



Impact of Farm Yard Manure and Goat Manure as Organic Amendment on Physico-chemical and Physical Properties of Theri Soil

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Authors' contributions

This work was carried out in collaboration between both authors. Author EI designed the study, wrote the protocol and wrote the first draft of the manuscript. Author EI managed the literature searches; analyses of the study performed the spectroscopy analysis and managed the experimental process. Author BA identified the species of plant. Both authors read and approved the final manuscript.

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ABSTRACT

The study on soil quality assessment in red sandy soils (chemical Theri soil) of Punnai Nagar (Kachanavillai) in Tuticorin district, Tamilnadu, south India was carried out during 2014(Oct) to 2015(Jan). Investigations were carried out on the surface (15 cm depth) of soil samples with the objective to assess the available nutrients and their relationship with various physico-Chemical properties. The soil has low available N=78 kg/ha, low organic carbon OC=0.19%, medium P=5 kg/ha, K=104 kg/ha and Fe, Mn, Zn, Cu are takes a value of 0.369 ppm, 0.985 ppm, 4.861 ppm and 1.996 ppms. Theri soil subject to higher rate of erosion resulting in low nutrient and minerals. The permeability of water in theri soil is high and is not suitable for agriculture which is presently considered as a wasteland. Hence, the fertility and productivity of theri soil may be improved on sustainable basis using Organic farming. The treatments of this study were combination of Farmacyard manure (FYM) and Goat manure. The experiment was laid out in Pot

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culture with 3 replications. All the amendments were applied and wetting with water regularly for 90 days without allowing them to get dried. After 90 days measurements were made. The result suggest that the use of organic amendment will increases NPK, Water holding capacity, Pore space, EC, Organic Carbon and decreased pH, bulk density, Particle density, Hydraulic conductivity. These changes in soil environment improved the soil fertility without affecting soil health.

Keywords: *Theri soil; FYM; goat manure; water holding capacity; reclamation; physico-chemical properties.*

ABBREVIATIONS

1. *W.H.C- Water holding capacity;*
2. *Vol.Exp- Volume Expansion;*
3. *Bulk.Den- Bulk density;*
4. *Th- Theri soil;*
5. *Hyd.Cond- Hydraulic Conductivity.*
6. *OC- Organic Carbon.*
7. *EC- Electrical Conductivity*
8. *FYM- Farmyard Manure*
9. *pH- Potential of Hydrogen*
10. *FG- Farmyard+ Goat manure*

1. INTRODUCTION

The coastal red sandy dunal soils of Tuticorin and Tirunelveli districts of Tamilnadu are locally called theri soils. They occur in the Tuticorin and Tirunelveli districts of Tamilnadu with an extend of 20,171 hectares [1]. Tuticorin district has the highest theri area (16,978 ha). The southern and eastern parts of two districts adjoining the coastal area of gulf of manner are degraded due to wind erosion and moving sand dunes. The high velocity wind blows from the Western Ghats during the months of June-July scoop the sand and moves it towards Bay of Bengal situated in the east, resulting in the formation of sand dunes. This type of transported soil is locally called as theri soil (Th). Wind speed up to 66 Km/hr has recorded. The colour span of theri soils is red due to the presence of iron compounds and the aerobic conditions prevailing confirm the presence of haematite mineral in the soil. Haematite is in the dust form to adhere on the soil particle uniformly [2]. Yadav et al. [3] inferred that both topography and drainage were responsible for the different colours in the associated red soils. Theri soils are poor in nutrient status, water holding capacity, organic carbon content and fertility status. Soil fertility is determined by the presence or absence of micro and macro nutrients. The availability of nutrients is particularly sensitive to changes in soil environment. The texture of Theri land profile soils were mostly sandy and loamy sand. Due to

this coarser texture theri soils had excessive drainage, poor moisture holding capacity, poor nutrient status etc. These observations are in line with the inferences of Mayalagu [4]. Addition of organic matter brings improvement of soil structure, favourable change in total porosity, and increase in water holding capacity, soil aeration and permeability [5]. The detail study of physical, physico-chemical character, available macro and micro nutrients of soil determines the soil potential which is essential for better scientific utilization of land use planning for crop growth. Keeping in view of above points the detailed micro level study was conducted to assess the physico-chemical characteristics of theri soil.

