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Influence of Nutrient Ratios of NPK on Rice Yield and Uptake of Phosphorus Using Tracer Technique

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Seven combinations of NPK with P applied as P-32 tagged superphosphate were studied for their effect on yield and uptake of phosphorus by four rice varieties viz., CO. 33, CO. 34, CO.35 and Pusa 221. N : P_2O_5 : K_2O ratio of 120 : 60 : 60 (2 : 1 : 1) appeared sufficient among the ratios tested for all the varieties studied.

Ishizuka (1965) gave evidence for the interacting effects of soil, climate, variety and numerous other factors on the uptake of nutrients, yield and quality of rice. The effect of seven combinations of N and K with a fixed level of P on the uptake of total and added P, yield of grain and straw with respect to four popular rice varieties was investigated.

MATERIALS AND METHODS

Seven ratios of N : P_2O_5 : K_2O viz., 60 : 60 : 60 (1 : 1 : 1) 120 : 60 : 0 (2 : 1 : 0), 120 : 60 : 60 (2 : 1 : 1), 180-60-60 (3 : 1 : 1), 90-60-30 (3:2:1), 120-60-30 (4:2:1) and 80-60-40 (4:3:2) were tested on four rice varieties viz., CO.33 (Karuna) CO.34 (Kanchi) CO.35 (Cauvery) and Pusa 221 (Kannagi) in a pot experiment with 3 replications. Half of N as ammonium sulphate and entire P and K were applied as basal dressing. Phosphorus was applied as P-32 tagged super phospate (0.1 mCi/gr of P_2O_5) at a rate of 60 kg/ha and N and K varied as per treatments. Each pot contained 8 kg soil and 8 seedlings (4 hills of two seedlings each) were planted. One hill from each plot was sampled for determination of total and fertilizer P on 40th day. Radioassay for fertilizer P was done by using G. M. counter. The soil of wetland farm of Tamil Nadu Agricultural University employed had pH 7.5, EC 1.0 mmho/cm and available N, P and K of 106, 6.8 and 400 kg/ha respectively.

RESULTS AND DISCUSSION

The mean values of biometric and chemical data along with the results of statistical analysis are presented in Table I and II.

(i) **Influence of varieties on yield of grain and straw and P uptake :** The yield of grain was influenced significantly by both the main effects 'Varieties, and 'Nutrient ratios', while the interaction effect was absent.

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TABLE I. Mean biometric and chemical data for varieties

Particulars	Varieties				Statistical parameters	
	CO.33	CO.34	CO.35	Pusa 221	SE	CD
Grain yield (gm/pot)	8.10	10.60	10.10	8.40	0.60	1.72
Straw yield (gm/pot)	7.60	11.10	9.80	7.90	0.59	1.67
Uptake of P by grain (gm/pot)	0.20	0.19	0.19	0.19		
Total P uptake during 40 days (mgm/plant)	4.90	2.60	3.60	4.50	0.35	0.99
Fertilizer P uptake during 40 days (mgm/plant)	1.80	1.10	1.50	1.50	0.16	0.45
Fertilizer utilization %	0.92	0.57	0.78	0.78		

TABLE II. Mean biometric and chemical data for nutrient ratios

Particulars	Nutrient ratios N : P_2O_5 : K_2O. kg/ha							Statistical parametres	
	60:60:60 1:1:1	120:60:0 2:1:0	120:60:60 2:1:1	180:60:60 3:1:1	90:60:30 3:2:1	120:60:30 4:2:1	80:60:40 4:3:2	S.E	C.D
Grain yield (gm/pot)	8.20	11.90	9.80	10.80	7.80	8.40	8.00	0.80	2.7
Straw yield (gm/pot)	7.20	10.80	9.50	10.80	8.20	9.10	7.80	0.78	2.2
Uptake of P by grain (gm/pot)	0.21	0.20	0.20	0.17	0.18	0.19	0.22	—	—
Total P uptake during 40 days (mgm/plant)	3.00	4.10	3.40	5.60	3.80	4.70	2.70	—	—
Fertilizer P uptake during 40 days (mgm/plant)	1.20	1.20	1.30	2.20	1.40	2.00	1.10	0.22	0.61
Fertilizer utilization %	0.62	0.61	0.68	1.14	0.72	1.02	0.55	—	—

