in terms of area, production and yield at state level, price in Calicut and Cochin market from 1980-81 to 2010-11 moved more or less similar pattern, though it recorded wide fluctuation over the years (Sajida, 2014). According to Ajagol (2016), absence of separate markets for selling and export of organic produce was the primary constraint faced by MI using farmers and that of conventional farmers was unexpected change in consumer preference. Lack of sufficient knowledge about plant protection measures, non-availability of timely guidance, the lack of knowledge about proper stage of control of insect pests, non availability of bio-agents at proper time etc. were the major constraints in adoption of bio agents in black pepper production (Dhaliwal and Singh, 1993). Crissman and Cole (1994) studied that cotton being a commercial crop, majority farmers expected a higher level of the extension activities, but the actual situation was not in accordance with their demands and hence, lack of adequate extension was one of the core factors along with the lesser impact of bio-fertilizers than that of the chemical fertilizers for not using the bio-control agents extensively. Lack of sufficient knowledge for seed treatment with *Trichoderma* sp. and unknowingness about practice of biological pest management strategies were the major constraints in cotton cultivation (Benitez, 2004).

Bio-N –a commercial product of *Azospirillum* has the shortest shelf life. Chupungco and Paunlagui (2004) marked in one of their papers that low shelf life affected marketing facet where producers were uncertain in producing the products without bulk orders for fear of product wastage. So inadequate supply of microbial inoculants was one of the constraints. Weak coordination between the actors of the policy, enterprise and demand domain of the bio fertilizer innovation system was major drawbacks in the sustained bio fertilizer adoption process and market development (Cuevas, 2005). Determining the feasibility and practicability of using microbial inoculants to enhance the species and genetic diversity of marginal soils and monitoring the survival and dispersal of inocula in treated soils were the challenges faced by the farmers who adopted microbial inoculants (Irtwange, 2006). The major restraints in adoption of biological practices were lack of knowledge and skill for determining Economic Threshold Level (ETL) (89%), non-availability of bio-control agents and bio fertilizers (91%), lack of knowledge about bio fertilizers (73%), lack of knowledge about untoward effect of chemical pesticides (32%) (Verma, 2006). The inaccessibility to credit made the farmers less inclined to go for adoption of bio inoculants. The empirical findings of Kallas *et al*. (2010) unwrapped that majority farmers needed credit for adopting disease suppressing agents. Therefore, if the farm family received credit, they were ultimately in favour of adoption of bio inoculants.

Adoption decision was influenced by farm size. A study conducted by Musara *et al*. (2012) disclosed that adopters of MI possessed more land area than the non-adopters; found that adopters had more land hence diversified crops. Conversion of farm practices from conventional to organic was much more difficult for resource poor farmers who were risk averse, especially under conditions of uncertainty. Exposure of comprehensive information on novel technologies, its utilities and applications, assurance of benefits and institutional support were essential inputs that could help the farmers' decision to adopt the innovations and overcome restraints (Yogesh and Mokshapathy, 2013). Microbial inoculants (MI) are plant growth promoting beneficial endophytes (microbes) that can be used as agricultural amendments. Microbial inoculants offer a biological protective covering capable of mobilizing nutrients from unavailable form to available form.

The production of bio-inoculants in India was reported as 20,040.35 tons in 2009-10 and Kerala is the third major producer with a share less than 10 per cent (Devi 2014). Black pepper when treated with the Plant Growth Promoting Rhizhobacteria (PGPRs) showed enhanced nutrient mobilization in the rhizhosphere and it exhibited significant uptake of Nitrogen (N) and Phosphorous (P) that resulted in improved plant growth and better root proliferation (Diby *et al*., 2005). Supanjani *et al.* (2006) reported that mineral availability, mineral uptake and plant growth of black pepper and cucumber were increased by the application of *Bacillus megatherium varphosphaticum* and potassium solubilizing bacteria *Bacillus mucilaginosus* to nutrient limited soil. According to Nair (2014) *Trichoderma* spp. *and Pseudomonas fluorescence*, which were antagonistic microbes, assisted in decreasing *Phytophthora* foot rot of black pepper. Application of *Trichoderma harzianum* around the base of the vine at the rate of 50g/vine had the capacity to reduce the disease incidence.

