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Utilization of Filter Cake as Phosphate Source for Paddy in Acid Sulfate Soil II. Comparative Study on the Effects of Filter Cake and Various Phosphorus Fertilizers on Growth, Yield and Phosphorus Uptake in Rice Plant Grown in a Submerged Acid Sulfate Soil.

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ABSTRACT

Comparative study on the effects of filter cake, KH_2PO_4, triple superphosphate and rock phosphate on growth, yield and phosphorus uptake in rice plant grown in a submerged acid sulfate paddy soil (Rangsit soil) was carried out in pot experiment.

Filter cake, KH_2PO_4, triple superphosphate and rock phosphate significantly increased growth, yield and total P uptake of the rice plant. The effectiveness of filter cake in increasing grain yield of rice plant was the same as those of KH_2PO_4 and triple superphosphate but higher than that of the rock phosphate

INTRODUCTION

Various phosphorus fertilizers were used in acid sulfate paddy soils in Thailand. It was reported that ammonium phosphate, diammonium phosphate, ordinary superphosphate and triple superphosphate showed similar effect on rice yield (Jugsujinda *et al,* 1968). Moreover, the same effect of triple superphosphate and rock phosphate on grain yield of rice plant was also observed (Jugsujinda and Suwanwong, 1972; Prabuddham, 1982).

This research was conducted as to compare the effects of filter cake, KH_2PO_4, triple superphosphate and rock phosphate on growth, yield and P uptake in rice plant grown in a submerged acid sulfate paddy soil.

MATERIALS AND METHODS

Soil sample of 0 – 20 cm. depth, Rangsit soil (acid sulfate soil, Sulfic Tropaquepts) was collected from Pathumthani Rice experiment Center, Thailand. This soil was air dried and crushed to pass through a 2 mm sieve. Fresh filter cake, waste material, was collected from sugar mill factory in Thailand. It was air dried and crushed to pass through a 0.5 mm sieve. The properties of soil sample and filter cake are shown in Table 1.

The experiment was laid out in completely randomized design with 5 treatments and 3 replications. The treatments were Check, Filter cake, KH_2PO_4, Triple superphosphate, and Rock phosphate (slow release fertilizer). Details of the treatments were shown in Table 2. The investigation was conducted either with urea or with $(NH_4)_2SO_4$ as a source of N. Each pot contained 6 kg soil.

Height, tiller number of rice plant at panicle initiation (PI) and flowering (F) stages were measured. Straw, grain yield and total P uptake in rice plant at harvesting stage were determined.

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Table 1 Properties of air dry soil sample and air dry filter cake

Properties of soil sample		Properties of filter cake	
Texture	clay		
pH (1:1 soil : H_2O)	3.9	pH	7.5
Total N (%)	0.150	Total P (%)	2.41
Total C (%)	1.466	Total C (%)	11.3
CEC (me/100 g soil)	37.5	Total N (%)	1.01
Free Fe (%)	0.92	C/N	11
Available P (Bray II) (ppm)	14	Ca (%)	8

Table 2 Experimental treatments

Treatment	Rate of total P gm/6 kg soil	Filter cake or P fertilizer gm/6 kg soil	Urea gm/6 kg soil	$(NH_4)_2SO_4$ gm/6 kg soil
with urea as source of N				
Check	0	0	3.41	0
Filter cake	1.71	71.25	3.41	0
KH_2PO_4	1.71	7.5	3.41	0
Triple superphosphate	1.71	8.52	3.41	0
Rock phosphate	1.71	12.24	3.41	0
with $(NH_4)_2SO_4$ as source of N				
Check	0	0	0	7.5
Filter cake	1.71	71.25	0	7.5
KH_2PO_4	1.71	7.5	0	7.5
Triple superphosphate	1.71	8.52	0	7.5
Rock phosphate	1.71	12.24	0	7.5

RESULTS AND DISCUSSION

1. Effects of filter cake, KH_2PO_4, triple superphosphate and rock phosphate on growth and yield of rice plant.

Effects of phosphate fertilizer and filter cake on height, tiller number and yield of rice plant were shown in Table 3 and Table 4 respectively.

