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Rice Response to Applied Phosphorus, Zinc and Farmyard Manure

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ABSTRACT

Response of rice to Zn, P and FYM was studied in green house by using sandy clay loam soil. Different combinations of N, P, K and Zn were applied @ 120-80-60 and 20 kg ha^{-1} along with FYM (@ 12 Mg ha^{-1}. All the growth parameters of rice increased with P application over control. Paddy and straw yields produced maximum by the application of FYM along with NPK + Zn. Nitrogen, P and K contents increased with the application of NPK fertilizers along with FYM and Zn but there was significant decrease in P contents by the application of Zn. Zinc contents were found maximum in those treatments where Zn and Zn + P were applied with NPK. The post harvest soil analysis showed that NPK contents were higher in pots with FYM incorporation but Zn was high in pots treated with $ZnSO_4$.

Key Words: Phosphorus; Zinc; FYM; Rice

INTRODUCTION

Rice occupies a conspicuous position in the predominately agricultural economy of Pakistan thus attention is required to improve its yield and quality. The yield of rice per hectare is very low in Pakistan as compared to that in other rice growing countries. This could be due to the fact that the soils of Pakistan are low in organic matter, N, P and also some micronutrients, particularly Zn in rice growing areas.

Most of the applied phosphorus becomes unavailable to growing plants due to alkaline and calcareous nature of the soils of Pakistan. The low availability of P is caused by its fixation on colloidal complex or formation of insoluble compounds as carbonate, appetite, hydroxyappetite and flour appetite. The efficient use of phosphatic fertilizers depends on the crop requirements, rate and time of application and placement methods. Zn deficiency is common in calcareous soils where high pH reduces zinc availability. Phosphorus after its absorption interacts in a complex manner with Zn, Mn, Fe and Cu affecting their mobility and translocation in the plant system (Warnock, 1970).

The role of organic matter is vital as it provides plant food nutrients, maintains good soil structure and improves the productivity of soil by promoting infiltration rate and aeration in soil (Prasad & Singh, 1980). Combined use of manures and P increased solubilization of the later (Sharif & Chaudhry, 1985). Taking into consideration the above observations, the present trial was planned to explore the necessity of phosphorus and zinc combination with FYM for rice growth.

MATERIALS AND METHODS

A pot experiment was carried out by using sandy clay loam soil with pH_s 7.8, EC_e 1.2 d Sm^{-1} and the extractable P, K and Zn were 6.2, 142 and 1.3 mg kg^{-1} of soil, respectively. The soil up to 15-cm depth was collected, air dried, ground, sieved and added to the polyethylene lined glazed pots @ 10 kg pot^{1}.

Before transplanting the rice seedling, N, P, K and Zn were applied @ 120, 80, 60 and 20 kg ha^{-1} as urea, SSP, K_2SO_4 and $ZnSO_4$, respectively while FYM was applied @ 12 Mg ha^{-1} to the allocated pots according to the following treatment combinations.

T_1 = Control (NK); T_2 = NK + P; T_3 = NK + P + FYM; T_4 = NK + P + Zn; T_5 = NK + P + FYM + Zn

These were mixed thoroughly with soil. Nitrogen was applied in two splits i.e. one half at transplanting time and other half 40 days after transplanting. Four plants of rice IR-6 were transplanted in each pot. The soil was kept flooded throughout the growth period. At maturity, the data regarding plant height, grains $panicle^{-1}$, 1000-grain weight, paddy and straw yields were recorded. Oven dried (70°C) straw and paddy samples were analyzed for N, P, K and Zn. Post harvest soil samples from the pots were also collected for N, P, K and Zn analysis using the standard analytical methods. The data obtained were subjected to statistical analysis according to Steel and Torrie (1980) for the interpretation of data.