Varieties Kanchi and Cauvery gave significantly higher yield of grain and straw than Kannagi and Karuna. The above yield trend was not reflected in P uptake. Variety Karuna showed the highest uptake of P during 40 days growth period. A slightly increased efficiency of var. Karuna in extracting

added phosporus was also revealed. The uptake of P by grain did not vary due to varieties. A point of importance is that the uptake of P by grain not differing significantly on one hand and significant differences in yield resulting on the other hand point to the fact that grain P is not related to the yield.

ii) Effect of increasing N levels under constant P and K doses on growth and uptake of phosphorus : A comparison of nutrient combinations of 60:60:60, 120:60:60 and 180:60:60 throw light on the influence of increased doses of N on the characteristics studied.

Significant increase in grain and straw yield as well as fertilizer P uptake were observed when N dose increased from 60 kg N/ha to 180 kg N ha. The increase from 120 to 180 kg however, was not appreciable and they tended to remain on par. The fertilizer P utilisation was the highest in 180kg N treatment. Mariakulandai(1957) observed the highest rice yields with 120 kg N/ha in combination with P and K. The effect of increasing N in enhancing P uptake was also observed by Bredero (1965). Grunes (1960) observed increased P uptake to be associated with increased root growth caused by increasing N levels. Increasing levels of N in the ratios tended to increase the fertilzer utilisation and this was more pronounced for the increase from 120 to 180 kg N/ha. This trend of increased P utilisation with increased N levels of the added P was also observed by Shinde and Datta (1964).

iii) Effect of increasing K levels on yield of grain and straw and uptake of P : The effect of K is brought out by comparing nutrient ratios of 120:60:0, 120:60:30 and 120:60:60. At constant levels of N and P, K addition failed to show any advantage in respect of grain and straw yield, both at 30 and 60 kg K_2O/ha levels as compared to no potash. The K application however, favoured more accumulation of P during 40 days growth and much of these derived from added fertilizer. However, the accumulation of P in grain at harvest was not influenced by increased K additions. Similar yield of grain even in the absence of K might be attributed to the specific condition of the soil which contained high amounts of available K. Krishnamaraja and Rao (1969) obtained increased response to 135 kg N combined with 50 kg P_2O_5/ha. Perur and Narayanan (1961) obtained high yield with 2:1 N, P_2O_5 ratios.

iv) Effect of simultaneous increase of N and K at constant level of P : A comparison of nutrient ratios 90:60:60 and 180:60:60 shows the effect of doubling of N and K. A marked increase in grain and staw yield was observed in the latter ratio. The high N and K also favoured substantially increased accumulation of total as well as fertilizer P during 40 days growth stage but its effect on ultimate grain uptake was not reflected Since K produced no beneficial effect on yield of grain and straw it is reasonable to assume that the effects produced in 180:60:60 are due to increased N rather than K. This is supported by the consideration of behaviour of 90:60:30 and

80:60:40 and 60:60:60 ratios which were inferior to 180:60:60.

With the background of discussion on nutrient ratios, the choice is restricted to combinations of 180 : 60 : 60, 120 60.60 and 120-60-0 for economic yield of grain and straw. The ratio of 180:60:60 can be eliminated not only on economic considerations but also because of the fact that the increase in yield of grain obtained was not appreciable from the other two ratios. In view of the recent emphasis on replenishment of nutrient elements it will be justifiable to fix 120:60:60 as the best and efficient combination for the varieties tested viz., Karuna, Cauvery, Kannagi and Kanchi.

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