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Influence of Enriched Pressmud Compost on Soil Chemical Properties and Yield of Rice

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Abstract: A field experiment was conducted to investigate the effect of enriched pressmud compost on soil chemical properties like pH, EC, major nutrient availability and yield of rice with five levels of pressmud compost viz., 0, 1.25, 2.50, 3.75 and 5.0 t ha^{-1} in two varieties viz., ADT 36 and ADT 43 and a hybrid ADTRH 1 during the kharif season of 2004 in the farm soil of Pandit Jawarhalal Nehru College of Agriculture and Research Institute, Tamil Nadu Agricultural University (TNAU). The results of the field experiment revealed that the hybrid ADTRH 1 manifested higher grain and straw yield, whereas, the variety ADT 43 and ADT 36 registered lower grain and straw yields, respectively. With regard to the enriched pressmud compost, the application of 1.25 t ha^{-1} of enriched pressmud compost showed its potentiality by providing more available nutrients to promote higher grain yields and it was comparable with 2.50 t ha^{-1} of enriched pressmud compost. However, the straw yield was higher with 2.50 t ha^{-1} of enriched pressmud compost and it was on par with 1.25 t ha^{-1} of pressmud compost. The soil reaction (pH) and Electrical Conductivity (EC) did not show any marked variation with application of enriched pressmud compost. The N, P and K availability in soil was at higher levels and comparable with application of 1.25 and 2.50 t ha^{-1} of enriched pressmud compost, whereas it was lower with control. The outcome of the present investigation revealed that the highest grain yield was obtained, at 1.25 t ha^{-1} of enriched pressmud compost along with inorganic fertilizers for the varieties and hybrid. Hence, the incorporation of 1.25 t ha^{-1} enriched pressmud compost as basal along with required remaining nitrogen through inorganic fertilizer as top dressing in three splits may be recommended for rice crop to realise maximum yield in kuruvai (Kharif) season.

Key words: Pressmud compost, pH, EC, nutrient availability, yield , rice

INTRODUCTION

India is the largest consumer and second producer of sugar in the world, with over 450 sugar factories located throughout the country. The sugar industry is amongst the largest agro-processing industries in India with average sugar production of about 176.75 lakhs tones with an annual turnover of Rs.150 billion. The pressmud and molasses are industrial by products of sugarcane industry in India and the production is, respectively to the tune of 7.0 and 7.5 million tones annually (Manickam, 2007). In the beginning of twentieth century, the pressmud and molasses were used as soil amendments. The value of pressmud as an organic manure has been well recognized for utilizing in agriculture, as it contains valuable plant nutrients in organic form besides being a very effective soil ameliorant (Ramaswami, 1999). Conversion of raw pressmud into enriched pressmud compost through

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composting process was increased the available nutrient content like N, P and K. Application of pressmud compost was increased the crop yield and soil properties than raw pressmud (Desmukh *et al*., 2003). Rice is the stable food crop in India with world ranking one in area (44.6 M ha) and second to China in production (93 Mt). India needs to produce about 325 million tones of food grains to feed an expected population of about 1.5 billion by 2025 (Anil *et al*., 2004). Keeping in view of the average annual population growth rate of 1.5% and per capita consumption estimate of about 400 g of rice per day, demand of rice is expected to be around 100 Mt during 2010 and 140 Mt by 2025. The Pondicherry Agro-Service and Industrial Corporation (PASIC) of Pondicherry are producing and selling the enriched pressmud compost in large quantities and is popularized among the farmers. But, this enriched pressmud compost has not been evaluated properly and optimized for rice crop. In this context, the present investigation was undertaken to study the effect of enriched pressmud compost on nutrient availability and yield of rice with the following objectives:

- To study the influence of enriched pressmud compost on soil reaction (pH) and Electrical conductivity
- To assess the availability of major nutrients in soil at various stages of crop growth.
- To study the influence of enriched pressmud compost on the yield of rice.

