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Effect of Organic Manures on Soil properties in Saline Soil with Sub-Surface Drainage System

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ABSTRACT

A field experiment was carried out during kharif, 2005 to study the effect of different organic manures (FYM, poultry manure, pressmud, green manure (Dhaincha) and green leaf manure (*Calotropis* sp)) on Salinity, bulk density, hydraulic conductivity, dehydrogenase activity and nutrient availability in saline soil with sub-surface drainage system, using rice (var: BPT 1768) as test crop. The experiment was laid out in randomized block design (RBD) with four replications. The results showed that addition of organic manures did not influence soil pH. However, ECe decreased with the addition of FYM, green leaf manure and green manure. Organic carbon content increased with the addition of organic manures. Addition of organic manures decreased the bulk density and increased the hydraulic conductivity of soils. Dehydrogenase activity was high due to the addition of FYM followed by green leaf manure, green manure, pressmud and poultry manure. Availability of nitrogen, phosphorus, potassium and DTPA extractable zinc, iron, manganese and copper increased with the application of organic manures following the order: FYM, green leaf manure, green manure, pressmud and poultry manure treatments, except available phosphorus, which was high in poultry manure treatment.

Key words : Organic manures, Rice, Saline soils.

The water logging and salinity problems not only cause severe physiological crop change but also increase cost per unit of crop production and decrease farm income. These problems can be overcome by effective and timely removal of excess water from the area. Provision of adequate sub-surface drainage to lower the water table and facilitate leaching of salts has been recognized as basis for any long-term success in the reclamation and management of saline and waterlogged soils (Sharma *et al*., 1992).

Apart from reclamation of the saline soils judicious management of nutrients through chemical fertilizers and organic fertilizers is extremely important for improving and maintaining fertility of these soils.

Application of bulky organic manures not only improves the efficiency of sub-surface drainage system by leaching of salts through improved physical properties but also plays a major role in nutrient management of salt affected soils besides enhancing the biological activity.

MATERIAL AND METHODS

A field experiment was conducted in operation research project site at Appikatla to study the "Effect of different organic manures on Salinity, bulk density, hydraulic conductivity, dehydrogenase activity and nutrient availability in saline soil with sub-surface drainage system" during *kharif* 2005. The system installed with an average drain depth of 1.0 m and drain spacing of 60 m was used as an experimental site. Corregated PVC pipes enveloped with synthetic geotextile material having pore sizes of 400 microns were used as horizontal collector lines. Soil reaction, ECe and organic Carbon were 8.8, 5.3 dSm^{-1} and 4.4 g kg^{-1}, respectively. Available N,P and K were 260.5, 27.5 and 450.2 kg ha^{-1}, respectively. The texture of the soil was clay loam with 34.5, 48.0 and 17.5 % of clay, silt and sand, respectively. The hydraulic conductivity of the soil before conducting the experiment was 0.132 m day^{-1}.

The experiment was laid out in randomized block design (RBD) with four replications, and it consisted of the following six treatments *viz*., control (T_1), FYM @ 10 t ha^{-1} + RDF (T_2), Poultry manure @ 5 t ha^{-1} (T_3), Press mud @ 5 t ha^{-1} + RDF (T_4), Green manure (dhaincha) @ 40 kg seed ha^{-1} + RDF (T_5) and Green leaf manure (*Calotropis* sp.) @ 5 t ha^{-1} + RDF (T_6). Each treatment was imposed in one acre area and samples were drawn at four places randomly.

Table 1. Effect of different organic manures on pH, ECe and Organic carbon in post harvest soils of rice.

