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EFFICACY OF MATON ROCK PHOSPHATE AS A SOURCE OF P FOR ACID RICE SOILS

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Abstract: To evaluate the efficiency of maton rock phosphate (MTRP) as a source of phosphorus for rice, a field experiment was conducted in farmers' field, Coorg district, Karnataka during kharif 1989-90 in terms of grain yield, labile-P in soil and P uptake by the crop. Maton rock phosphate and 25% acidulated MTRP recorded 7.8% and 15.68% increase in yield respectively over SSP as source of P. The physical mixture of MTRP + triple superphosphate (3:1) and 25% acidulated MTRP emerged as the best P sources with respect to grain yield and phosphorus use efficiency though the cost benefit ratio was highest with only MTRP.

Key words: Maton rock phosphate, P source, acid rice soil

INTRODUCTION

Most common practice to supply phosphorus to crops is in the form of water soluble chemically processed phosphatic fertilizers. Due to high cost of chemically processed fertilizers and due to the possibility of more soluble P getting locked up in amorphous clay system, less soluble and less expensive rock phosphate is preferred source of P in low pH soils (Minhas and Kick, 1974). As early as in 1958 Kanwar and Grewal reported the suitability of rock phosphate for acid soils. Partial acidulation of low grade rock phosphates and, physical mixtures of rock phosphate and water soluble P fertilizers in different proportions are very attractive substitutes. According to Minhas and Tripathi (1986), mixture of rock phosphate and SSP is as effective as superphosphate for rice culture. Conjunctive use of organic manure like farm yard manure is also found to influence the efficiency of rock phosphate as reported by Marwaha *et al.* (1981). Information on the use and efficiency of mussoorie rock phosphate is available in literature. However, many new deposits are being mined in different parts of the country and the usefulness of these new deposits need to be studied under varying agroclimatic situations. Maton rock phosphate is from the rock phosphate deposits which occur in the Aravali metasediments of sedimentary phosphate. X-ray diffractograph of MTRP revealed that it is substituted flourapatite, which contained 32.61% P_2O_5, 43.23% CaO and 7.50% of SiO_2. An attempt was therefore, made to study the performance of maton rock phosphate as a source of P in acid soils of Coorg district in Karnataka, India.

MATERIALS AND METHODS

A field was selected in farmers holding at Nadikere village of Coorg district for conducting the experiment. The soil had pH 5.7, EC 0..09 dS m^{-1}, OC 0.69%, CEC of 5.7 cmol (+) kg^{-1} and available P was 23 kg ha^{-1}. Rice variety IET-7191 was used as the test crop. The design adopted was randomised block design with three replications and the plot size was 5 m2. Fertilizer and FYM were given at recommended levels. Nitrogen was given in two splits and K and P were given as basal dressings. The sources of P used were SSP (single superphosphate), TSP (triple superphosphate), MTRP (maton rock phosphate), DAP (diammonium phosphate) 25% and 50%, MTRP + TSP at 3:1, 1:1 and 1:3 ratios apart from MTRP + FYM. Soil and plant samples were collected at maximum tillering stage, panicle initiation and at harvest. The analysis of soil and plant samples were carried out as per Jackson (1958).

RESULTS AND DISCUSSION

Grain yield of rice increased significantly with phosphatic fertilizer application and it ranged from 2655 kg ha^{-1} in no P treatment to 3416 kg ha^{-1} in PAMTRP 25% as given in Table 1. Maton rock phosphate recorded 7.8% increase in yield over SSP, but it was on par with TSP and DAP treatment. There was 15.63% increase in grain yield by the application of PAMTRP 25% over SSP, whereas application of MTRP + TSP at 3:1 ratio increased the yield by 13.82% over SSP. This reflects that about 25-30% water soluble P sources combined with rock phosphate could be a better source of P to meet the requirement during early stages of crop growth as well as gradual dissolution of insoluble rock phosphate to meet P requirement during later stages of plant growth.