Table 1. Production constraints faced by MI using black pepper farmers

Sl. No	Production constraints	Garret's score	Rank
1	Less availability of microbial inoculants other than *Pseudomonas* and *Trichoderma*	63.44	2
2	Difficulty in proper identification of pests and diseases	70.36	1
3	Gall wasp attack of standards	51.68	5
4	Climate change	53.30	4
5	High cost of PP chemicals	46.98	7
6	Lack of support from agricultural institutions	47.96	6
7	Difficulty in availing institutional credit	37.95	8
8	Difficulty in intercultural operations	34.41	9
9	High price of MI	30.71	10
10	Lack of knowledge about correct dose, method and time of application of MI	60.54	3

Table 2. Marketing constraints faced by MI using black pepper farmers

Sl No.	Marketing constraints	Garret's score	Rank
1	Lack of demand from local households	46.11	5
2	Unorganized marketing channels	37.15	6
3	Lack of coordination among pepper growers	48.86	4
4	Frequent fluctuation in market price	75.35	1
5	High market margins	54.13	3
6	Difficulty in meeting export standards of pepper	60.76	2

Table 3. Technological constraints faced by MI using black pepper farmers

Sl No.	Technological constraints	Garret's score	Rank
1	Lack of knowledge about MI	49.75	3
2	Lack of awareness about practical utility of novel technologies	63.71	1
3	Lack of technical expertise on MI	57.71	2

MATERIALS AND METHODS

Nedumkandam panchayat from Nedumkandam block and Irattayar panchayat from Kattappana block of Idukki district were selected for the study. From each Panchayath, 15 farmers adopting microbial inoculants in black pepper cultivation were selected randomly. Thus the total sample size was 30.

Constraint analysis - garret's ranking technique: During survey, the respondents were asked to rank the identified constraints. These ranks were converted into percentage position by the following formula

Per cent position = $100 \times (R_{ij} - 0.5) / N_j$

R_{ij} = Rank given for i^{th} factor by j^{th} farmer.
N_j = Number of factors ranked by the j^{th} farmer (Garret, 1969)

The percentage position estimated is converted into scores with reference to the Garret's table. Thus for each constraint identified, the scores of various respondents were added and the mean value was calculated. Thus obtained mean scores for each of the constraint were arranged in descending order and the major constraint would be the attribute with highest mean value.

RESULTS AND DISCUSSION

Constraint analysis: Constraint is anything that prevents development of a system. In this study respondents were asked to rank the difficulties they faced during pepper cultivation and adoption of MI in black pepper cultivation. A thorough understanding of constraints helps to formulate research and to suggest suitable policy options. The constraints were classified into 3 groups, such as production constraints, marketing constraints and technological constraints.

The constraints faced by pepper growers were ranked and scores were obtained using the Garret's ranking techniques were presented in tables.

Production constraints: As shown in table 1, the major production constraint faced by MI users was difficulty in proper identification of pests and diseases (score 70.36) followed by less availability of microbial inoculants other than *Pseudomonas* and *Trichoderma* (score 63.44 to 63.41) and lack of knowledge about correct dose, method and time of application of MI (score 60.54) climate change is the next major threat to pepper producers. During the flowering time lead to low yield. *Erythrina* sp. is the most commonly used standard for pepper vines. Gall wasp attack on *Erythrina* was also an important challenge faced by MI using pepper farmers.

Marketing constraints Table 2: The major marketing constraints faced by MI users were frequent fluctuation in market price (score75.35), followed by difficulty in meeting export standards of pepper (score 60.76). Organic standards followed by farmers of study area were not up to the mark of export quality was the challenge and high market margin was the third major threat faced by MI users in marketing the product.

Technological constraints Table 3: Lack of awareness about practical utility of novel technologies such as Microbial inoculants technology (63.71) and lack of technical expertise on MI (57.71) were the two major technological constraints of MI using black pepper farmers. Lack of proper knowledge about MI was also a challenge.

Conclusion

From the study it was observed that all farmers in the study area were facing one or the other constraints, which hindered them to adopt the novel technologies. Lack of awareness about practical utility and technical expertise on microbial inoculants

are the critical challenges. Moreover they faced constraints like frequent fluctuation in market prices for black pepper, difficulty in meeting export standards and the lack of knowledge about correct dose and method of application of these bio inoculants. Bringing awareness of these new and enhanced technologies would certainly lead the farmers to battle their constraints.

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