MATERIALS AND METHODS

Field experiment was conducted at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal in the Union Territory of Pondicherry to study the effect of enriched pressmud compost on nutrient availability and yield of rice in kuruvai (Kharif) season during the year 2004. The experimental soil (Fluventic Haplustept) was with pH of 7.80 and EC of 0.22 dS m^{-1}. The available N, P, K status was 153 kg ha^{-1}, 12.4 and 220 kg ha^{-1}, respectively. The organic carbon content was 0.45% with CEC of 23.2 cmol (P×) kg^{-1}. The textural classification revealed loamy type of soil with 20.9% of clay, 40.0% of silt, 23.4% of fine sand and 15.6% of coarse sand. The experiment was conducted in a Factorial Randomized Block Design (FRBD) with three cultivars and five treatments in three replications. The treatments were adopted T_1- 0 t ha^{-1}, T_2-1.25 t ha^{-1}, T_3 -2.50 t ha^{-1}, T_4 - 3.75 and T_5 -5.00 t ha^{-1} of enriched pressmud compost. The rice varieties viz., ADT 36, ADT 43 and the hybrid ADTRH 1 were used for the experiment. Twenty-eight days seedlings were transplanted at the rate of two seedlings per hill in the case of ADT 43 and ADT 36 and one seedling per hill in the case of ADTRH 1 with the spacing of 20×10 cm.

A blanket recommendation of 120 kg N, 40 kg P_2O_5 and 40 kg K_2O ha^{-1} was adopted for this investigation. The P_2O_5 and K_2O were applied in the form of Single Super Phosphate (SSP) and Muriate of Potash (MOP) before transplanting after the application of enriched pressmud compost and the N was applied as per the treatments by using Enriched Pressmud Compost. (EPC) and urea. The EPC was incorporated as basal and the urea was applied in three equal splits as top dressings at the time of active tillering, panicle initiation and first flowering stages. The surface soil samples (0-15 cm depth) were collected from all the plots at important phenological stages viz., active tillering and panicle initiation stages and at post harvest for the analysis of soil pH, EC and major available nutrients and analysed following standard methods. The grain and straw yield and analytical data were statistically analysed.

RESULTS AND DISCUSSION

Effect of Enriched Pressmud Compost on Grain and Straw Yield of Rice

The hybrid ADTRH 1 recorded significantly higher grain and straw yield than ADT 43 and ADT 36 (Table 1). This might be due to the known fact that the hybrid could be able to produce higher yield

Table 1: Effect of enriched pressmud compost grain and straw yield (t ha^{-1})

Pressmud Compost levels (t ha^{-1})	Grain yield				Straw yield			
	ADT 36	ADT 43	ADTRH 1	Mean	ADT 36	ADT 43	ADTRH 1	Mean
0.00	1.26	1.80	2.72	1.93	2.75	3.58	6.42	4.25
1.25	1.84	2.88	3.19	2.65	5.17	4.75	7.83	5.92
2.50	1.82	2.72	3.11	2.55	5.42	5.00	7.92	6.11
3.75	1.62	2.65	3.01	2.42	4.67	4.75	7.25	5.56
5.00	1.56	2.53	2.78	2.29	4.50	4.33	7.00	5.28
Mean	1.62	2.52	2.96		4.50	4.48	7.28	
Source	V	T	V×T		V	T	V×T	
SED	0.10	0.13	0.23		0.31	0.40	0.69	
CD (p = 0.05)	0.21	0.21	NS		0.64	0.82	NS	

