



Short Note

Direct and Residual Effect of Phosphorous Sources and Manures on Yield and Nutrient Uptake by Rice in Alfisol

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Field experiments were conducted to study direct and residual effect of P-sources and organic manures on rice. Green leaf manuring increased the yield and nutrient uptake by rice. The increase in grain yield with the addition of GLM + URP @ 60 kg P₂O₅ ha⁻¹ over URP @ 60 kg P₂O₅ ha⁻¹ were 31 per cent in the fertilized plots and 27.9 per cent in the residual plots. Combined application of GLM and P @ 60 kg P₂O₅ ha⁻¹ irrespective of the P source increased the nutrient uptake by rice. A drastic reduction of value : cost ratio at higher level of fertilizer P application, irrespective of the P sources was recorded. The additional expenditure on incorporation of poultry manure was the highest which dropped the value : cost ratio considerably.

Key words : Rice, organic manures, fertilizer-P, yield, nutrient uptake

Declining trend in productivity due to continuous use of chemical fertilizers alone have been observed in several long term experiments all over India (Nambiar, 1994). Therefore emphasis should be specified to optimize the use of chemical fertilizers and to improve their use efficiency. Integrated use of organics and fertilizers for improving the long term productivity of rice based cropping system was reported by Bhandari *et al.* 2002. Effective utilization of P sources in combination with organic amendments under rice ecosystem has become the subject of investigation in recent years. Keeping these facts in view, the efficiency of P sources along with organic manures were evaluated for meeting the phosphorus requirement of rice crop under wet land ecosystems.

Materials and Methods

Field experiments were conducted to evaluate the direct and residual efficiency of P sources along with organic manures with rice as test crop. (Kharif season-I crop; Rabi season-II crop –residual crop). As per the treatment schedule, P at three levels viz., 0, 30 and 60 kg P₂O₅ ha⁻¹ was added through two P sources viz., single super phosphate (SSP) and Udaipur rock phosphate (URP) with or without organic manures viz., FYM, poultry manure and green leaf manure (GLM) @ 12.5 t ha⁻¹. Treatment combinations were triplicated and the design of the experiment was factorial RBD. The experiment was conducted in Madukkur soil series (Alfisol). The grain and straw yields were recorded. To study the residual effect, original layout was maintained

without disturbance and second crop of rice was raised as residual crop in rabi season. In the triacid digest of plant samples, N, P and K were determined by microkjeldhal method (Bremner, 1965), Vanadomolybdate yellow colour method (Jackson, 1973) and flame photometric method (Stanford and English, 1949) respectively. The value-cost ratio (VCR) worked out from the value of increased yield due to the incorporation of organic manures and the additional expenditure on incorporation of organic manures.

Results and Discussion

The initial soil was sandy clay loam in texture (clay 23%, silt 9% and sand 67%), neutral in soil reaction (pH 7.3), non-saline (EC : 0.24 dSm⁻¹) and had a CEC of 22.2 c mol (p+) kg⁻¹ soil. The organic carbon content of the soil was 0.48% with initial available N of 146 kg ha⁻¹, available P of 9.50 kg ha⁻¹ and K of 250 kg ha⁻¹.

Among the organic manures studied, green leaf manuring increased the grain yield (Table 2). The decomposing green leaf manuring release organic acids and CO₂, both tending to lower the soil pH and raise solubility of calcium phosphate (Singh, 1984). This increased P availability which in turn increased the dry matter production, P uptake and thus grain yield. These findings corroborates with the results of Hundal *et al.* (1992).

Application of SSP has recorded the highest grain yield compared to URP. The grain yield (5.51 t ha⁻¹) recorded in the treatment that received SSP @ 60 kg ha⁻¹ was significantly higher than the yield

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Table 1. Effect of organic manures and P sources on rice grain yield (t ha⁻¹)

Treatment	I crop		II crop
	Fertilised		Residual
Organic Source			
No manure	3.68	4.21	3.34
FYM @ 12.5 t ha ⁻¹	4.54	4.87	3.98
Poultry manure @ 12.5 t ha ⁻¹	4.33	4.66	3.78
Green leaf manure @ 12.5 t ha ⁻¹	5.06	5.30	4.38
Inorganic source			
SSP ₀	3.72	4.04	3.17
SSP ₃₀	4.90	5.11	4.14
SSP ₆₀	5.51	5.69	4.74
URP ₀	3.38	3.79	2.99
URP ₃₀	4.15	4.74	3.86
URP ₆₀	4.75	5.19	4.31
CD (P=0.05)			
Manure	0.10	0.50	0.20
P Source	0.11	0.11	0.11
P levels	0.11	0.24	0.14