Treatment	pH	ECe ($dS\ m^{-1}$)	Organic Carbon ($g\ kg^{-1}$)
T_1 : Control (RDF)	8.9	3.7	5.52
T_2: RDF + FYM @ 10t ha^{-1}	8.5	3.2	7.76
T_3: RDF + poultry manure @ 5t ha^{-1}	8.8	3.6	6.90
T_4: RDF + Pressmud @ 5t ha^{-1}	8.8	3.4	7.03
T_5: RDF + Green manure (Dhaincha) @ 40kg seed ha^{-1}	8.7	3.2	7.10
T_6: RDF + Green leaf manure (*Calotropis* spp.) @ 5t ha^{-1}	8.6	3.2	7.10
SEm $\pm$	0.2	0.1	0.31
CD (0.05%)	NS	0.4	0.92
CV (%)	3.7	8.8	8.9

Table 2. Effect of different organic manures on bulk density and hydraulic conductivity in post harvest soils of rice

Treatment	Bulk density ($Mg\ m^{-3}$)	Hydraulic conductivity ($m\ day^{-1}$)
T_1 : Control (RDF)	1.80	0.135
T_2: RDF + FYM @ 10t ha^{-1}	1.52	0.186
T_3: RDF + poultry manure @ 5t ha^{-1}	1.76	0.141
T_4: RDF + Pressmud @ 5t ha^{-1}	1.65	0.148
T_5: RDF + Green manure (*Dhaincha*) @ 40kg seed ha^{-1}	1.57	0.153
T_6: RDF + Green leaf manure (*Calotropis* spp.) @ 5t ha^{-1}	1.55	0.168
SEm $\pm$	0.02	-
CD (0.05%)	0.06	-
CV (%)	2.37	-

Recommended dose of fertilizer (RDF) consisted of 120-60-30 N, P_2O_5 and K_2O kg ha^{-1}, respectively. Half of N and the entire dose of P and K were applied as basal dressing, the rest of N was applied in two split doses at maximum tillering and boot leaf stage of the crop. Nutrients were applied in the form of urea, single super phosphate and muriate of potash to supply N, P and K, respectively. *Dhaincha* was grown and incorporated into the soil one week before transplanting. Calotropis, FYM, press mud and poultry manure were applied before puddling. Biological activity of the soil was determined by dehydrogenase enzyme assay (Dhyan Singh *et al.*, 1999).

RESULTS AND DISCUSSION

Physico- Chemical and Physical Properties.

Installation of sub-surface drainage system decreased ECe of soil from initial 5.3 to 3.7 d Sm^{-1} in control and it was still decreased with the addition of organic manures. Addition of organic manures increased the organic carbon content of the soil

Table3. Effect of different organic manures on soil available N, P_2O_5 and K_2O at harvest of rice

Treatment	N	P_2O_5	K_2O
	kg ha^{-1}		
T_1 : Control (RDF)	214.9	29.1	364.4
T_2: RDF + FYM @ 10t ha^{-1}	279.5	36.4	519.6
T_3: RDF + Poultry manure @ 5t ha^{-1}	253.7	42.7	392.4
T_4: RDF + Pressmud @ 5t ha^{-1}	264.9	31.0	446.5
T_5: RDF + Green manure (Dhaincha) @ 40kg seed ha^{-1}	270.5	32.3	457.3
T_6: RDF + Green leaf manure (*Calotropis* spp.) @ 5t ha^{-1}	273.1	34.6	510.7
SEm $\pm$	8.0	1.6	10.9
CD (0.05%)	24.0	4.8	32.7
CV (%)	6.1	9.3	4.8

Table 4. Effect of different organic manures on DTPA extractable zinc, iron, manganese and copper in soil

Treatments	Zn	Fe	Mn	Cu
	ppm			
T_1 : Control (RDF)	0.68	58.06	29.20	6.52
T_2: RDF + FYM @ 10t ha^{-1}	1.48	89.30	51.02	10.64
T_3: RDF + poultry manure @ 5t ha^{-1}	0.86	61.10	36.52	7.86
T_4: RDF + Pressmud @ 5t ha^{-1}	0.98	64.40	36.68	8.52
T_5: RDF + Green manure (Dhaincha) @ 40kg seed ha^{-1}	1.02	74.20	41.56	9.32
T_6: RDF + Green leaf manure (*Calotropis* spp.) @ 5t ha^{-1}	1.08	78.20	45.36	11.02
SEm $\pm$	0.04	2.07	1.24	0.48
CD (0.05%)	0.11	6.22	3.75	1.46
CV	7.17	5.83	6.21	10.78

significantly over control. The increase followed the order: FYM, green leaf manure, green manure, pressmud and poultry manure though statistically on par with each other (Table 1). The lowering of ECe in soil might be due to improved soil structure, decreased bulk density and increased hydraulic conductivity which resulted in more leaching of soluble salts (Table 2). Similar results were also reported by Singaravel *et al*. (2001) and Singh *et al*. (2002). Increased organic carbon content due to addition of organic manures was reported by several workers (Yaduvanshi, 2001).