2. 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- 2015. The 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 [6]. In the screen house study, 1 litre (1000 c.c) of theri soil thoroughly mixed with different percentage of farm yard and goat manure mixture in a clay pot. (2 mm sieve powder). Ten different combinations, namely theri soil (Th)+10% of FG (FYM + Goat manure); Th+20% of FG; Th+30% of FG; Th+40% of FG; Th+50% of FG; Th+60% of FG; Th+70% of FG; Th+80% of FG; Th+90% of FG; Th+100% of FG. These different combinations were thoroughly

ameliorated mechanically before use. For example Th+10% of FG mean 100 cc of Fym+Goat manure was mixed with 1000 cc of theri soil. The volume of the soil is fixed. It was found that 100 cc of FG is equal to 35 g. It was also found that 100 cc of theri soil is equal to 165 g. 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.

2.1 Methods Used for Analysis

The soil samples were characterized for important physico-chemical properties using standard procedures. Bulk density, Particle density, Water holding capacity, Porosity, Volume expansion by KeenRaczkowski(KR) Box model [7], 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 [8], Organic Carbon determined Chromic acid wet oxidation method [9]. Available "N" alkaline permanganate method [10]. The available "P" was estimated by Flame photometer [11] and available "K" determined by Ammonium acetate method [12]. Finally 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.

3. RESULT S AND DISCUSSION

Application of FYM and Goat manure with theri soil at various proportions show a regular increase of all oxidizable organic carbon fractions except in control shown in (Table 2). Application of FYM enhances the OC content of the soil. Increased OC values range from 0.55% to 0.71% (Table 2) with the mean value of 0.62% was observed. Addition of FG with theri soil decreases the pH, Bulk density, Particle density, Hydraulic conductivity but increases the EC, Water holding capacity, Volume expansion and Porosity (Table1). The bulk density of soil ranges from 1.23-1.77 g/cm³, generally bulk density of 1.5-1.6 g/cm³ is critical for root growth of the most of the plants [13]. But theri soil has bulk density of 1.73 g/cm³ which shows less convenience for root growth. The decrease in

bulk density might be due to higher organic matter content of the soil (figure) with the application of FYM and Goat manure, this result was already inferred by Gopal Reddy and Surya narayan Reddy [14]. The nitrogen content increases as the dosage of the amendment increases. It ranges from 84 kg/ha-112 kg/ha (Table2). Srikanth et al. [15] showed that the decreased in soil pH with the application of FYM. The reduction in soil pH was due to increased CO₂ concentration in soil arising from the microbial decomposition of FYM & Goat manure. The CO₂ in contact with water forms Carbonic acid, which reacts with native CaCO₃ of soil to bring Ca in soil solution, resulted in to lower value of soil pH. Reduction in soil pH and ESP by the application of FYM due to microbial decomposition was also reported by [16]. FG treated theri soil shows a pH values ranges from 7.34-7.11 (Table 2). The pH value above 9 is undesirable and pH value below 4.5 is good. Here in all treatments the porosity ranges from 40%-51% (Table 1).

This range of porosity slightly hinders the growth of plants. The neutral pH value is obtained for all FG treatments. So this is most favourable for the cultivation purpose. The EC values vary from 0.9dsm⁻¹ to 1.1dsm⁻¹ (Table 2) higher than the control soil, but in all treatments EC do not exceed the threshold limit. The desired increase of water holding capacity ranged from 26.13% to 33.8% (Table1) will improve the ability to supply the nutrients to the soil. The hydraulic conductivity controlled from very rapid stage to moderate rapid stage ranges from 190 mm/hr to 102 mm/hr shown in (figure) this enhances soil nutrients. In all the treatments water holding capacity increases and attains the maximum value of 33.82% (Table1) and the hydraulic conductivity reduces to the minimum value of 102.3 mm/hr (Table 1). There is an inverse relationship between porosity and bulk density. Total pore space is typically increased by addition of organic matter [17,18].

