

EFFECT OF PHOSPHORUS SOLUBILIZING MICROORGANISMS ON YIELD PARAMETERS OF PADDY

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ABSTRACT

A field experiment was conducted for two seasons during Kharif 2000 and 2001 at ICAR, Mizoram Centre, Kolasib to study the effect of graded doses of P along with phosphorus solubilizing microorganisms on yield performance of paddy in an acid Inceptisol. The results revealed that the grain yield was significantly increased with the increased doses of P application up to 90 kg P₂O₅/ha during Kharif 2000 and up to 60 kg P₂O₅/ha in 2001. Highest grain yield was recorded in both the seasons with the bacterial (*Pseudomonas striata*) inoculation of rice seedling of 60 kg P₂O₅/ha. Inoculation of solubilizing microorganism and application. The results indicated that bacterization of seedlings in combination with application of optimum dose of P fertilizers enhanced the grain yield and minimized the expenditure on fertilizer cost to an extent of 20-30 %.

INTRODUCTION

Rice is the major staple food crop in Mizoram and occupies an area of 68,392 ha (68 % of total cropped area) with a production of 1.10 lakh tones (61 % of total food grains production) (Anonymous, 2000). However, the productivity is higher in low lying areas (2280)kg/ha in comparison to Jhum lands (1262kg/ha). Low crop productivity is due to topography, unfavorable climatic condition, severe soil erosion, acidity and other associated problems (Laxminarayana and Azad Thakur, 1999). The fertilizer consumption in this state is very low i.e. 0.25, 0.53 and 0.37 thousand tones of N, P, K according to the estimated of 1998-99 (FAI, 2000). Low mineralization of organic P, fixation of P compound with iron and aluminium oxides and sorption of P with organic compounds have resulted in low P use efficiency. Introduction of P solubilization microorganisms in the rhizosphere of crop and soil increases the availability of P from insoluble sources of phosphate, desorption of fixed phosphate and also increases the efficiency of phosphatic fertilizers (Gaur, 1990). In this context, the present investigation was carried out to study the effect of graded doses of P in combination with P solubilizing microorganisms on yield performance of lowland paddy.

MATERIAL AND METHODS

A field experiment was conducted during Kharif 2000 and 2001 at ICAR Mizoram Centre, Kolasib. Initial soil sample was collected, processed and analysed for textural components, organic C and other physico-chemical properties. The experiment was laid out in a randomized block design in three replications with 10 treatments (control, 30 kg P₂O₅/ha, 60 kg P₂O₅/ha, 90 kg P₂O₅/ha, Phosphorus Solubilizing Bacteria (PSB) inoculation, 30 kg P₂O₅/ha + PSB, 60 kg P₂O₅/ha + PSB, Vesicular Arbuscular Mycorrhiza (VAM) inoculation, 30 kg P₂O₅/ha + VAM and 60 kg P₂O₅/ha + VAM. The experiment soil is sandy loam in texture, acidic (pH 5.1), high in organic C (0.82 %) low in available N (236 kg/ha) and P (9.4 kg/ha) and high available K (208 kg/ha). The VAM culture was broadcasted on the seedbed before sowing. However, the seedlings were inoculated in PSB treated slurry by root dipping for two hours and transplanting the inoculated seedlings in the respective treatments. A uniform dose of N @ 100kg/ha (½ at basal, ¼ at tillering and ¼ at panicle initiation stage) in the form of urea and K @ 40 kg/ha K₂O/ha in the form of

muriate of potash at basal were applied. The P dose were applied at basal as per the treatments in the form of single super phosphate. Rice (cv RCPL - 1-88-75) seedlings were transplanted at a spacing of 20 x10 cm. The crop was harvested at maturity and yield parameter like number of tillers/hill, number of grains/penicle, 100 grain weight, grain yield and straw yield were recorded. Per cent yield response and yield response per kg of applied P2 O5 were calculated.

$$\text{Percent yield response} = \frac{\text{Treatment yield (kg/ha)} - \text{Control yield (kg/ha)}}{\text{Control yield (kg/ha)}} \times 100$$

$$\text{Per cent yield response} = \frac{\text{Treatment yield (kg/ha)} - \text{Control yield (kg/ha)}}{\text{Amount of P2O5 applied(kg/ha)}} \times 100$$