The bulk density of soil among the treatments, varied from 1.52 to 1.80 Mg m^{-3}. The lowest was recorded by the treatment received FYM followed by green leaf manure and green manure, which were on par with each other but significantly lower than other treatments. However, bulk density recorded by the treatment received pressmud, though significantly less than poultry manure and control, was higher than the other three treatments. The decreased bulk density due to addition of organics could be attributed to more contribution of organic matter to the soil, which might have helped in good soil aggregation and increased pore space. Similar results were also reported by Tiwari *et al.* (2000).

Hydraulic conductivity ranged from 0.135 to 0.186 m day^{-1}. The increased hydraulic conductivity of the soil under different treatments

Table 5. Effect of different organic manures on dehydrogenase activity of soils

Treatment	Dehydrogenase (mg TPF g^{-1} 24 hrs)
T_1 : Control (RDF)	3.7
T_2: RDF + FYM @ 10t ha^{-1}	9.1
T_3: RDF + poultry manure @ 5t ha^{-1}	5.5
T_4: RDF + Pressmud @ 5t ha^{-1}	7.0
T_5: RDF + Green manure (*Dhaincha*) @ 40kg seed ha^{-1}	7.6
T_6: RDF + Green leaf manure (*Calotropis* spp.) @ 5t ha^{-1}	8.0
SEm $\pm$	0.2
CD (0.05%)	0.6
CV (%)	5.9

TPF: Tryphenyl formazan

might be attributed to several cultural practices besides changes in the bulk density. These results are similar to the findings of Hati *et al*. (2005) and Selvi *et al*. (2005).

Effect of Organic manure on available N, P and K

The available N, P and K showed significant variation with the addition of organic manures. The percentage increase of the available N with the addition of FYM, green leaf manure, green manure, pressmud and poultry manure was 30.10, 27.10, 25.9, 23.3 and 18.1, respectively, over control. Available K also followed the same trend as that of nitrogen due to the addition of organic manure with 42.4, 40.2, 25.5, 22.5 and 7.7 per cent increase. However, available P was higher due to addition of poultry manure followed by FYM, green leaf manure, green manure and pressmud with 46.8, 25.1, 18.9, 11.0 and 6.5 per cent, respectively (Table 3). The increase in the availability of N, P and K nutrients due to application of organic manures was also reported by More, (1994) and Omar Hettab *et al*., (1998). The increase of available N may be attributed to the mineralization of organic manures with high N content and narrow C: N ratio. Phosphorus build up in the soil due to addition of organic manures may be due to mineralization of organic P, production of organic acids making soil P more available besides mobilization of native soil P by the vigorous root system of green manure crops. Increase in available K may be mainly due to the displacement of K from clay by ammonium ions under submerged conditions and also aided by liberated acids and decomposition products of organic acids resulting in more build up. These results are similar to the findings of More, (1994) and Yaduvanshi, (2001).

Effect of Organic manure on DTPA extractable Zn, Fe, Mn and Cu

The soils collected at harvest of rice were also analyzed for DTPA extractable Zn, Fe, Mn and Cu. Results showed significant increase in the availability with the addition of organic manures. The percentage increase of Zn recorded with the addition of FYM, green leaf manure, green manure, pressmud and poultry manure was 117.7, 58.8, 50.0, 44.1 and 26.1, while the per cent increase of Fe was 53.8, 34.7, 27.8, 10.9 and 5.2, respectively over control. DTPA extractable Mn also increased with the addition of organic manures following the same trend as that of Zn and Fe with 74.7, 55.3, 42.3, 25.6 and 25.1 per cent over control. However, extractable Cu was more with the addition of green leaf manure followed by FYM, green manure, pressmud and poultry manure with 69.0, 65.3, 42.9, 30.7 and 20.6 per cent, respectively over control (Table 4).