Table 1. Effect of different P sources on grain yield and available P and P uptake at different growth stages of rice

Treatment	Grain yield kg ha^{-1}	Availlable P, kg ha^{-1}			Uptake of P, kg ha^{-1}		
		MTS	PIS	HS	MTS	PIS	HS
$N_0P_0K_0$	2655	21.8	24.6	2.7	3.29	5.11	10.45
SSP	2954	30.4	45.6	5.1	3.16	6.91	12.81
TSP	3005	29.2	24.1	3.8	3.20	7.45	14.34
DAP	2984	26.2	26.4	3.4	4.38	6.78	13.63
MTRP	3185	23.1	35.4	6.4	2.86	6.22	12.41
MTRP +TSP 3:1	3363	27.8	42.3	8.9	4.14	7.48	14.76
" 1:1	3018	29.0	23.8	6.2	3.28	6.06	12.73
" 1:3	2993	24.1	30.8	5.4	3.89	7.11	12.62
PAMTRP 25%	3416	20.8	46.6	7.9	4.22	7.46	15.95
MAPTRP 50%	2895	23.1	37.7	5.9	3.38	6.88	12.93
MTRP + FYM	2995	22.9	33.3	5.2	3.30	6.76	13.04
FYM	2841	19.8	22.1	1.9	2.53	6.54	11.86
CD(0.05)	216	6.0	10.0	2.9	1.01	1.60	2.47

MTS = Maximum tillering stage PIS = Panicle Initiation stage IIS = Harvest stage

Available P at different growth stages shows substantial differences due to different P fertilizers. At maximum tillering stage, water soluble sources of P recorded more available P in soils, obviously due to more solution P in the equilibrium system, compared to other less soluble sources. However, at panicle initiation stage, all sources of P resulted in more available P in soil due to combined effect of the presence of large amount of active roots and more solubilization of P from the insoluble sources of P. At harvesting stage rock phosphate treatments maintained more available P compared to water soluble P fertilizer treatments. The dif-

Table 2. Economics and phosphorus use efficiency

Treatment		Benefit/ cost ratio	P use efficiency
SSP		16.41	39.38
MTRP		28.31	42.46
MTRP+TSP	3:1	26.29	44.84
"	1:1	21.06	40.24
"	1:3	18.86	36.90
PAMTRP	25%	26.40	45.54

ference in water solubility of fertilizers resulted in this difference in the trend of available P in the soil. In the treatments which involve physical mixture of rock phosphate and SSP as well as partially acidulated RP, priming action of water soluble sources as well as residual acidity results in slow dissolution and thereby increased efficiency of these P sources. Liming action of rock phosphate due to the presence of 43.2% CaO also reduces fixation in low pH soil systems. Similar results were reported in various low pH soil systems (Panda 1986, Sahu and Pal, 1986). Sushama (1990) reported more dissolution of acidulated rock phosphate in low pH paddy soils after 60 days of transplanting of paddy seedlings.

The data on uptake of P as illustrated in Table 1 revealed that at maximum tillering stage, combination of MTRP + TSP at 3:1 ratio and PAMTRP 25% increased the uptake of P over water soluble P fertilizer and MTRP alone. This continues in other two growth stages. Use of organic manure as an amendment or adjunct along with MTRP resulted in slight increase in uptake of P by rice plants.

MTRP recorded more P use efficiency over SSP (Table 2). Among the combination of MTRP + TSP, 3:1 ratio was found superior in terms of phosphorus use efficiency (PUE) over 1:1 and 1:3 ratios. Partial acidulation of MTRP to 25% level had shown maximum PUE (45.54) among all treatments. Cost benefit ratio varied from 16.45 in SSP treatment to 28.31 in MTRP treatment. Combination of MTRP + TSP at 3:1 ratio registered 26.29 cost-benefit ratio compared to 21.06 and 18.86 in 1:1 and 1:3 ratios respectively. Partial acidulation of MTRP to the tune of 25% was found to be comparable to the CB ratio to that of 3:1 ratio.

It can be concluded from this study that application of maton rock phosphate could be used in place of SSP as a source of P for rice in low pH soils of this area. Similar observations are made in many other low pH soils where mussoorie rock phosphates are found to be equally good or even better than SSP (Pandurangaiah *et al.* 1986; Guruprasad *et al.*, 1987).

However, physical mixing of rock phosphate with water soluble sources like TSP or SSP in order to get 25-30% easily available P in the fertilizer mixture is to be preferred to avoid the deficiency of P at the initial establishment stage of the crop. If 25% acidulated rock phosphate is readily available, the farmers can definitely exploit its advantage by maximising crop production with minimum input.

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