RESULTS AND DISCUSSION

The results revealed that the grain yield was increased significantly with the increased dose of P up to 90 kg P2 O5/ha. Highest grain yield was recorded with the inoculation of PSB and application of 60 kg P2 O5/ha (55.30 q/ha) closely followed by 90 kg P2 O5 /ha (53.30 q/ha). However, highest straw yield was recorded with the application of 90 kg P2 O5/ha (156.0q/ha) followed by 60 kg P2 O5/ha + PSB (153.6 q/ha). All other yield attributes showed similar trend with the grain yield. It was observed that bacterization of paddy with *Pseudomonas striata* and application of 60 kg P2 O5/ha has recorded highest yield response (505) as compared to control and 11% higher than the application of 60 kg P2 O5/ha. Application of 60 kg P2 O5/ha along with inoculation of PSB showed higher yield response than the application of higher doses of P i.e. 90 kg P2 O5/ha. The per cent yield response at different graded doses of P (30,60 and 90 kg P2 O5/ha) was found to be 20.9, 35.2 and 44.4, indicating that increased doses of P application up to 90 kg P2 O5/ha showed positive response on grain yield. Inoculation of PSB and VAM without any P fertilizer has recorded an increased of 17 and 9 per cent grain yield in comparison with control, emphasizing the beneficial effect of P solubilizing microorganisms. Inoculation of P solubilizing microorganisms in combination with chemical P fertilizers showed higher yield response might be due to an increase in the availability of P from insoluble phosphates, mineralization of organic P and increase in the efficiency of added P fertilizers. These results are in accordance with the findings of Gaur (1985)

It was found that highest percent yield response per kg of applied P (39.3) was recorded with the application of 30 kg P2 O5/ha + PSB. The fertilizer use efficiency in terms of grain yield with the application of graded doses of P was found to be 25.7, 21.7 and 18.2 kg grain per kg of applied P2 O5. Increased doses of P fertilizers showed decreased trend of P use efficiency. Inoculation with bacteria (PSB) showed higher crop response and P use efficiency than the fungal (VAM) inoculation. The grain yield was significantly increased with the graded doses of P up to 60 kg P2 O5/ha during Kharif 2001 (Table 2). Highest grain yield (53.93 q/ha) was recorded with the application of 60 kg P2 O5/ha and bacterial inoculation followed by 60kg P2 O5/ha + VAM (52.02 q/ha). It was noticed that inoculation of P solubilizing microorganisms without externally added P did not show significant response on crop yields combination with added P, the P solubilizers showed significant response as compared to application of phosphorus fertilizers. The per cent yield response in terms of grain yield was found to be highest (34.29) with the application of 60 kg P2 O5 /ha and PSG inoculation followed by 60 kg P2 O5/ha + VAM (29.53_ it was noticed that the P use efficiency in terms of grain yield per kg of applied P2 O5 was higher (30%) with the inoculation of PSB and application of 30 kg P2 O5/ha and decreased with increased doses of P application.

It was observed that the efficiency of added P fertilizers was higher along with the inoculation of P solubilizing microorganisms than the application of graded doses of fertilizer alone, which might be due to reduced fixation of P with Fe and Al oxides and decreased sorption of inorganic form of P. These results are in corroboration with the findings of Sharma and Singh (1996).

The results indicated that inoculation of paddy seedlings with bacteria or fungus in combination with optimum dose of P fertilizers enhances the grain yields by increasing availability of P sources and increased efficiency of added P fertilizers. Inoculation with different P solubilizing microorganisms in lowland paddy minimizes the expenditure on fertilizers cost equivalent to 15-30 kg P₂O₅/ha.

REFERENCES

- Anonymous (2000). Statistical abstract. Department of Agriculture and Minor Irrigation, Government of Mizoram. P 10
- FAI (2000) Fertilizer statistics. The Fertilizer Association of India, New Delhi p 86
- Gaur, A.C. (1985) Phosphate solubilizing microorganisms and their role in plant growth and crop yield. Proceedings of soil biology symposium, Hissar, pp 125-138.
- Laxminarayana, K. and Azad Thakur, N.S. (1999) Effect of phosphorus on yield performance of wheat in acidic soils of Mizoram. *J. Hill Res.* 12:138-140
- Sharma, U.C. and Singh, R.P. (1996). Nutrient management in rice I North Eastern states of India. *Intern J. Trop. Agric.* 16: 1-23.

