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Farmer participatory evaluation of integrated nutrient management system involving PGPR Mix-I in rice in Kollam district

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Abstract

Use of biofertilizers as a component of the integrated nutrient management system has been proved as an ecofriendly and economically viable approach towards sustainable agriculture. Krishi Vigyan Kendra, Kollam under Kerala Agricultural University had undertaken a farmer participatory on farm testing programme to assess the effect of PGPR mix I (plant growth promoting rhizobacteria consortium developed by Kerala Agricultural University), a NPK biofertilizer as a component in the integrated nutrient management system of rice on growth, yield attributes and yield in ten randomly selected farmers' fields in Kollam District of Kerala. This trial was laid out in a randomized block design with 10 replications. The experiment consisted of three treatments viz., T_1 farmers's practice i.e. unscientific use of complex fertilizers, T_2- lime(600 kg /ha) + organic manure(5t/ha)+100% recommended dose of fertilizers ie., NPK @90:45:45 kg/ha, T_3 - lime (600 kg /ha) + organic manure(5t/ha)+75% recommended dose of fertilizers (NPK) +PGPR Mix I @2 kg/ha. The results of the study revealed that the treatment involving PGPR Mix I (T_3) showed significantly higher growth and yield attributes viz., plant height, number of tillers per hill, number of productive tillers per hill and filled grain per panicle. The highest grain yield (4.95 t/ ha) was observed with the treatment T_3, wherein PGPR mix I was applied alongwith lime, organic manures and 75% RDF (NPK). The resuls of the study proved that the application of PGPR mix I could save 25% fertilizers without compromising yield. Hence use of PGPR mix I as a component in INM of rice is economical and effective with advantages in growth and yield.

Key words: integrated nutrient management, plant growth promoting rhizobacteria, rice, grain and straw yield

Introduction

Area under rice cultivation is diminishing rapidly in Kerala. Presently rice is cultivated in 1.98 lakh ha with a production of 5.62 lakh tones and an average productivity of 2.87 t/ha (Maneesh and Deepa, 2016). The productivity of rice in Kerala is low. The reasons for low productivity is imbalanced and heavy use of complex chemical fertilizers, toxicity of some nutrients and reduced rate of application of lime for acidity management. Continuous and indiscriminate use of chemical fertilizers has resulted in deterioration of soil health and environmental pollution. The productivity improvement can be achieved by the adoption of integrated nutrient management (INM) practices and proper liming. INM is the integrated use of different source of nutrients like organic manures, chemical fertilizers and biofertilizers which are essential for improving the productivity. Biofertilzers are ecofriendly and environmentally safe technology which forms an integral part of INM and are now being widely used in rice production. Plant growth promoting rhizobacteria (PGPR) are heterogeneous group of bacteria that can be found in the rhizosphere, at root surfaces and in association with roots (Ahamad *et al.*, 2008) .PGPR include *Azotobacter sp., Azospirillum sp., Pseudomonas sp., Bacillus sp.* etc that stimulate plant growth, maintain soil health through fixation of nitrogen and enhance the response to potassium, phosphorus and other nutrients in a variety of crops (Ahamad *et al.*, 2008 and Kamnev and Lelie, 2000). Kerala Agricultural University has isolated and commercialized a product containing plant growth promoting rhizobacteria named as PGPR Mix 1 which include the organisms serving as biofertilizers for N, P and K. However the assessment of the effect of this NPK biofertilizer in rice has so far been not done in Kollam district. Hence an OFT was conducted with

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an objective to evaluate the effect of PGPR Mix 1 as a component in the INM of rice on crop growth and yield through farmers participatory research.

Materials and methods

On farm testing (OFT) programmes with active participation of farmers is a practical way to identify technologies compatible with the complex, diverse, risk prone environment of the farmers, which ultimately leads to sustainable production. This OFT was carried out during rabi season in ten randomly selected fields of farmers of Kollam district. The trial was conducted with active participation of farmers from sowing to harvest. The experiment was laid out in randomized block design and the fields of farmers in different locations were taken as replications. The fertility status of selected plots was low to medium in organic carbon, high in available P and low to medium in available K and the plot size was 1000 m^2 (25cents). The rice variety selected was Uma (a medium duration high yielding rice variety with red kernel). Scientists of KVK monitored the farmers' experiment focusing in particular on their assessment of the technology. This trial consisted of three treatments; T_1- farmers's practice (heavy use of complex fertilizers), T_2- Recommended dose of fertilizers as per Package of Practices (90:45:45 kg N,P,K per ha) + Lime(600 kg/ha) + 5 t OM, T_3- 75 % recommended dose of fertilizers as per POP (90:45:45 kg N,P,K per ha) + Lime(600 kg/ha) +5 t OM+PGPR Mix1@2 kg/ha. Biofertilizer used in the trial was purchased from the Department of Agricultural Microbiology, College of Agriculture, KAU, Vellayani. One kg of biofertilizer PGPR Mix I was mixed with 100 kg farm yard manure and was applied. All agronomic and plant protection measures as per Package of Practices of KAU were followed. There was direct involvement of farmers at all stages of the experiment right from the conduct of field experiments, taking observations, evaluation and arriving conclusions throughout the trial. Observations on plant height(cm), number of tillers(number per hill) at 30 and 60 days after planting, number of productive tillers/hill, filled grain per panicle, 1000 grain weight(g), grain yield(t/ha) and straw yield(t/ha) were recorded. The data were analyzed using statistical procedure with the 10 farmer's fields serving as replications (Panse and Sukhatme,1985). Economical analysis of the technologies were done and results are presented below.