NS = Non Significant

Table 2: Soil reaction at different physiological stages

Treatments (T) Pressmud compost levels (t ha^{-1})	Active tillering Varieties(V)				Panicle initiation Varieties(V)				Post harvest Varieties(V)			
	ADT 36	ADT 43	ADTRH 1	Mean	ADT 36	ADT 43	ADTRH 1	Mean	ADT 36	ADT 43	ADTRH 1	Mean
0.00	7.98	7.81	7.78	7.86	7.97	7.82	7.78	7.86	7.98	7.77	7.76	7.84
1.25	7.73	7.77	7.77	7.76	7.66	7.69	7.69	7.68	7.54	7.59	7.62	7.59
2.50	7.63	7.74	7.74	7.70	7.66	7.65	7.69	7.67	7.48	7.58	7.48	7.51
3.75	7.47	7.73	7.73	7.65	7.62	7.59	7.55	7.59	7.47	7.56	7.44	7.49
5.00	7.42	7.73	7.70	7.61	7.50	7.53	7.52	7.52	7.45	7.51	7.36	7.44
Mean	7.65	7.75	7.74		7.68	7.66	7.65		7.58	7.60	7.53	
Sources	V	T	V×T		V	T	V×T		V	T	V×T	
SED	0.08	0.11	0.18		0.08	0.11	0.18		0.08	0.10	0.17	
CD (5%)	NS	NS	NS		NS	0.22	NS		NS	0.20	NS	

NS = Non Significant

than the conventional varieties due to its inherent genetic make up and its ability to mobilize more nutrients for realising potential yields. While studying the effect of enriched pressmud compost levels, the 1.25 t ha^{-1} level registered higher grain yield of 2.65 t ha^{-1}, which was on par with the 2.50 and 3.75 t ha^{-1} level. The lowest yield of 1.93 t ha^{-1} was recorded at control. Though the 1.25 t ha^{-1} of enriched pressmud compost established its superiority and on par with 2.50 t ha^{-1} in realising more grain yield, further this treatment became second to 2.50 t ha^{-1} of enriched pressmud compost in producing the straw yield. The yield reduction was observed with increase in the levels of pressmud compost. Higher grain yield obtained from the above treatments might be attributed to rapid mineralization of N and sustained supply of N from pressmud, which might have met the N requirement of crop over a long period and specifically at the critical stages of crop growth. This is in accordance with the reports of Yadvinder Singh *et al.* (2003) and Swarup *et al.* (2004). The interaction effects did not manifest any difference in realising grain and straw yield. However, the hybrid ADTRH 1 recorded the highest grain and straw yield of 3.19 and 7.92 t ha^{-1} with 1.25 and 2.50 t ha^{-1} of pressmud compost and the variety ADT 36 registered the lowest grain and straw yield of 1.26 and 2.75 t ha^{-1} with control.

Effect of Enriched Pressmud Compost on Soil Reaction (Soil pH)

At active tillering stage, the pH of the soil did not show any marked variations due to varieties and treatments. In panicle initiation stage also the varieties did not show any differences in pH values of the soils. Among the treatments, the control registered the highest pH value of 7.86 and the lowest pH value of 7.52 was observed at 5.00 t ha^{-1} of enriched pressmud compost (Table 2). In the case of interaction effects, no significant variations were seen. However, numerically the highest pH value of 7.97 was recorded at control with ADT 36 and the lowest pH value of 7.50 with ADT 36 at 5.00 t ha^{-1} level of enriched pressmud compost. At post harvest stage, the varieties did not bring any difference in pH values of the soil. Among the treatments, the control registered higher pH value

Table 3: Electrical Conductivity (dS m^{-1}) at different physiological stages

Pressmud compost levels	Active tillering				Panicle initiation				Post harvest			
(t ha^{-1})	ADT 36	ADT 43	ADTRH 1	Mean	ADT 36	ADT 43	ADTRH 1	Mean	ADT 36	ADT 43	ADTRH 1	Mean
0.00	0.21	0.20	0.22	0.21	0.21	0.20	0.22	0.21	0.21	0.20	0.22	0.21
1.25	0.23	0.22	0.23	0.23	0.22	0.23	0.23	0.23	0.23	0.25	0.24	0.24
2.50	0.23	0.23	0.23	0.23	0.23	0.24	0.25	0.25	0.24	0.25	0.25	0.25
3.75	0.23	0.24	0.24	0.24	0.24	0.27	0.24	0.25	0.25	0.25	0.26	0.25
5.00	0.24	0.25	0.26	0.25	0.24	0.25	0.27	0.26	0.25	0.29	0.28	0.27
Mean	0.23	0.23	0.24		0.23	0.24	0.24		0.24	0.25	0.25	
Sources	V	T	V×T		V	T	V×T		V	T	V×T	
SED	0.01	0.08	0.02		0.008	0.01	0.02		0.01	0.01	0.02	
CD (5%)	NS	0.02	NS		NS	0.02	NS		NS	0.02	NS	

