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## EFFICIENCY OF NITROPHOSPHATES IN RICE-WHEAT SEQUENCE

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### ABSTRACT

Field experiments were conducted on mollisols at Pantnagar to study the efficacy of two nitrophosphate grades differing in P solubility vis-a-vis urea + triple superphosphate (TSP) in rice-wheat sequence. Grain yield response of rice to both the nitrophosphate grades was similar but its magnitude was less than the response to urea + TSP. The relative agronomic effectiveness of nitrophosphate decreased with increasing level of application. Total N and P uptake by rice was also less in the plots fertilized with either grade of nitrophosphate as compared to urea + TSP plots. The residual effects of nitrophosphates on wheat were however more or less similar to urea + TSP when additional N was adequately supplied.

KEY WORDS: Nitrophosphates, Rice-wheat sequence, Grain yield.

Production of nitrophosphate fertilizers is of special interest because it does not require the use of sulphur which has to be imported due to absence of its deposits in the country. Nitrophosphates are however complex materials containing N and P in more than one chemical form which may influence the nutrient availability to plants and thereby the effectiveness of the fertilizers. There are conflicting reports about the suitability of nitrophosphates for rice (Prasad *et al.* 1971; Singh *et al.* 1976; Lal and Mahapatra, 1977). Several factors such as the degree of water solubility of its P, soil pH and mode of application may influence the efficacy of nitrophosphates (Sekhon, 1979; Atanasiu and Westphal, 1980). In view of these, the present study was undertaken to ascertain the

efficacy of two nitrophosphate fertilizers differing in their P solubility vis-a-vis urea and triple superphosphate for rice and the residual effects were evaluated on a succeeding wheat crop.

### MATERIALS AND METHODS

Field experiments were conducted in 1982-83 and 1983-84 at the Crop Research Centre of the University at Pantnagar on P deficient sites (Olsen P 8.6 and 9.1 kg/ha). The soils of the experimental plots were clay loam with alkaline reaction (pH 8.1, 8.0), 0.98 and 0.86 per cent organic carbon and 0.11 and 0.09 per cent total N in 1982-83 and 1983-84 respectively.

The experiment was laid out in randomized block design with three replications. Two grades of nitrophos-

phates (15-15-15 and 20-20-0) having 30 and 60 per cent of the total P in water soluble form respectively and urea + triple superphosphate (TSP 46% P<sub>2</sub>O<sub>5</sub>) were applied at three rates, 30-30, 60-60 and 90-90 kg/ha N and P<sub>2</sub>O<sub>5</sub>. Additional plots for urea at 30, 60 and 90 kg/ha, TSP at 30 kg P<sub>2</sub>O<sub>5</sub>/ha and check (N<sub>0</sub>P<sub>0</sub>) were included to facilitate comparison. The amount of K<sub>2</sub>O was equalized at 90 kg/ha in every plot using muriate of potash. Full dose of nitrophosphates and TSP and half portion of urea were broadcast during puddling before transplanting. Remaining half portion of urea was top-dressed in two equal instalments at 25 and 50 days after transplanting. Seedlings of rice var. Jaya were transplanted in the first week of July and the plots were kept flooded till flowering stage. Adequate bunding was done to avoid overflow of flood water from the plots.

After harvest of rice, the layout was kept undisturbed and wheat was

sown in the next rabi season without fresh P application. N and K were however applied uniformly in all plots at 120 and 60 kg/ha respectively. Relative agronomic effectiveness (RAE) of the nitrophosphates for rice was calculated on the basis of grain yield response taking the response to urea + TSP equal to 100. N and P contents in the grain and straw samples were determined by standard methods and total N and P uptake by the crops was computed.

## RESULTS AND DISCUSSION

Data on the yield of rough rice in the plots fertilized with nitrophosphates, urea + triple superphosphate (TSP) and urea alone showed that at the low rate of application there was no significant difference between the two nitrophosphate fertilizers and urea + TSP (Table 1). At higher rates of application, however, urea + TSP was superior to nitrophosphates.

TABLE 1. Direct effects of fertilizers on the yield of rice

Fertilizer	Level of N-P <sub>2</sub> O <sub>5</sub> , Kg/ha	Yield of rice (g/ha)		
		1982	1983	Mean
Nitrophosphate (15-15-15)	30-30	52.37	50.58	51.43
	60-60	53.37	53.69	54.98
	90-90	59.63	56.74	58.19
Nitrophosphate (20-20-0)	30-30	52.37	49.92	51.16
	60-60	57.25	53.60	55.47
	90-90	60.00	57.17	58.59
Urea + TSP	30-30	53.93	51.75	52.84
	60-60	60.37	56.33	58.35
	90-90	64.16	60.48	62.32
Urea	30-30	52.65	51.12	51.89
	60-00	57.52	56.17	56.85
	90-00	60.46	59.71	60.09
TSP	0-30	46.38	43.64	45.11
Control	0-0	45.83	43.96	44.90
C.D. 5%		3.64	3.33	

Although the two nitrophosphates had different P solubility (30 and 60 per cent in water), they were found to be equally effective for rice grain production probably because the crop responded mainly to the N component and little to the P component of the fertilizer. This is evident from a comparison of the yield responses to urea alone *vis-a-vis* nitrophosphates. On an average, the fertilizer use efficiency of the nitrophosphates (15-15-15 and 20-20-0) and urea + TSP at N<sub>30</sub>P<sub>30</sub> were 10.9, 10.4 and 13.2 kg grain/kg (N + P<sub>2</sub>O<sub>5</sub>) as compared to 23.3 kg grain/kg N in case of urea alone. These results suggest that the lower rice yields ob-

tained with the use of nitrophosphates may be ascribed to low nitrogen use efficiency due to loss of nitrate-N through denitrification under flooded soil condition in the rice field. These results are in conformity with those of Sarangamath *et al.* (1975), Hundal and Sekhon (1975) and Singh *et al.* (1976).