RESULTS AND DISCUSSION

Plant growth and yield. Plant height, grains $panicle^{-1}$ and 1000-grain weight of rice were increased significantly with the application of P and further enhancement was observed with the application of Zn and/or FYM (Table I). NPK + FYM treated pots produced better paddy and straw yield of rice which were further increased with Zn application. The comparison of different treatment combinations revealed that the best results were obtained by the combined application of P, Zn and FYM over control. These results are in agreement with the findings of Sharma and Yadav (1986) and Roy and Jha (1987).

Table I. Effect of P, Zn and FYM on plant growth and yield

Treatments	Plant height (cm)	Grains panicle^{-1}	1000-grain weight (g)	Paddy yield pot^{-1} (g)	Straw yield pot^{-1} (g)
Control (NK)	77.87 c*	95.33 c	18.17 c	44.01 d	48.69 e
NK + P	85.85 b	104.00 b	19.07 b	46.63 c	50.48 d
NK + P + FYM	91.27 ab	108.00 a	19.56 a	52.19 a	55.83 b
NK + P + Zn	90.02 ab	109.00 a	19.06 a	50.32 b	53.75 c
NK + P + Zn + FYM	92.29 a	111.33 a	19.47 a	53.67 a	57.73 a

Treatment means bearing the same letter(s) are statistically alike

Paddy and straw analysis. Nitrogen, phosphorus, potassium and zinc concentrations of the rice plant samples were recorded from the grain and straw (Table II a, b).

Table II a. Effect of P, Zn and FYM on chemical composition of paddy

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Zinc (ppm)
Control (NK)	1.70 b	0.25 d	0.17 c	26.56 b
NK + P	1.72 b	0.28 bc	0.20 bc	29.96 b
NK + P + FYM	1.87 a	0.30 a	0.25 a	31.95 a
NK + P + Zn	1.86 a	0.27 c	0.21 b	35.27 a
NK + P + Zn + FYM	1.90 a	0.29 ab	0.27 a	34.60 a

*Treatment means bearing the same letter(s) are statistically alike

Table II b. Effect of P, Zn and FYM on chemical composition of rice straw

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Zinc (ppm)
Control (NK)	0.85 d	0.054 c	1.26 c	17.36 b
NK + P	0.87 cd	0.068 ab	1.46 b	20.68 a
NK + P + FYM	0.98 ab	0.070 a	1.61 ab	21.54 a
NK + P + Zn	0.92 bc	0.064 b	1.56 ab	23.29 a
NK + P + Zn + FYM	0.99 a	0.069 a	1.72 a	22.70 a

*Treatment means bearing the same letter(s) are statistically alike

Nitrogen and phosphorus contents in grain and straw showed an increasing pattern with the application of NK + P and FYM but P concentration decreased significantly by Zn application. Potassium concentration of rice grain and straw showed a significant increase over control and maximum contents were noted in treatments where FYM was applied. Zinc concentration also displayed an increasing trend but highly significant increase was noticed in those treatments where Zn was applied and it was more in grains than that in straw. These results fairly agreed to the findings of Rashid (1983) and Maskina and Randhawa (1988).

Post harvest soil analysis. Soil was analyzed for NPK and Zn concentration after the harvest of the crop. Concentration of N and K increased significantly over control and were found maximum in the pots where FYM was incorporated (Table III). Extractable P in soil was more in pots with FMY but it decreased in pots where Zn was applied. Zinc concentration in the soil was higher in the pots treated with $ZnSO_4$ although the other treatments also showed significant increase over control. This conclusion was well supported by the research work conducted by Chaudhry *et al.* (1981) and Duraisamy *et al.* (1986).

Table III. Post harvest soil analysis

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Zinc (ppm)
Control (NK)	0.058 d	5.37 d	150.77 c	1.32 d
NK + P	0.062 c	7.57 b	155.11 c	1.40 c
NK + P + FYM	0.068 a	8.97 a	184.11 a	1.52 b
NK + P + Zn	0.064 bc	6.67 c	164.00 bc	1.68 a
NK + P + Zn + FYM	0.068 a	7.97 b	170.37 ab	1.65 a

*Treatment means bearing the same letter(s) are statistically alike

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