NS = Non significant

of 7.84 than the other levels. In the case of interaction effects, again there was no significant variation among them. Though numerical variation in soil reaction was seen within the varieties and varied levels of enriched pressmud compost in all the three stages, they were not much conspicuous and maintaining almost neutral pH (Table 2). This is certainly due to the fact that the presence of excess amount of salts keeps the soil reaction neutral. Moreover, when the soil is completely under submergence, the soil reaction always poises towards neutrality irrespective of the soil types, fertility status and soil initial pH (Ponnamperuma, 1972 and Aruloli, 2002)

Effect of Enriched Pressmud Compost on Electrical Conductivity

At all the three stages, the EC of the soil did not exhibit any marked variations due to varieties and hybrid. Among the treatments, the application of 5.00 t ha^{-1} of enriched pressmud compost slightly increased the EC and the other levels did not influence the soil EC. The EC was increased with increasing the levels of enriched pressmud compost, but not to a greater extent (Table 3). This sort of increased EC is possible, because the decomposition processes of organic matter favour the accumulation of CO_2 and release of large amount of salts in solution which results in higher EC (Omar Hattab, 2000). Mathakiya and Meisheri (2003) also reported that the application of pressmud increased the EC of the soil. These findings are in contrast to the reports given by Rajmannar (1983); who reported that application of pressmud reduced the pH and EC of alkali soils.

Effect of Enriched Pressmud Compost on Nitrogen Availability

The available nitrogen in soil at active tillering stage was not influenced either by cultivars or by treatments and its interactions. At panicle initiation also, the available soil nitrogen was not influenced by the varieties and hybrid. Among the treatments, the control recorded significantly lower amount of available soil nitrogen of 127 kg ha^{-1}, whereas the other four treatments established more of less equal status of available soil nitrogen at panicle initiation stage. The interaction between varieties and treatments did not influence the available soil N at panicle initiation stage. At post harvest, the varieties and hybrid did not show any effect on realising available soil nitrogen at this stage. Among the treatments, the application of 1.25 t ha^{-1} of enriched pressmud compost favoured for higher amount of available soil nitrogen of 171 kg ha^{-1}, followed by 2.50, 3.75, 5.00 t ha^{-1} and by control at post harvest stage. The application of 1.25 t ha^{-1} of enriched pressmud compost sustained higher N availability and it was comparable with 2.50 t ha^{-1} of enriched pressmud compost (Fig. 1). The increase in available soil nitrogen on account of these pressmud application indicated that the nitrogen present in pressmud was immediately available for crop nutrition (Indiraraj and Raj, 1979). This is in agreement with the view expressed by Pandalai *et al.* (1958) that since the C/N ratio of the