Table 1. Effect of P solubilizing microorganisms on yield attributes of paddy during 2000

Treatment	No. of Tillers / Hills	No. of grains/ Penicle	100 grain weight (g)	Grain Yield (q/ha)	Straw Yield (/ha)	Percent Yield response	Per cent Yield Response Per kg P ₂ O ₅
Control	5.8	151	2.44	36.90	103.30	-	-
30kg P ₂ O ₅ /ha	7.2	172	2.56	44.60	141.60	20.9	25.7
60kg P ₂ O ₅ /ha	8.0	190	2.62	49.90	150.20	35.2	21.7
90kg P ₂ O ₅ /ha	8.2	191	2.58	53.30	156.00	44.4	18.2
Phosphorus solubilizing Bacteri	6.5	161	2.52	43.10	140.10	16.8	-
30kgv=/ha + PSB	7.7	175	2.58	48.70	146.30	32.0	39.3
60 kg P ₂ O ₅ /ha =PSB	8.6	186	2.64	55.30	153.60	50.0	30.7
Vesicular Arbuscular Mycorrhiza	6.3	159	2.54	40.10	138.40	8.7	-
30kg P ₂ O ₅ /ha + VAM	7.2	172	2.61	47.50	144.50	28.7	35.3
60kg P ₂ O ₅ /ha + VAM	8.1	178	2.63	50.50	150.60	36.9	22.7
Mean	7.4	2.57	2.57	46.99	142.46	-	-
CD (P=0.05)	0.75	44.5	0.27	7.75	39.29	-	-

Table 2. Effect of P solubilizing microorganisms on yield attributes of paddy during 2001

Treatment	No. of Tillers/Hills	No. of grains/penicle	100 grain weight (g)	Grain Yield (q/ha)	Straw Yield (/ha)	Percent Yield response	Per cent Yield Response Per kg P ₂ O ₅
Control	5.5	158	2.69	40.16	136.88	-	-
30kg P ₂ O ₅ /ha	6.2	183	2.72	45.45	143.60	13.17	17.63
60kg P ₂ O ₅ /ha	6.5	190	2.84	49.98	154.58	24.45	16.37
90kg P ₂ O ₅ /ha	6.6	186	2.82	49.86	152.78	24.15	10.78
Phosphorus solubilizing Bacteria	6.0	164	2.72	40.62	121.18	1.15	-
30kgv=/ha + PSB	7.3	192	2.84	49.17	144.98	24.44	30.03
60 kg P ₂ O ₅ /ha =PSB	8.1	203	3.06	53.93	150.25	34.29	22.95
Vesicular Arbuscular Mycorrhiza	5.8	161	2.69	40.94	116.01	34.29	-
30kg P ₂ O ₅ /ha + VAM	6.7	182	2.82	48.66	146.38	21.17	28.33
60kg P ₂ O ₅ /ha + VAM	7.2	178	2.63	52.02	146.62	29.53	19.77
Mean	6.6	180	2.78	47.08	141.33	-	-
CD (P=0.05)	0.52	8.23	0.08	1.52	14.13	-	-

INTRODUCTION

Thrips (*Scirtothrips dorsalis*) aphids (*Myzus persicae* and *aphis gossypii*) and tarsonemid mite (*Polysphincta solanaceae*) are major pests of chilli (*Capsicum*, 1976) and known to be involved for the cause of leaf curl (Khadawa, 1975). Ahmad et al. (1987) reported 34.2% yield loss due to infestation of these pests. Full control of these pests could only save the crop from leaf curl. A number of systemic and contact insecticides have been tried and recommended. Realizing the danger involved in frequent use of chemicals, certain biopesticides (Botanicals and microbial origins) and their integration with conventional pesticides with a view to reduce pesticide load were evaluated to develop ecofriendly and sustainable pest management tactics for containing the pest on the chilli under agroclimatic condition of south Gujarat.

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