The experimental results either with urea or $(NH_4)_2SO_4$ as a source of N were similar. Filter cake and KH_2PO_4, triple superphosphate and rock phosphate significantly increased growth and yield of the rice plant (Prabuddham, 1982). Height, tiller number and weight of straw of the rice plant grown in the acid sulfate soil amended with filter cake was similar to those of the rice plant grown in the acid sulfate soil amended with KH_2PO_4, triple superphosphate and rock phosphate. It was found that the effectiveness of filter cake in increasing grain yield of the rice plant was the same as those of KH_2PO_4 and triple superphosphate but higher than that of rock phosphate. This may be due to the rapid release P of filter cake (Chanchareonsook and Wada, 1987), KH_2PO_4 and triple superphosphate and the slow release P of rock phosphate. Percentage of sterility of rice plant grown in the acid sulfate soil amended with filter cake was rather low.

Table 3 Height (cm) and tiller number of rice plants at panicle initiation (PI) and flowering (F) stages

Treatment	with urea as source of N				with $(NH_4)_2SO_4$ as source of N			
	Height		Tiller No.		Height		Tiller No.	
	PI	F	PI	F	PI	F	PI	F
Check	82	106	7	10	85	101	6	8
Filter cake	102	119	31	32	101	116	27	28
KH_2PO_4	103	120	35	34	104	120	31	32
Triple superphosphate	99	122	30	30	103	119	25	26
Rock phosphate	108	128	26	28	105	116	22	25
F-test	**	**	**	**	**	**	**	**
LSD .05	8	9	6	5	5	10	5	5
.01	11	13	9	8	7	14	7	7
% C.V.	4	4	13	11	3	5	12	12

** = significant at .01 level of probability

Table 4 Rice yield in each treatment

Treatment	with urea as source of N				with $(NH_4)_2SO_4$ as source of N			
	Grain g/pot	Straw g/pot	Panicle no.	Sterility %	Grain g/pot	Straw g/pot	Panicle no.	Sterility %
Check	19	24	9	7	16	22	8	7
Filter cake	54	59	26	3	65	60	27	3
KH_2PO_4	57	65	29	5	64	64	27	6
Triple superphosphate	48	61	25	4	59	59	25	3
Rock phosphate	41	63	25	5	53	59	23	4
F-test	**	**	**	NS	**	**	**	NS
LSD .05	13	13	4	–	11	14	3	–
.01	19	18	6	–	16	20	5	–
% C.V.	16	13	9	21	12	15	8	23

** = significant at .01 level of probability NS = non significant

2. Effects of filter cake, KH_2PO_4, triple superphosphate and rock phosphate on total P uptake in rice plant.

Total P uptake in rice plant and percentage of efficiency of filter cake and phosphate fertilizers were shown in Table 5.

Filter cake, KH_2PO_4, triple superphosphate and rock phosphate significantly increased total P uptake in rice plant. Total P uptake in rice plant grown in the acid sulfate soil amended with filter cake, KH_2PO_4, triple superphosphate and rock phosphate were similar.

With urea as a source of N, the percentage of the efficiency of filter cake, KH_2PO_4, triple superphosphate and rock phosphate were 15, 16, 15 and 14, respectively. With $(NH_4)_2SO_4$ as a source of N the efficiency of filter cake was 16 percent and those of KH_2PO_4, triple superphosphate and rock phosphate were 15 percent.

Table 5 Total P uptake in rice plant and percent efficient use of P (base on 1710 mg P applied)

Treatment	with urea as source of N		with $(NH_4)_2SO_4$ as source of N	
	Total P uptake mg/pot	Efficiency[a/] %	Total P uptake mg/pot	Efficiency[a/] %
Check	49	–	34	–
Filter cake	299	15	311	16
KH_2PO_4	322	16	293	15
Triple superphosphate	299	15	296	15
Rock phosphate	293	14	288	15
F-test	**		**	
LSD .05	62		52	
.01	88		74	
% C.V.	13		11	

** = significant at .01 level of probability

a/ Efficiency (%) = $\frac{\text{Total P uptake from P applied}}{\text{Total P applied}} \times 100$

CONCLUSION

The effectiveness of filter cake in increasing yield of the rice plant grown in the acid sulfate paddy soil was similar to that of chemical phosphate fertilizer.

LITERATURE CITED

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