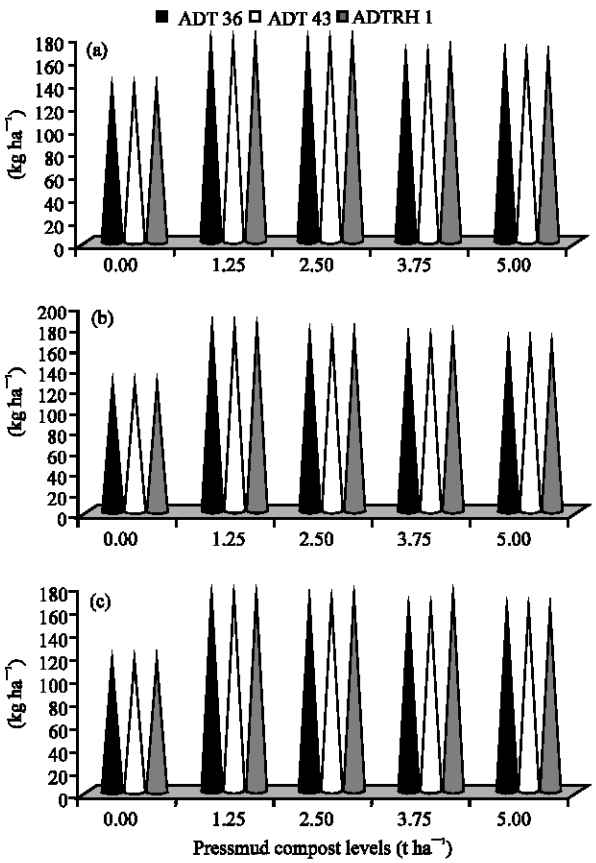

Fig. 1: Available soil nitrogen at different physiological stages (kg ha^{-1}), (a) Active tillering stage (b) Panicle initiation stage and (c) Post harvest stage

increment in levels of enriched pressmud compost declined the status of available soil P was material was narrow and the nitrogen present would be immediately available for plant use. Similar results were obtained by many authors (Singh *et al*., 2003; Satheesh and Balasubramaniyan, 2003; Mathakiya and Meisheri, 2003; Swarup and Yaduvanshi, 2004). They have also confirmed the results of the present investigation.

Effect of Enriched Pressmud Compost on Phosphorus Availability

The available soil phosphorus at active tillering, panicle initiation and at post harvest stages is presented in the Table 4. At active tillering stage, the varieties and treatments did not bring any marked variation regarding the available soil phosphorus. Among the treatments, the soil available phosphorus was higher (19.5 kg ha^{-1}) at 1.25 t ha^{-1} of enriched pressmud compost. The lowest soil available phosphorus of 15.2 kg ha^{-1} was recorded at control. The two-way interactions could not show any significant variation. At panicle initiation stage also, similar trend was observed regarding the available soil phosphorus except the various levels of enriched pressmud compost. At post harvest, the available soil phosphorus status recorded by hybrid and varieties and their interaction with treatments did not show any marked influence. The trend of results at active tillering and panicle initiation stage reflected at this stage also regarding the treatments. The level of 1.25 t ha^{-1} recorded

Table 4: Available soil Phosphorus (kg ha^{-1}) at different physiological stages

Pressmud compost levels	Active tillering				Panicle initiation				Post harvest			
(t ha^{-1})	ADT 36	ADT 43	ADTRH 1	Mean	ADT 36	ADT 43	ADTRH 1	Mean	ADT 36	ADT 43	ADTRH 1	Mean
0.00	15.5	14.9	15.1	15.2	14.3	13.9	13.9	14.1	13.8	12.8	13.5	13.4
1.25	19.2	19.3	19.9	19.5	19.3	19.6	20.8	19.9	19.0	19.3	20.6	19.6
2.50	18.8	19.1	19.8	19.2	19.2	19.2	20.1	19.5	18.7	19.1	19.5	19.1
3.75	18.5	18.8	19.0	18.8	19.7	18.7	19.7	19.0	18.6	18.6	18.8	18.7
5.00	18.2	18.7	18.4	18.4	18.5	18.9	19.0	18.8	18.0	18.2	18.7	18.3
Mean	18.0	18.2	18.4		18.0	18.1	18.7		17.6	17.6	18.2	
Sources	V	T	V x T		V	T	V x T		V	T	V x T	
SED	0.47	0.61	1.06		0.60	0.78	1.34		0.39	0.50	0.87	
CD (5%)	NS	1.25	NS		NS	1.59	NS		NS	1.03	NS	

