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RESEARCH ARTICLE

INFLUENCE OF FARM YARD MANURE AS ORGANIC AMENDMENT ON PHYSICO-CHEMICAL AND PHYSICAL PROPERTIES OF THERISOIL

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ABSTRACT

A pot culture study was conducted during 2014(Oct) to2015(Jan) in Theri soil. Theri lands are located along the coastal areas of Tuticorin district of Tamilnadu, South India. Proper management of the land is difficult because of its poor quality structure, low nutrition, meagre moisture holding capacity, low value of organic content, and high value of hydraulic conductivity. The permeability of water in theri soil is high and is not suitable for agriculture which is presently considered as a wasteland. The objective is to nurse the soil back to health and reclaim the soil, Farm Yard Manure (FYM) is amended with theri soil to reduce the fertility constraints of the soil. The effect of soil physical properties were investigated by ameliorating the soil with Farm Yard Manure. The experiment was laid out in a pot culture with ten treatments replicated thrice. In order to reduce soil Physical constraints and to make the soils fit for sustained water availability and large agricultural applications, different proportions of FYM tried on soil and the Physical and Physico -chemical parameters which brings the soil cultivable are studied and their inter relationships were determined.

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INTRODUCTION

Theri soils are situated in Tuticorin and Tirunelveli districts of Tamilnadu with an extend of 20,171 hectares (Jawahar 1996). Research field is in Punnai nagar (Kachanavilai), Tuticorin district, Tamil Nadu, India. This place lies between Long: 78°11E , Lat:8 °30° N . Soil samples (TH) were collected at this location at 19 km west from Tiruchendur 5km from Nazerath. These soils are also prone to soil and wind erosion. This type of transported soil is locally called as theri soil (Th). Theri soils had excessive drainage, poor moisture holding capacity, poor nutrient status etc. These observations are in line with the inferences of Mayalagu (1986). Different interpretive systems indicated that these are not suitable for agriculture (Janakiraman *et al*., 1997). The unfavourable topography of the soil causes a lot of problems for intensive cultivation. The maximum water holding capacity was generally low clay content of the soil. The volume expansion on wetting was low in theri land soils. The pore space percentage was high in theri land soils. The intensive agriculture, which ushered in an era of green revolution is now becoming the cause of severe degradation of soil quality, questioning the sustainability of the production system.

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Hence Biological techniques are to be adopted for the control of soil erosion by wind and water and rehabilitation of sand dunes. The organic amendment not only supplements the chemical fertilizers but also reduces the environmental pollution. A substantial increase in production can be obtained by use of fertilizers. However, due to high cost of fertilizers, only a few farmers can afford to apply chemical fertilizers as per recommended doses. Organic matter increases biological activity, Therefore to improve the overall biological, chemical and Physical conditions of the dry land soils, regular addition of Organic material would be beneficial (Barzegar *et al*., 2002). At present FYM which is an organic source helps in increasing the yield as well as increasing soil Physical, Physico-chemical and Chemical properties of Theri soil. It helps in maintaining environment health by reducing the level of pollution. FYM was used to replace 50% requirements of the chemical fertilizers (Bagla *et al*., 2008). Keeping in view of above points the detailed micro level study was conducted to assess the physical, physico-chemical characteristics and available nutrients status of theri soil

MATERIALS AND METHODS

Soil samples (Th) were collected at Punnai nagar (Kachanavilai) that is located at 19 km west from Tiruchendur in Tuticorin district of Tamil Nadu.

A soil sample was collected in the experimental site by making 'V' shaped cut at a depth of 15 cm air dried ground, mixed pass through 2 mm sieve and analyzed for their physico-chemical and physical properties. A pot experiment was conducted during Rabi season during 2014 (Oct) to 2015 (Jan). Theri soil was sandy clay loam in texture, neutral in reaction having pH range of 7.63 and low in organic carbon 0.19%, available NPK values are 84 kg/ha, 5 kg/ha and 104 kg/ha. EC was found to be below 1.0dsm^{-1}. The experiment was laid out in a pot culture with ten treatments replicated thrice. The pots were arranged under the screen house according to Steel and Torrie (1980).

