Madras Agric. J. 90 (10-12) : 661-664 October-December 2003

https://doi.org/10.29321/MAJ.10.A00156

Effect of integrated phosphorus management on rice yield, grain quality and total uptake of nutrients

M. MALARKODI AND P. SINGARAM
Dept. of Soil Sci. and Agrl. Chemistry, Tamil Nadu Agrl. University, Coimbatore - 641 003, Tamil Nadu

Abstract: The investigation was carried out to study the effect of Jhabua rock phosphate (JRP) in combination with single super phosphate (SSP), farmyard manure (FYM) and phosphobacteria (PB) on quality parameters and total nutrient uptake of rice crop (Co 43) in clay loam soil. Combined application of JRP and SSP in 1:1 ratio along with FYM (12.5 t ha^{-1}) and PB significantly increased the grain yield, quality parameter like crude protein content and total uptake of nitrogen, phosphorus and potassium over application of 100 per cent JRP alone but comparable with application of 100 per cent SSP alone.

Key words : Jhabua rock phosphate, Quality parameters, Nutrient uptake.

ntroduction

Phosphorus, in general plays an important ole in root proliferation, uniform grain filling, igher yield and good grain quality besides eing a constituent of ADP and ATP energy onds and also was involved in many plant rocesses like photosynthesis, cell division, tissue evelopment and growth (Bhattacharyya and ain, 2000). Superphosphate is one of the most ommonly used phosphatic fertilizers in the ountry. However, the problem with water soluble hosphate is that if often gets fixed or rendered insoluble or less soluble in acid and calcareous soils. Only about 25 to 30 per cent of the applied phosphate was available to the crops in the year of its application and remaining part was converted into insoluble forms (Vaishya *et al.* 1996). In this context, it is worth while to assess the phosphate rock resource position in India. In India PR deposit was now estimated to about 260 m.t. (Narayanasamy and Biswas, 1998). The efficiency of rock phosphate was improved by combined application of water soluble fertilizer, organic manure and biofertilizers. The present investigation was undertaken to study the effect of Jhabua rock phosphate in combination with super phosphate, farmyard manure and phosphobacteria on yield, grain quality and total nutrient uptake of rice crop.

Materials and Methods

A field experiment was conducted in Vertic Ustochrept of wetland, Tamil Nadu Agricultural University, Coimbatore with rice var. Co 43 as test crop during late samba season of 2000-2001. The soil of the experimental site was clay loam in texture with pH-8.4, EC 0.4 dSm^{-1}, OC-0.82 per cent and CEC-29.8 C mol (p+) kg^{-1}, the available N, P and K status were 226.8, 16.0 and 368.0 kg ha^{-1} respectively. The experiment was laid out in a randomized block design with 14 treatments and three replications.

The treatments consist of, T_1 - control; T_2-SSP recommended dose as per crop production guide (CPG) (50 kg P_2O_5 ha^{-1}); T_3-JRP (50 kg P_2O_5 ha^{-1}); T_4-T_3 + Phosphobacteria (PB) (seed treatment (600 g ha^{-1} of seeds), T_5-T_3 + Farm yard manure (FYM) (12.5 t ha^{-1}); T_6-T_5 + PB (seed treatment (600 g ha^{-1} of seeds), seedling treatment (2 kg in 12 lit. of water) and soil application (2 kg ha^{-1}); T_7-75% JRP + 25% SSP; T_8-T_7 + PB (seed treatment) (600 g ha^{-1} of seeds), seedling treatment (2 kg in 12 lit. of water) and soil application (2 kg ha^{-1}); T_9-T_7 + FYM (12.5 t ha^{-1}); T_{10}-T_9 + PB (seed treatment (600 g ha^{-1} of seeds, seedling treatment (2 kg in 12 lit. of water) and soil application (2 kg ha^{-1}); T_{11}-50% JRP + 50% SSP; T_{12}-T_{11} + PB (seed treatment (600 g ha^{-1} of seeds), seedling treatment (2 kg in 12 lit. of water) and soil application (2 kg ha^{-1}); T_{13}-T_{11} + FYM (12.5 t ha^{-1}); T_{14}-T_{13} + PB (seed treatment (600 g ha^{-1} of seeds), seedling treatment (2 kg in 12 lit. of water) and soil application (2 kg ha^{-1}).