The DTPA extractable Zn, Fe, Mn and Cu were influenced significantly by the addition of organic manures. This may be due to formation of metallo organic complex (Maskina and Randhawa, 1983) and evolution of CO_2 on decomposition of organic materials which caused transformation of ferric to ferrous and prevented precipitation and subsequent oxidation of Mn compounds. The complexing properties of organic manures which prevent the precipitation and fixation and keep them in soluble form of these micronutrients and acting itself as good source was also reported by Gopal Reddy and Suryanarayana Reddy, (1998).

Dehydrogenase activity

The dehydrogenase activity was determined in the soils collected from the rhizosphere of rice at harvest showed significanty variation by the addition of organics. The highest dehydrogenase activity was recorded by the application of FYM followed by green leaf manure, green manure, pressmud, poultry manure and control (Table 5). The higher enzyme activity due to addition of organics might be due to increased bacterial population (Pedrazzini and Mckee, 1984). The increased microbial activity due to the formation of root exudates, mucigel and sloughed –off cells was also reported by Goyal *et al*. (1992).

LITERATURE CITED

Dhyan Singh, Chhonkar P K and Pandey R N 1999. Soil plant water analysis. A methods *Mannual. Indian Agricultural Research Institute (ICAR), New Delhi, pp. 120-122.*

Gopal Reddy B and Suryanarayana Reddy M 1998. Effect of green leaf manures and nitrogen level on soil available nutrient status in maize-soybean cropping system. *Journal of the Indian Society of Soil Science* 46 (3): 474-476.

Goyal S, Mishra M M, Hooda I S and Raghubirsingh 1992. *Soil. Biol. Biochemistry 24:1081.*

Hati K M, Misra A K, Mandal K G, Ghosh P K and Bandyopadhyay K K 2005. Irrigation and nutrient management effect on soil physical properties under soybean-mustard cropping system. *Environment and Ecology* 23 (3): 640-643.

Maskina M S and Randhawa N S 1983. Effect of organic manures and zinc levels on availability of zinc, iron, manganese and copper in wet land rice. *Indian Journal of Agricultural Sciences* 53: 49-53.

More S D 1994. Effects of farm wastes and organic manures on soil properties, nutrient availability and yield of rice-wheat grown on sodic vertisol. *Journal of the Indian Society of Soil Science* 42 (42): 253-256.

Omar Hattab K, Natarajan K and Gopalaswamy A 1998. Influence different organic manures on yield and N use efficiency of rice. *Journal of the Indian Society of Soil Science* 46 (2): 239-242.

Pedrazzini F R and McKee K L 1984. Effect of flooding on soil dehydrogenase and alcohol dehydrogenase in rice. Soil Science Plant Nutrition 30: 359-365.

Selvi D, Santhy P and Dhakshinamoorthy M 2005. Effect of inorganics alone and in combination with farm yard manure on physical properties and productivity of vertic haplustepts under long term fertilization. *Journal of the Indian Society of Soil science* 53 (3): 302-307.

Sharma D P, Singh K N and Rao K V G K 1992. Effect of sub surface drain spacing on soil salinity soil water, content and growth of wheat on a saline soil. *Journal of the Indian Society of Soil Science* 40: 348-352.

Singaravel R, Balasundaram C S, Imayavaramban V and Thanunathan 2001. Residual effect of gypsum, pyrite and organic amendments on the nutrient availability, yield and nutrient uptake of rice in coastal saline soil. *Journal of the Indian Society of Soil Science* 19 (1&2): 162-166.

Singh R P, Ram H and Jagdishprasad 2002. Effect of pyrite, gypsum and FYM on pH and yields on paddy and wheat in a sodic soil. *Indian Joural of Agricultural Chemistry* 35 (1): 49-51.

Tiwari N, Tiwari K N and Awasthi P N 2000. Role of *Sesbania rostrata* and phosphomicrobe at varying levels of N sustaining the production and productivity of soil under rice-wheat/chickpea cropping sequence. *Journal of the Indian Society of Soil Science* 48 (2): 257-262.

Yaduvanshi N P S 2001. Effect of five years of rice – wheat cropping and NPK fertilizer use with and without organic and green manures on soil properties and crop yields in a reclaimed sodic soil. *Journal of the Indian Society of Soil Science* 49 (4):714-719.

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