In the screen house study, 1 litre(1000c.c) of theri soil thoroughly mixed with different percentage of farm yard and keep this mixture in a clay pot (2 mm sieve powder). Ten different combinations, namely theri soil (Th) +10% of FYM(Farmyard manure); Th + 20% of FYM ; Th+ 30% of FYM; Th +40% of FYM; Th+ 50% of FYM; Th+60% of FYM; Th+ 70% of FYM; Th + 80% of FYM; Th+ 90% of FYM; Th +100% of FYM. These different combinations were thoroughly ameliorated mechanically before use. For example Th+10%of FYM means 100 cc of Farm yard manure was mixed with 1000 cc of theri soil. The volume of the soil is fixed. It was found that 100cc of FYM is equal to 35g.It was also found that 100cc of theri soil is equal to 165g. These mixtures were allowed to settle for a period of 90 days by wetting with water regularly and without allowing them to get dried. After 90 days measurements were made on the physical and physico-chemical properties, such as pH, EC, NPK, particle density, bulk density, porosity, water holding capacity, volume expansion, organic carbon content and hydraulic conductivity.

Methods used for analysis

The soil samples were characterized for important physical, physico-chemical properties using standard procedures. Bulk density ,Particle density, Water holding capacity, Porosity, Volume expansion Keen Raczkowski (KR) Box model. (Keen *et al*., 1921) Soil pH and EC was determined in 1:2.5 soil, water suspensions with help of glass electrode pH meter with a digital display and with a null balance conductivity meter correspondingly. (Jackson, 1973) Organic Carbon determined Chromic acid wet oxidation method. (Walkley and Black, 1934) Available "N" alkaline permanganate method. (Subbaiah and Asija, 1956) The available "P" was estimated by Flame photometer. (Olsen *et al*., 1954) and available "K" determined by Ammonium acetate method. (Hanway and Heidel, 1952) Thermal conductivity of the soil determine by Lees disc method (Ouseph *et al*., 2007). Soil samples were collected from pots and air dried in shade processed and screened through a 2mm sieve. After sieving all the samples were packed in polythene bags for analysis.

RESULT AND DISCUSSION

Physical Properties

B.D and P.D

After different combination of organic amendments the bulk density decreased to the control plot. Further Regression analysis indicated that bulk density was significantly reduced with increase in every unit of Organic Carbon and negatively correlated by showing high R^2 value (Fig.1).

Table 1. Effect of Various Mixtures of Farmyard on Physical Properties of Theri soil

Treatment	pH	EC dsm^{-1}	OC %	N Kg/ ha	P Kg/ ha	K Kg/ ha
Th+10%FYM	7.22	1.1	0.36	78	11.8	386
Th+20%FYM	7.21	1.12	0.4	82	15.6	394
Th+30%FYM	7.18	1.14	0.42	87	21.6	402
Th+40%FYM	7.16	1.16	0.48	92	28.4	412
Th+50%FYM	7.12	1.17	0.52	94	35.4	426
Th+60%FYM	7.1	1.18	0.56	97	42.2	432
Th+70%FYM	7.09	1.19	0.59	102	47.2	447
Th+80%FYM	7.08	1.2	0.6	106	53.6	456
Th+90%FYM	7.08	1.21	0.61	112	57.8	468
Th+100%FYM	7.07	1.21	0.62	116	64.8	474
Control	7.63	0.84	0.19	78	10.8	315

W.H.C-Water holding capacity; Vol.Exp-Volume expansion; Hyd.Cond-Hydraulic conductivity; FYM-Farmyard Manure; Th-Therisoil; Thermal cond. -Thermal conductivity

Table 1. Effect of Various Mixtures of Farmyard on Physical Properties of Theri soil

