

## Effect of rock phosphate on yield and nutrient uptake in rice (*Oryza sativa*) and its residual effect on linseed (*Linum usitatissimum*)

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### ABSTRACT

A field experiment conducted in an acidic silt-loam soil during 1991 and 1992 showed significant direct effects of rock phosphate : single superphosphate mixtures as P source on grain yield of rice (*Oryza sativa* L.) and nutrient uptake. The maximum grain yield and nutrient uptake were recorded in 50 : 50 mixture of rock phosphate : single superphosphate treatment. Application of rock phosphate to rice crop had significant residual effect on the succeeding linseed (*Linum usitatissimum* L.) crop in terms of yield and nutrient uptake.

Palam valley soils of Himachal Pradesh are generally acidic in reaction where rice (*Oryza sativa* L.)-based cropping sequence is the most common practice. Linseed (*Linum usitatissimum* L.) is broadcast in the standing rice (*utera* method) without any fertilizer, resulting in low yield. Fertilizer-use efficiency of water-soluble phosphatic fertilizers is low in acidic soils due to high rate of its fixation by sesquioxides. Further, the steep hike in the prices of phosphatic fertilizers deters the farmers from their liberal use. Under such conditions the use of rock phosphates which release P slowly can be exploited in acid soils. Shinde *et al.* (1978) and Jagadesan *et al.* (1986) reported usefulness of rock phosphate in rice crop. Hence the present study was undertaken to study the direct effect of rock phosphate on the yield and nutrient uptake in rice and their residual effect on linseed.

### MATERIALS AND METHODS

The field experiment was conducted during 1991 and 1992 at the Rice Research Station, Himachal Pradesh Krishi Vishvavidyalaya, Malan, in silt-loam soil of Palam valley area, having acidic reaction (pH 5.9), 0.90% organic carbon and 439, 16 and 172 kg/ha of N, P and K respectively. The experiment was laid out in randomized block design with plot size of 5 m x 3 m. The treatments comprised control (no phosphorus) and various combinations of rock phosphate and single superphosphate. Thirty-day-old seedlings of 'HPU 741' rice were planted keeping 3 seedlings/hill during both the years. Basal application of nitrogen and potassium was done @ 90 kg N/ha and 40 kg K<sub>2</sub>O/ha through urea and muriate of potash respectively. Half of the N was applied at transplanting time and another half at panicle-initiation stage.

Phosphorus application was made through single superphosphate (16%  $P_2O_5$ ), Udaipur rock phosphate (16% total  $P_2O_5$ ) and Mussoorie rock phosphate (20% total  $P_2O_5$ ) in different proportions.

To study the residual effect of phosphorus applied to rice, 'Himalini' linseed was sown using seed rate of 75 kg/ha by broadcasting (*utera* method) in the standing rice during the second week of October 1991 at appropriate moisture content in the rice fields. Half of the basal dose of N (50 kg/ha) was applied through urea soon after harvest of rice crop and remaining N was applied at flowering stage. Yield data of rice and linseed were recorded and grain samples were stored for nutrient analysis. For soil analysis standard methods outlined by Jackson (1967) were followed. Di-acid ( $HNO_3$  :  $HClO_4$ )-digested plant samples were analysed for P and Ca following vanadomolyb-

do yellow colour and flame photometric method respectively.

## RESULT AND DISCUSSION

### Grain yield

Rock phosphate alone was not effective but when applied with single superphosphate in ratio of 75 : 25, 50 : 50 and 25 : 75 resulted in significant increase in rice grain yield over the control. Among the 3 ratios of rock phosphate and single superphosphate, 50 : 50 mixture recorded the maximum grain yield, followed by 25 : 75 and 75 : 25 ratio in descending order. As far as the sources of rock phosphate are concerned, there was no perceptible difference between the two. The response to applied P can be attributed to the low content of available P (16 kg P/ha) in the experimental soil. Shinde *et al.* (1978) reported the usefulness of rock phosphate application on rice yield in acid

**Table 1.** Direct and residual effects of rock phosphates on yield and nutrient uptake of rice and linseed, and effect of rock phosphates on available P status after rice harvest 1991

Treatment	Direct effect (rice)						Residual effect (linseed)			Available P (kg/ha)
	Yield (q/ha)		Nutrient uptake (kg/ha)				Yield (q/ha) <sup>Y</sup>	Nutrient uptake <sup>Y</sup>		
	A	B	A		B			P	Ca	
			P	Ca	P	Ca				
Control	29.1	30.2	7.17	4.88	6.87	4.74	7.2	2.49	2.04	12.0
100% URP	31.8	35.5	10.61	8.26	10.67	8.13	8.1	3.21	3.21	21.5
75% URP + 25% SSP	35.3	35.3	12.70	8.18	11.57	7.43	9.2	4.01	3.47	19.4
50% URP + 50% SSP	36.6	38.6	18.09	8.26	16.83	8.60	11.1	5.70	4.85	19.5
25% URP + 75% SSP	35.3	38.0	11.30	7.17	11.67	7.15	9.6	4.48	3.69	17.9
100% MRP	30.4	32.8	10.42	7.56	10.53	6.92	7.9	3.26	3.39	24.9
75% MRP + 25% SSP	34.7	34.8	11.12	8.54	11.73	7.29	10.4	4.98	4.03	19.4
50% MRP + 50% SSP	37.7	37.8	18.49	8.36	16.53	8.46	11.9	6.16	4.55	19.5
25% MRP + 75% SSP	37.1	37.2	11.80	7.29	10.60	6.89	8.8	3.53	3.35	17.9
CD (P = 0.05)	5.6	4.3	3.19	1.49	1.43	1.07	1.3	0.72	0.63	2.6

URP, Udaipur rock phosphate; MRP, Mussoorie rock phosphate; SSP, single superphosphate

A, Rainy season 1991; B, rainy season 1992; <sup>Y</sup>winter season 1991-92

soils. The results also corroborate the findings of Kothandaraman and Namatchivayan (1986), who studied the effect of rock phosphate application in rice crop with and without farmyard manure in red sandy-loam soil.

There was significant residual effect of rock phosphate on the linseed yield. Maximum linseed yield of 11.1 and 11.9 q/ha was obtained when 50 : 50 mixture of rock phosphate and single superphosphate was applied to rice crop. The residual effect of rock phosphate may be attributed to the P build-up in the soil, which is substantiated by data of Table 1, indicating the substantial P build-up in the soil.

#### *Nutrient uptake*

Application of phosphorus significantly increased the P and calcium uptake by rice grain. The maximum uptake of both was observed when rock phosphate and single superphosphate were applied in 50 : 50 ratio, which was the highest yielding treatment (Table 1). The P-uptake values in rice grains ranged between 7.17 and 18.49 and 6.87 and 16.83 kg P/ha during rainy season (*khariif*) of 1991 and 1992 respectively. The uptake of P and Ca by linseed was also high-

est in the treatment where rock phosphate and single superphosphate were applied in 50 : 50 ratio. The increased P uptake by linseed crop may be attributed to the P build-up in the soil as result of slow P release from rock-phosphate sources.

Thus 50 : 50 mixture of rock phosphate and single superphosphate as P source has substantial direct and residual effect on the yield and nutrient uptake by rice and linseed respectively.

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