Table 1. Effect of treatments on straw and grain yield of rice

(Mean of three replications)

Treatments	Yield (kg ha^{-1})	
	Straw	Grain
T_1 - Control	7825	4340
T_2 - 100% SSP	8025	6040
T_3 - 100% SSP	7838	4425
T_4 - T_3 + PB	7844	4488
T_5 - T_3 + FYM	7850	4513
T_6 - T_5 + PB	7849	4628
T_7 - 75% JRP + 25% SSP	7928	4745
T_8 - T_7 + PB	7966	4885
T_9 - T_7 + FYM	7976	5080
T_{10} - T_9 + PB	7989	5987
T_{11} - 50% JRP + 50% SSP	7978	5482
T_{12} - T_{11} + PB	7993	5963
T_{13} - T_{11} + FYM	8017	5997
T_{14} - T_{13} + PB	9250	6129
Mean	8023.5	5193.(
CD (P=0.05)	202.63	177.09

Table 2. Effect of treatments on rice grain quality and total nutrient uptake

(Mean of three replications)

Treatments	Quality parameters (%)		Total nutrient uptake (kg ha^{-1})		
	Carbohydrate	Crude protein	Nitrogen	Phosphorus	Potassium
T_1 - Control	69.12	6.40	82.26	15.81	72.13
T_2 - 100% SSP	72.08	7.38	121.04	42.64	99.62
T_3 - 100% SSP	69.36	6.56	86.84	20.93	77.68
T_4 - T_3 + PB	69.24	6.50	92.03	24.56	81.03
T_5 - T_3 + FYM	69.27	6.50	90.89	23.99	83.63
T_6 - T_5 + PB	69.39	6.63	89.09	25.09	81.98
T_7 - 75% JRP + 25% SSP	69.52	6.75	97.22	26.67	88.26
T_8 - T_7 + PB	69.57	6.62	99.56	29.43	89.09
T_9 - T_7 + FYM	69.63	7.00	106.37	31.58	91.15
T_{10} - T_9 + PB	72.03	7.00	118.14	37.12	94.43
T_{11} - 50% JRP + 50% SSP	69.88	6.56	105.45	32.50	91.57
T_{12} - T_{11} + PB	72.04	7.13	117.52	37.05	97.17
T_{13} - T_{11} + FYM	72.06	7.25	122.45	40.42	96.73
T_{14} - T_{13} + PB	72.28	7.63	137.28	50.36	117.62
Mean	70.39	6.85	104.78	31.3	90.15
CD (P=0.05)	NS	0.28	3.5	1.195	3.483

Phosphobacteria seed treatment was given by soaking the seeds (600 g ha^{-1} seeds) in water for overnight. The excess water was poured over the nursery area itself. Rice seedling roots were dipped and kept in PB slurry (2 kg PB dissoled in 12 lit. of water) for 30 minutes. Then, the seedlings treated with and without PB were transplanted in their respective plots with a spacing of 20 cm x 10 cm. PB @ 2 kg ha^{-1} was applied after mixing with sand

to those plots as per the treatment. The FYM application was done at the beginning @ 12.5 t ha^{-1} for those plots as per the treatment schedule and incorporated in the soil.

The straw and grain yields were recorded and the quality parameters like carbohydrate and crude protein content in rice grain were analyzed. The grain and straw samples were collected and analyzed for N,P and K content. The uptake of nutrients was calculated by multiplying the grain and straw yields (kg ha^{-1}) with the corresponding nutrient concentrations. The sum of uptake of grain and straw was expressed as the total uptake (kg ha^{-1}).

Uptake of nutrient = Dry matter x Nutrient concentration (%)

Results and Discussion

i. Straw and grain yield (kg ha^{-1})

The data in Table 1 indicated that the maximum grain yield (6129 kg ha^{-1}) was obtained with the combined application of 1:1 JRP and SSP along with FYM and PB which was on par with 100 per cent SSP alone (6040 kg ha^{-1}) and application of 1:1 JRP and SSP with FYM (5997 kg ha^{-1}) or with PB (5963 kg ha^{-1}). The highest straw yield was obtained by the treatment T_{14} (9250 kg ha^{-1}). The highest yield in T_{14} treatment might be due to (i) dissolution effect of organic manures on rock phosphate (ii) release of nutrients from decomposition of organic manures themselves (iii) increased available P due to the application of phosphorus solubilizing bacteria (PB) as suggested by Prakash and Badrinath (1995).

ii. Quality of rice [carbohydrate (%) and crue protein (%)]