Treatement	Bulk Density g/cm^3	Particle Density g/cm^3	Porosity %	W.H.C %	V0l. Exp. %	Hyd. Cond. mm/hr	Thermal Cond. W/m/k
Th+10% FYM	1.80	3.20	38.41	23.349	3.631	140.183	0.13606
Th+20% FYM	1.76	3.08	40.39	25.286	4.446	129.472	0.14337
Th+30% FYM	1.70	2.60	41.07	28.691	4.487	126.179	0.15111
Th+40% FYM	1.60	2.60	41.61	29.847	4.589	119.871	0.15933
Th+50% FYM	1.58	2.58	41.63	30.395	4.764	114.233	0.16806
Th+60% FYM	1.57	2.45	41.91	31.396	5.425	112.448	0.17735
Th+70% FYM	1.55	2.35	42.59	32.174	5.935	112.174	0.18727
Th+80% FYM	1.48	2.22	43.85	33.556	6.562	106.132	0.19786
Th+90% FYM	1.38	2.10	44.15	34.321	7.985	98.032	0.20921
Th+100% FYM	1.36	1.86	45.46	35.038	8.833	88.146	0.22140
Control	1.73	2.857	39.13	25.12	3.90	210.00	0.12581

Ec-Electrical Conductivity; FYM-Farmyard Manure; Th-Therisoil; OC-Organic Carbon

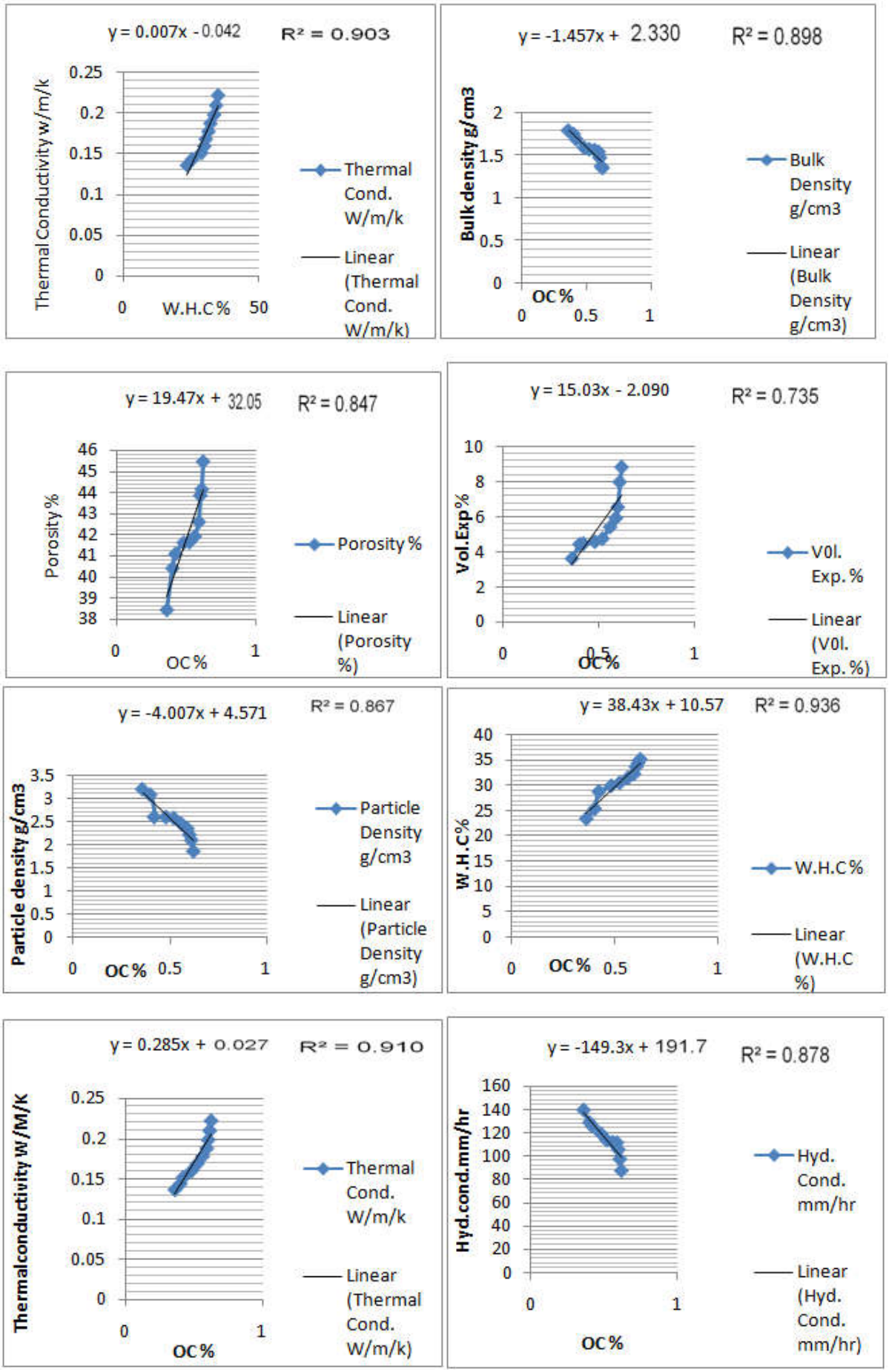

Figure 1. Relation between Organic Carbon and Physical properties of Therisoil

Bulk density and Particle density was decreased as the dosage of organic manure was increased as shown in Table (1). Bulk density was reduced to1.80g/cc to 1.36g/cc respectively. Generally in the normal soil the Particle density was 2.65 g/cc with the increase of OM of soil the Particle density decreased. Here Particle density decreased as 3.20 g/cc to1.86 g/cc. The optimum value of P.D (2.6g/cc) and B.D(1.70g/cc) was obtained in the treatement of Th+30%FYM. Naveed Iqbal Khan *et al*. (2010) [14] reported similar finding with the application of Farm yard Manure. Lower bulk density implies greater pore space and improved aeration developing suitable environment for biological activities. Improvement in physical properties in this experiment correlate well with each other (bulk density vs OC % R^2=0.898 and Particle density vs OC % R^2=0.867).

OC

