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Effects of Filter Cake on Phosphate Status in a Submerged Acid Sulfate Soil (Rangsit Soil)

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ABSTRACT

The effects of filter cake on phosphate status in a submerged acid sulfate soil (Rangsit soil) were studies. In addition, effects of filter cake on pH and reduction state of acid sulfate soil were also included. Rangsit soil was amended with filter cake or KH_2PO_4 or KH_2PO_4 + $CaCO_3$ in the rate of 0 and 2.868 mg P/10g of dried soil and 0, 9.5 mg Ca/10g of dried soil. Filter cake increased the amount of available P in the submerged acid sulfate soil (Rangsit soil). The effectiveness of filter cake in increasing available P in acid sulfate soil was more or less the same as that of KH_2PO_4. Filter cake also increased pH of acid sulfate soil. Furthermore the ability of filter cake in increasing pH of acid sulfate soil was similar to that of $CaCO_3$. Filter cake did not enhance reduction state of submerged acid sulfate soil.

INTRODUCTION

Filter cake is a kind of waste materials from sugar mill factory which was obtained from the process of clarifying cane juice. Utilization of filter cake as nitrogen source for paddy in Thailand was recently studied (Vacharotayan *et al,* 1985). The experimental results indicated that filter cake increased small amount of NH_4^+-N in paddy soils (Chanchareonsook *et al,* 1985); however the content of phosphorus in rice plant grown in an acid sulfate soil amended with filter cake was found to be remarkably high (Panichsakpatana *et al.* 1985).

This research was conducted as to investigate the effects of filter cake on the amount of available phosphorus in submerged acid sulfate soil (Rangsit soil). In addition the effects of filter cake on pH and reduction state of an acid sulfate soil were also elucidated.

MATERIALS AND METHODS

Soil sample (acid sulfate soil, Sulfic Tropaquept, Rangsit soil) was collected from Pathumthani Rice Experiment Center, Thailand. This soil was air-dried and crushed to pass through a 2 mm. sieve. Its properties are shown in Table 1. Filter cake 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 filter cake is shown in Table 1.

Table 1 Properties of soil sample (Rangsit soil) and filter cake.

Properties of soil sample (Rangsit soil)		Properties of filter cake	
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/100g. soil)	37.5	Total N (%)	1.01
Free Fe (%)	0.92	C/N	11
Available P (Bray II) (ppm)	14	Ca (%)	8

Ten grams of air dried soil amended with filter cake or KH_2PO_4 or $KH_2PO_4 + CaCO_3$ in the rate of 0, 2.868 mg P/10 g. of dried soil and 0, 9.5 mg Ca/10 g. of dried soil (details of these treatments are shown in Table 2) were incubated in the test tube under submerged condition (using H. Wada's technique (Tsuchiya et al, 1986)) at 30°C for 0, 7, 14 and 18 day. pH, CO_2 water-soluble P (most labile fraction),

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Table 2 Details of the treatments

Treatment	Rate of P	Rate of Ca	KH_2PO_4	Filter cake	$CaCO_3$
	mg/100g of dried soil				
Check	0	0	0	0	0
Filter cake	2.868	9.5	0	119	0
KH_2PO_4	2.868	0	12.5	0	0
$KH_2PO_4 + CaCO_3$	2.868	9.5	12.5	0	24

adsorped P (labile fraction), water-soluble Fe^{2+}, and adsorped Fe^{2+} were determined. Methods of soil analysis are showned in Table 3.

Table 3 Method of soil analysis

Item	Extraction	Determination
pH	–	Glass electrode
CO_2	–	CO_2 analyzer
Water soluble P	H_2O	Colorimetry (Watanabe and Olsen, 1965)
Adsorped P	Bray II	Colorimetry (Watanabe and Olsen, 1965)
Water souble Fe^{2+}	H_2O	Colorimetry (Kumada and Asami, 1958)
Adsorped Fe^{2+}	$CaCl_2$	Colorimetry (Kumada and Asami, 1958)

RESULTS AND DISCUSSION

1. Effects of filter cake on available phosphorus in the submerged acid sulfate soil

The amount of water-soluble P, adsorped P and Bray II P (water-soluble P + adsorped P) in each treatment are shown in Table 4. The amount of adsorped P and the amount of Bray II P (water-soluble P + adsorped P) were decreased in the following order : $KH_2PO_4 + CaCO_3 > KH_2PO_4$, Filter cake $>>$ Check. This suggests that filter cake increases the amount of available P in the submerged acid sulfate soil. It was found that the effectiveness of filter cake in increasing available P in acid sulfate soil was more or less the same as that of KH_2PO_4. Application of KH_2PO_4 in combination with $CaCO_3$ enhanced the effectiveness of KH_2PO_4 in increasing the amount of available P in submerged acid sulfate soil, though the amount of water-soluble P was decreased by application of $CaCO_3$.