Results and discussion

The data pertaining to the effect of NPK biofertilizer PGPR mix I on growth, yield attributes and yield of transplanted rice are given in table 1. The results of the study clearly showed that the growth, yield and yield attributes were significantly improved by the tested INM practice ie., integration of NPK biofertilizer PGPR Mix 1, organic manure and chemical fertilizer.

Application of biofertilizer PGPR mix I along with 75% of recommended dose of NPK nutrients (T_3) has shown significant effect on plant height at 30 and 60 DAT. This treatment resulted in maximum plant height of 53.93 cm and 98.29 cm at 30 and 60 DAT respectively However the plant height was comparable to T2 at 60 DAT.

The statistical analysis of the data on number of tillers/hill showed that at 30DAT the treatment T_3 produced maximum number of tillers (5.89) which was on a par with T_2 (5.6) while at 60 DAT the treatment T_3 was significantly superior(10.12) to all other treatments. The farmers practice ie, use of complex fertilizers resulted in poor growth of rice indicated by short plants with least number of tillers. Perusal of the data on yield attributes indicated that highest number of productive tillers (8.25) was recorded in T_3 which was statistically different from the other treatments. The treatment T_1 produced the lowest number of tillers (6.03). In T3, the adoption of INM resulted in plants with more filled grains per panicle (99.19) which was also significantly different from that in T_2 (96.75). Application of PGPR MIX I did not show any significant influence on thousand grain weight.

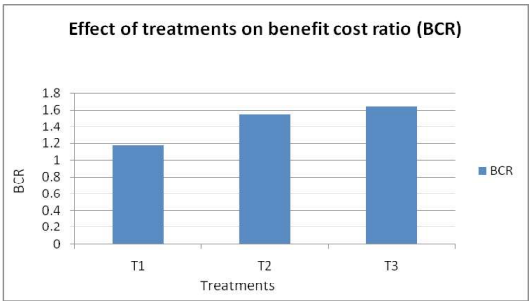
Grain and straw yields were significantly influenced by the treatments. The highest grain yield of 4. 95 t/ha was obtained in T_3 and was significantly superior to all other treatments and the lowest grain yield (3.24 t/ha) was observed with T_1.The highest straw yield of 7 t/ha was recorded by T_3 though there was no significant difference between T2 and T3 a and the lowest straw yield of 4.67 t/ha were observed in T1. The treatment T_3 also registered the highest benefit cost ratio of 1.64. Hence the treatment involving the biofertilizer was found to be economic also (Fig. 1). The economic analysis of the technologies indicated superiority of T3 (B:C 1.64) over other treatments.

The concept of integrated nutrient management (INM) system as proposed by Adesemoye and Kloepper (2009) relating to the use of biofertilizers in combination with chemical fertilizers to stimulate uptake of nutrients proves to be promising in Kollam

Table 1: Effect of integrated nutrient management system involving PGPR Mix-I in rice

Treatments	Plant height(cm)		No of tillers (no/hill)		No of productive tillers(no/hill)	Filled Grain (%)	1000 grain weight(g)	Yield (t/ha)	
	30DAT	60DAT	30DAT	60DAT				Grain	Straw
T1	47.09	88.49	4.76	8.2	6.03	81.30	21.92	3.24	4.65
T2	50.36	97.58	5.6	9.36	7.57	96.75	22.17	4.67	6.87
T3	53.93	98.29	5.89	10.12	8.25	99.14	22.26	4.95	7.00
CD(0.05)	1.921	3.164	0.463	0.607	0.597	2.295	NS	0.250	0.238
CV	4.051	3.552	9.126	6.997	8.723	2.643	2.929	6.150	4.076
SEm±	0.636	1.065	0.156	0.204	0.202	0.773	0.239	0.083	0.080

Fig. 1: Effect of integrated nutrient management system involving PGPR Mix-I on BCR



district. The unscientific use of complex fertilizers taken as farmers' practice produced crop with impaired growth and yield In the present experiment, application of NPK biofertilizer PGPR mix I along with 75% of recommended dose of NPK nutrients (T_3) enhanced the growth and yield of rice. PGPRs produce plant hormones such as gibberellins, cytokinins and auxins, which at low concentrations influence plant physiological processes such as host's root respiration rate, metabolism, and root abundance (Kloepper et al. 1991). The favourable effect of biofertilizers on growth and yield attributes could be due to the better availability of nutrient from the different sources of nutrients along with the growth promoting effects of PGPR Mix 1 which might have enhanced the growth attributes that in turn increased the yield attributes and yield. Effective PGPR strains which increased plant growth and nutrient uptake of rice (Meunchang et al.2006). In another work, Young et al. (2003) found 25 % increase of lettuce yield over the control when he used multifunctional biofertilizer (mixture of *Bacillus sp. B. subtilis, B. erythropolis, B. pumilus, and P. rubiacearum*).The integration of biofertilizer in the INM was also economic and environmentally safe as it reduced the quantity of chemical fertilizers in soil.

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