The Relative Agronomic Efficiency (RAE) of nitrophosphates ranged between 72.5 and 85.0 per cent and it decreased with increase in the level fertilizer application, probably due to enhanced loss of nitrate-N component of the fertilizer by denitrification in the flooded rice field (Table 2).

TABLE 2. Relative Agronomic Effectiveness (RAE) of nitrophosphates for rice

Fertilizer	Level of N-P <sub>2</sub> O <sub>5</sub> , Kg/ha	RAE (%)		
		1982	1983	Mean
Nitrophosphate (15-15-15)	30-30	80.7	85.0	82.9
	60-60	72.5	78.7	75.6
	90-90	75.3	77.4	76.3
Nitrophosphate (20-20-0)	30-30	80.7	76.5	78.6
	60-60	78.7	77.9	78.3
	90-90	75.3	79.9	77.6

The total N uptake by the rice in the plots fertilized with urea + TSP or urea alone was more than in those receiving either grade of nitrophosphate (Table 3). The two grades of nitrophosphate (15-15-15 and 20-20-0) however showed similar N uptake by rice. This observation lends credence to the contention that the relatively low efficacy of nitrophosphates as compared to urea + TSP was mainly due to loss of nitrate-N component of the former by denitrification in the flooded rice field

as it contained about half of its N in nitrate form.

Total P uptake by rice was also less in the plots fertilized with nitrophosphates or urea alone than those receiving urea + TSP. In 1982, the nitrophosphate having 60 per cent water solubility of P (20-20-0 grade) showed slightly more P uptake than the one having 30 per cent water solubility (15-15-15 grade). In the next

TABLE 3. Direct effect of fertilizers on the uptake of N and P by rice

Fertilizer	Level of P <sub>2</sub> O <sub>5</sub> (Kg/ha)	Total N uptake (Kg/ha)		Total P uptake (Kg/ha)	
		1982	1983	1982	1983
Nitrophosphate (15-15-15)	30-30	60.13	57.85	17.32	16.81
	60-60	72.28	68.67	21.22	20.85
	90-90	78.96	74.35	23.86	22.61
Nitrophosphate (20-20-0)	30-30	59.77	56.83	19.31	16.74
	60-60	70.42	66.44	22.85	20.83
	90-90	79.25	76.19	24.78	23.35
Urea + TSP	30-30	63.24	60.35	20.48	18.05
	60-60	76.85	72.61	24.22	22.46
	90-90	91.27	88.15	27.28	24.94
Urea	30-0	62.24	59.35	16.85	14.99
	60-0	76.51	71.46	17.71	16.81
	90-0	90.18	86.32	18.34	17.25
TSP	0-30	49.20	46.56	16.95	15.85
Control	0-0	48.50	45.82	16.62	14.16
C.D. 5%		3.17	3.24	0.73	0.65

year, however, this difference disappeared probably because submergence could mobilize sufficient soil-P to meet the demands of the crop. This view is supported by the fact that there was little crop response to the P component of the fertilizers as discussed above. The plots fertilized with urea + TSP however showed more P uptake than those receiving urea alone. Hundal and Sekhon (1975) and Rishi and Goswami (1977) also observed lower P uptake by plants fertilized with nitrophosphates as compared to superphosphate.

Data regarding grain yield of wheat showing the residual effects of the P sources revealed that both the nitrophosphates and the TSP showed

similar residual effects on wheat when adequate N was supplied. Total P uptake by wheat was however less in the plots fertilized with nitrophosphate (15-15-15) having 30 per cent water solubility of P as compared to TSP. The other nitrophosphate (20-20-0) having 60 per cent water solubility of P stood at par with TSP in regard to P uptake. These results support the previous observations regarding residual effects of nitrophosphates (Mishra *et al.*, 1986).

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TABLE 4. Residual effects of the fertilizers on wheat grain yield and P uptake

Fertilizer applied to previous crop	Level of N-P <sub>2</sub> O <sub>5</sub> (Kg/ha)	Wheat grain yield (q/ha)		Total P uptake (Kg/ha)	
		1982-83	1983-94	1982-84	1983-84
Nitrophosphato (15-15-15)	30-30	41.43	37.64	14.86	13.32
	60-60	42.66	39.00	15.89	14.68
	90-90	43.15	39.67	16.91	15.55
Nitrophosphate (20-20-0)	30-30	42.92	37.36	15.59	14.57
	60-60	45.17	38.78	16.82	15.90
	90-90	44.67	39.97	17.54	17.83
Urea + TSP	30-30	43.15	38.32	16.06	14.93
	60-60	45.61	40.07	17.28	16.03
	90-90	46.17	41.11	20.04	17.73
Urea	30-00	39.04	34.93	11.74	11.48
	60-00	37.84	35.85	11.93	11.34
	90-00	38.86	35.05	11.86	11.32
TSP	0-30	42.75	37.27	15.80	14.39
Control	0-0	39.54	35.50	11.56	11.06
C.D. 5%		2.83	2.67	0.82	1.07

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