By comparing all the treatments, no significant different was observed in carbohydrate content of rice grain. The value of crude protein content in rice grain revealed that the treatment T_{14} registered the highest crude protein content (7.63%), which was comparable with the treatment T_2 (7.38%) (Table 2). Increased crude protein content can be ascribed to increased P supply. Similar findings were reported by Chandrasekaran (1980) and Dhanasekaran (2000).

iii. Total nutrient uptake (kg ha^{-1})

Nitrogen

The total uptake of nitrogen varied from 82.26 to 137.28 kg ha^{-1}. Treatment T_{14} (137.28 kg ha^{-1}) recorded the highest uptake followed by T_2 (121.04 kg ha^{-1}) and T_{13} (122.45 kg ha^{-1}) (Table 2), which were on par with each other. The reason might be due to the solubilizing effect of the FYM and PB which would have resulted in better nutrient availability and thus increased the dry matter production and nutrient content resulting in higher N uptake. This corroborates with the findings of Anilkumar *et al.* (1994).

Phosphorus

The treatment T_{14} recorded the highest total phosphorus uptake (50.36 kg ha^{-1}) followed by T_2 (42.64 kg ha^{-1}) and T_{13} (40.42 kg ha^{-1}) (Table 2), which were significantly varied from each other. The highest uptake in T_{14} treatment might be ascribed to the solubilization of insoluble P from rock phosphate by the organic acids produced during decomposition of FYM and due to the enhancement of phosphate solubilizing power of phosphobacteria or any other native phosphate solubilizers leading to the increased availability of P, higher P content of plant and higher yield of dry matter resulting in higher total P uptake. This is in conformity with the findings of Dhanasekaran (2000).

Potassium

The highest potassium uptake has been noticed in T_{14} (117.62 kg ha^{-1}) (Table 2) followed by T_2 (99.62 kg ha^{-1}), T_{12} (97.17 kg ha^{-1}) and T_{13} (96.73 kg ha^{-1}), which registered an on par trend. This might be due to the increased root activity resulting in the increased K content in straw and grain and dry matter production. Similar findings were reported by Shanthi *et al.* (1991).

Based on the present investigation, it is concluded that combined application of 50 per cent JRP plus 50 per cent SSP along with FYM and PB to rice improved the quality parameters, yield and nutrient uptake. Hence in the current context of the escalation of the cost of chemical phosphatic fertilizers and the problem of P fixation, indigenously available,

slow P releasing Jhabua rock phosphate can be effectively and profitably utilized in combination with SSP, FYM and PB for improving the quality and nutrient uptake by rice in clay loam soil.

References

Anilkumar, L., Verma, P. and Room Singh (1994). Evaluation of mussoorie rock phosphate as source of P for summer Moong. *J. Indian Soc. Soil Sci.* **42**: 843-848.

Bhattacharyya, P. and Jain, R.K. (2000). Phosphorus solubilizing biofertilizers in the Whirlpool of rock phosphate-challenges and opportunities. *Fert. News,* **45**: 45-51.

Chandrasekaran, N. (1989). Comparative effect of mussoorie phos and superphosphate on soil properties, yield and quality of rice and succeeding blackgram. *M.Sc. (Ag.) Thesis,* TNAU, Coimbatore.

Dhanasekaran, G. (2000). Studies on the efficiency of Jhabua rock phosphate as a phosphorus source to rice (ADT 38). *M.Sc.(Ag.) Thesis,* TNAU, Coimbatore.

Narayanasamy, G. and Biswas, D.R. (1998). Phosphate rocks of India. Potentialities and constraints. *Fert. News,* **43**: 21-28

Prakash, T.R. and Badrinath, M.S. (1995). Utilization of rock phosphate as a source of phosphorus and calcium in acid soil. *J. Indian Soc. Soil Sci.* **43**: 474-475.

Shanthi, R., Jeyaraman, S., Mayalagu, K. and Gopalswamy, A. (1991). Efficiency of composted coirpith with different levels of inorganic N on nutrient availability and uptake by rice. Seminar on utilization of coirpith in Agriculture, TNAU, Coimbatore

Vaishya, U.K., Bapat, P.N. and Dubey, A.V. (1996) Phosphate solubilizing efficiency of microorganiss on gram grown on vertiso *J. Indian Soc. Soil Sci.* **44**: 524-526.

(Received: December 2002; Revised: September 200