Duiker and Lal (1999) found a positive linear response of soil Organic Carbon and physical properties of the soil. Application of FYM enhances the OC content of the soil. Increased OC values range from 0.36% to 0.62% (Table 2.) with the mean value of 0.516% was observed. It is 36% more than control (Table 1). Gupta *et al*., (1988) noticed an increase in Organic Carbon content in soil due to continuous addition of FYM. Similar results were obtained by Bharadwaj and Omanwar (1994).

WHC

A definite linearity was observed with respect to water holding capacity, Porosity, Volume expansion and thermal conductivity in relation to Organic Carbon and positively correlated to show high regression coefficient(WHC vs OC% R^2=0.936) shown in Fig.1. The WHC had greatly increased in all treatments than control as the dosage of Organic manure increased. Control has very low water retention of 25.12% and high permeability of 210mm/hr. Here in all treatments W.H.C increases and attains the max value of 35.038% It was 39.5% higher than control. In the present study regression analysis indicated that soil organic carbon was the leading variable for increasing the water holding capacity (Fig.1) and other physical parameters.

Porosity

WHC and Porosity increased as the dosage of Organic manure increased in different proportion of amendment. This was in conformity with Rehana Rasool *et al*. (2008) . Who reported that the average WHC of soil during maize was 21% higher in FYM plot than in control plots. There is an inverse relationship between bulk density and Porosity. The percentage of Porosity were increased proportionaly 38.41%..., 41.91% .... 45.46% respectively (Table.1).It was max as 41.63% for the treatement of TH+40%FYM. It was 6.3% more than control. Application of gypsum, FYM and sulphuric acid according to Hussain *et al*., 2001 improved the bulk density and porosity and has contributed to enhanced water permeability and hydraulic conductivity. Soil organic matter might have encouraged aggregation and soil porosity thereby making more room available for soil water. These results confirmed the findings of Hati *et al.* (2006).