NS = Non significant

Table 5: Available soil potassium (kg ha^{-1}) at different physiological stages

Pressmud compost levels	Active tillering				Panicle initiation				Post harvest			
(t ha^{-1})	ADT 36	ADT 43	ADTRH 1	Mean	ADT 36	ADT 43	ADTRH 1	Mean	ADT 36	ADT 43	ADTRH 1	Mean
0.00	210	207	217	212	201	202	210	204	193	194	213	200
1.25	254	254	260	256	264	266	267	266	257	260	263	260
2.50	254	241	250	248	260	254	259	258	254	253	257	255
3.75	248	235	238	240	257	253	247	253	251	249	246	249
5.00	240	230	234	235	254	250	246	250	240	247	240	242
Mean	241	233	240		247	245	246		239	241	244	
Sources	V	T	V x T		V	T	V x T		V	T	V x T	
SED	6.34	8.18	14.2		7.68	9.91	17.2		5.05	6.52	11.3	
CD (5%)	NS	16.8	NS		NS	20.3	NS		NS	13.4	NS	

NS = Non significant

the higher available soil P of 19.6 kg ha^{-1} and the lower value of 13.4 kg ha^{-1} at control. The observed at this stage. The available phosphorus status of the soil at different physiological stages was higher with the application of 1.25 and 2.50 t ha^{-1} of enriched pressmud compost. The decomposition processes of easily degradable organic might have reduced the binding energy and P sorption capacity of flooded rice soil which favoured the higher P availability as envisaged from the study of Hundal *et al*. (1987) and Nagarajah (1989). The increase in available P content of the soil with pressmud compost application was due to the phosphorus content of the material and probably due to the solubilization of insoluble forms of phosphate by organic acids produced during the decomposition of organic matter present in pressmud (Indiraraj and Raj, 1979). This has confirmation with the results of many authors (Singh *et al*., 2003; Satheesh and Balasubramaniyan, 2003; Swarup and Yaduvanshi, 2004).

Effect of Enriched Pressmud Compost on Available Potassium

The independent effects of varieties and hybrids and their interaction effects did not show any marked variation regarding the available soil potassium in all three physiological stages of rice. While seeing the effect of treatments, the levels of 1.25 t ha^{-1} and 2.50 t ha^{-1} of enriched pressmud compost had equal status in establishing the available soil potassium and significantly superior over other levels in all the stages. The lowest available potassium was recorded at control in all the physiological stages. The positiveness of individual application of 1.25 and 2.50 t ha^{-1} of enriched pressmud compost on K availability was established in all stages irrespective of varieties and hybrid (Table 5). This effect could be attributed to the highly reduced condition created by the easily degradable organic associated with the release of nutrient cations particularly K^+ at higher proportions in soil solution. These kinds

of results were also evinced from the reports of many authors (Singh *et al*., 2003; Satheesh and Balasubramaniyan, 2003; Mathakiya and Meisheri, 2003; Swarup and Yaduvanshi, 2004).

CONCLUSION

The outcome of the present investigation revealed that the highest grain yield was obtained, at 1.25 t ha^{-1} of enriched pressmud compost along with inorganic fertilizers for the varieties and hybrid. The varieties and treatments did not show any marked variation regarding soil reaction and electrical conductivity. The pH values were in neutral range at all the three stages of crop growth. However, the higher EC value was observed with application of 5.00 t ha^{-1} level of enriched pressmud compost at all the stages of crop growth. The N, P and K availability in soil was at higher levels and comparable with application of 1.25 and 2.50 t ha^{-1} of enriched pressmud compost, whereas it was lower with control. Hence, the incorporation of 1.25 t ha^{-1} enriched pressmud compost as basal along with required remaining nitrogen through inorganic fertilizer as top dressing in three splits may be recommended for rice crop to realise maximum yield in kuruvai (Kharif) season.

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