SSP: Single Super Phosphate; URP: Udaipur Rock Phosphate

Table.2 Nutrient uptake by rice grain (kg ha⁻¹)

Treatment	I Crop			Fertilized			II Crop		
	N	P	K	N	P	K	N	P	K
Organic source									
No manure	36.3	11.3	9.4	42.9	13.7	12.9	31.4	10.3	8.8
FYM @ 12.5 t ha ⁻¹	52.4	13.8	11.7	57.7	17.1	14.0	45.5	12.9	10.6
PM @ 12.5 t ha ⁻¹	52.2	11.9	10.8	57.3	14.6	13.0	45.1	11.4	9.9
GLM @ 12.5 t ha ⁻¹	59.6	15.6	13.9	63.9	19.7	16.5	51.4	15.1	12.6
Inorganic P source									
SSP ₀	35.5	9.5	8.8	39.9	11.8	10.9	29.9	8.4	7.9
SSP ₃₀	59.9	13.4	12.6	63.5	18.0	16.3	49.0	13.6	11.1
SSP ₆₀	69.3	19.9	16.7	72.8	22.8	11.1	58.1	18.0	14.8
URP ₀	32.5	8.1	7.5	36.9	10.3	10.0	28.3	7.5	6.9
URP ₃₀	47.6	12.6	9.9	55.8	15.8	12.6	29.1	12.3	9.8
URP ₆₀	55.9	15.3	13.3	63.9	18.9	15.1	34.1	14.7	12.6
CD(P=0.05)									
Manure	1.1	0.8	0.5	4.6	0.7	0.9	2.5	0.6	0.7
P Source	0.8	0.5	0.4	3.2	0.5	0.6	1.8	0.4	0.5
P levels	0.9	0.7	0.5	3.9	0.6	0.8	2.2	0.5	0.6

SSP: Single Super Phosphate; URP: Udaipur Rock Phosphate

Table 3. Calculated value :cost ratio (VCR) and additional return per hectare to the incorporation of organic manures

Treatment	Per hectare return due to organic manuring	VCR
FYM		
SSP ₃₀	8720	13.9
SSP ₆₀	4672	7.5
URP ₃₀	8888	14.2
URP ₆₀	6504	10.4
PM		
SSP ₃₀	5010	3.1
SSP ₆₀	1864	1.1
URP ₃₀	6196	3.8
URP ₆₀	4790	2.9
GLM		
SSP ₃₀	15,582	17.9
SSP ₆₀	7992	9.1
URP ₃₀	15,040	17.2
URP ₆₀	10,524	12.0

SSP: Single Super Phosphate; URP: Udaipur Rock Phosphate

(4.90 t ha⁻¹) recorded due to the application of SSP @ 30 kg ha⁻¹ (Table 1). This could be due to the fact that the readily available P in SSP has favoured better absorption of P as evidenced by higher P uptake by grain and straw as compared to slowly available P sources like URP. This is in accordance with the findings of Rani Perumal *et al.* (1994).

In the residual plots, increase in grain yield due to the incorporation of GLM over no manured plots was 31.1 per cent. This indicates that the incorporation of GLM alone resulted in higher yield and supplementation of P fertilizers either in the form of URP or SSP exhibited an additive effect. The residual effect of organic manures on rice grain yield in rice-rice cropping sequence was reported by Ladha *et al.*, 2000.

Green leaf manuring increased the N, P and K uptake by grain. Application of P through SSP

favoured higher nutrient uptake by grain (Table.1). (Chutia *et al.* 1998 ; Yadvinder singh *et al.*, 2004). Irrespective of the P sources, the highest nutrient uptake was registered at 60 kg P₂O₅ ha⁻¹ as compared with that of 30 kg P₂O₅ ha⁻¹.

A drastic reduction in VCR was observed at higher level of fertilizer P application. The additional expenditure on incorporation of poultry manure was the highest which dropped the VCR considerably. (Table.3) Combined application of organic manure + SSP / URP @ 60 kg P₂O₅ ha⁻¹ although increased the grain yield higher than the application of organic manure + SSP / URP @ 30 kg P₂O₅ ha⁻¹ it was not an economic increase. Hence, combined application of GLM @ 12.5 t ha⁻¹ + SSP /URP@ 30 kg P₂O₅ ha⁻¹ can be applied for rice monoculture under wetland ecosystem to save the fertilizer P bill.

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