Physico-Chemical properties

pH and EC

In the present work PH and EC ranged from 7.07 to 7.22 and1.1 to1.21 dS/m respectively increased in the successive treatements as shown in Table (2). In all treatements the pH values were decreased than control (without Organic manure). The decrease of pH was confirmed by Sarwar *et al.* (2008) due to the production of Organic acids(amino acids, glycine cystein and humic acid) during mineralization (amminization and ammonificantion) of organic materials. The value pH obtained is most favourable for the cultivation purpose. The significant reduction in EC due to the organic application might be due to the leaching of salts by organic acid released from the organic sources.(Sharma *et al.,* 1982).

NPK

The value of Nitrogen content was maximum116 Kg/ ha in the treatement of Th+100%FYM.Which was 48.7% higher than the control plot(Table1). The significant increase in available N content of soil due to application of FYM may be attributed to minerallization of N by FYM in soil (Yaduv'anshi, 2001). The increase in available' P' content of soil might be due to greater mobilization of native' P by vigorous root proliferation and contribution through biomass. It takes a maximum value as 64.8Kg/ha in the treatement of Th+100%FYM.Which was higher than the control plot(Table1). Similarly the availability of 'K' increased in different proportions of amendment. It varies from386Kg/ha to474 Kg/ha .The buildup of available soil potassium under FYM application was the result of addition of 'K' supplied through it, the solublizing action of certain organic acids produced during decomposition and its greater capacity to hold' K' in the available form (Yaduvanshi, 2001).

In the organic treatments, Farmyard manure increases the soil organic matter and improve the soil structure and biological activity of soil. This would have reduced the loss of nitrogen further by improving the structure of the soil by more aggregation, water holding capacity and air permeability are increased. These comprehensive changes in soil might improve the rhizome development. This is in line with the finding of Mizuno (1996). Further, the reduced loss of Nitrogen by ammonia volatilization and narrower C:N ratio might have also contributed to better performance of crop supplied with Farmyard Manure (Kirchmann and Witter, 1992). Continuous use of Organic manures preferably with Poultry manure, Neem cake, FYM, Vermicompost can improve the microbial activity in soil and these improving the fertility (Sudha and Chandani, 2003).

Thermal conductivity

Moisture content is the most important factor influencing the thermal characteristics of soils(Myer and Heilman 1969). According to Myer the thermal conductivity of dry soil is low and increases with increasing moisture content. Soil thermal conductivity measurements describe the soil properties which depends on heat capacity.

The average result of thermal conductivity of FYM treated theri soil at steady state condition is .175102w/m/k. Improvement in physical properties in this experiment correlate well with each other (Thermal conductivity vs OC % R^2=0.910).

Conclusion

Based on the above physical analysis, Th+40% FYM and Th+50%FYM are better than the other combinations for the purpose of cultivation. Giving more importance to the soil physical parameters, namely the water retention and the permeability, Th+50% treatement can be predicted as the best among all the treatements. The organic carbon and the bulk density seem to be the important variable deciding the water holding capacity of the FYM amended theri soils. The Organic amendment not only supplements to the chemical fertilizers but also reduces the environmental pollution in this strategy, the cost of production is also reduced. It is therefore imperative that to solve these soil problems and make the lands highly productive on a sustainable basis, we need to develop the technologies suitable to specific locations which will be economically feasible and workable at farmer' field. To achieve this, it is essential to have thorough understanding of the soils and their problems first. A complete idea about the need of the farmers, their socio economic conditions and level of knowledge is also essential for effective implementation of these experimental findings at farm level. At the same time develop suitable technologies to reclaim the Therisoils and bring more wastelands under cultivation.

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