2. Effects of filter cake on neutralization and reduction state of the submerged acid sulfate soil

pH of water-extracts are shown in Table 5. It was found that pH of water-extract of the soil amended with filter cake was rather similar to that of the soil amended with $KH_2PO_4 + CaCO_3$ but higher than those of the soils amended with KH_2PO_4 and Check. This indicates that filter cake has rather similar ability to increase pH of acid sulfate soil as $CaCO_3$.

On the basis of the amount of water-soluble Fe^{2+}, adsorped Fe^{2+} and $CaCl_2$ extractable Fe^{2+} (water-soluble Fe^{2+} + adsorped Fe^{2+})

Table 4 The amount of water-soluble P, adsorped P and Bray II P (water-soluble P + adsorped P) in each treatment

Treatment	Water-soluble P (ppm) Time of Incubation (day)				Adsorped P (ppm) Time of Incubation (day)				Bray II P (water soluble P + Adsorped P) (ppm) Time of Incubation (day)			
	0	7	14	18	0	7	14	18	0	7	14	18
Check	0.736	0.193	0.129	0.129	15	15	22	16	15.736	15.193	22.129	16.129
Filter cake	0.904	0.883	1.012	0.546	103	124	139	138	103.904	124.883	140.012	138.546
KH_2PO_4	5.930	3.482	0.789	0.211	94	137	147	124	99.930	140.482	147.789	124.211
$KH_2PO_4 + CaCO_3$	0.417	0.508	0.654	0.652	94	142	169	149	94.417	142.508	169.654	149.652

(Table 6), we can say that filter cake does not enhance reduction state of submerged acid sulfate soil. Application of filter cake increased the amount of CO_2 in acid sulfate soil (Table 7). This must be due to the dissolution of $CaCO_3$ contained in filter cake in the submerged acid sulfate soil.

Table 5 pH of water-extracts

Treatment	Time of Incubation (day)			
	0	7	14	18
Check	3.9	3.9	3.9	3.9
Filter cake	4.8	5.4	5.2	5.8
KH_2PO_4	3.9	3.8	3.9	4.0
$HK_2PO_4 + CaCO_3$	6.1	5.1	5.2	5.3

Table 6 The amount of water-soluble Fe^{2+}, adsorped Fe^{2+} and $CaCl_2$ extractable Fe^{2+} (water-soluble Fe^{2+} + adsorped Fe^{2+}) in each treatment

Treatment	Water-soluble Fe^{2+} (ppm) Time of Incubation (day)				Adsorped Fe^{2+} (ppm) Time of Incubation (day)				$CaCl_2$ extractable Fe^{2+} (Water-soluble Fe^{2+} + Adsorped Fe^{2+}) (ppm) Time of Incubation (ppm)			
	0	7	14	18	0	7	14	18	0	7	14	18
Check	0	21	35	43	1	213	444	n.d.*	1	234	479	n.d.*
Filter cake	0	14	34	42	1	127	424	n.d.	1	141	458	n.d.
KH_2PO_4	0	16	26	40	2	185	387	n.d.	2	201	413	n.d.
$KH_2PO_4 + CaCO_3$	0	15	26	38	1	139	328	n.d.	1	154	354	n.d.

* not determined

Table 7 The amount of CO_2 in each treatment (mg/100 g soil)

Treatment	Time of Incubation (day)			
	0	7	14	18
Check	0	n.d.*	21	23
Filter cake	trace	n.d.	119	139
KH_2PO_4	trace	n.d.	21	19
$KH_2PO_4 + CaCO_3$	0	n.d.	131	96

* not determined

CONCLUSION

Filter cake increased available phosphate as indicated by Bray II, in acid sulfate soil more or less the same as KH_2PO_4 which reveals filter cake is a promising phosphate source for paddy in acid sulfate soils.

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