The FYM & Goat manure in addition to its ameliorative effect being a store house of almost all the nutrients required for plant growth and improved soil environment via improvement in physio-chemical properties of soil. Thus on addition of FYM & Goat manure, increases the nutrient status due to mineralization of native as well as applied nutrients through organic fertilisers in addition to its own nutrient content. The significant increase in available 'N' content of soil due to application of FYM may be attributed to mineralization of 'N' by FYM in soil.

Application of gypsum, FYM and sulphuric acid according to Hussain et al. [19] improved the bulk density and porosity and has contributed to enhanced water permeability and hydraulic conductivity. So the use of organic amendment helps to build up soil humus and beneficial microbes, besides improvement of soil physical properties.

Table 1. Effect of various mixtures of farmyard and goat manure on physical properties of theri soil

Treatment	Bulk density. g/cm ³	Particle density g/cm ³	Porosity, %	W.H.C %	Vol. Exp, %	Hyd. Cond.mm/hr
Th+10%FG	1.77	2.967	40.02	26.13	4.36	190.22
Th+20%FG	1.60	2.854	43.83	26.63	4.56	183.23
Th+30%FG	1.57	2.76	43.15	26.91	4.65	177.12
Th+40%FG	1.46	2.583	43.65	27.29	5.82	165.03
Th+50%FG	1.40	2.550	45.63	27.59	6.22	154.74
Th+60%FG	1.42	2.500	46.89	28.71	6.33	155.15
Th+70%FG	1.43	2.350	51.21	28.31	7.09	142.51
Th+80%FG	1.33	2.300	50.97	31.72	8.40	127.00
Th+90%FG	1.27	2.222	51.47	33.24	8.54	120.54
Th+100%FG	1.23	2.050	51.07	33.82	8.56	102.29
Control	1.73	2.857	39.13	25.12	3.9	210.00

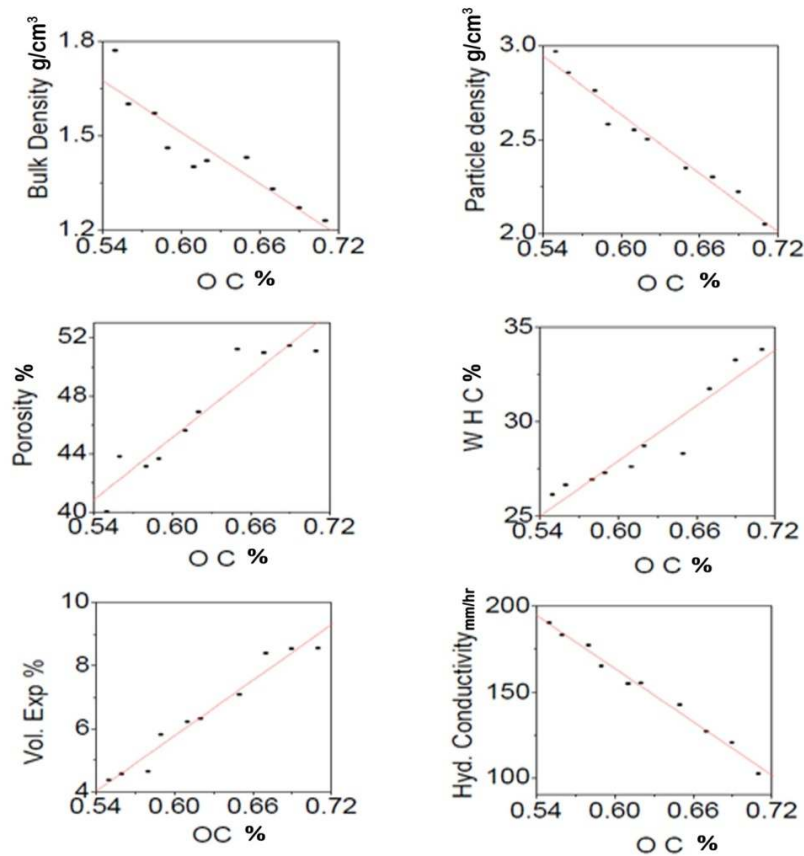


Fig. 1. Relation between organic carbon and physical properties of theri soil

Table 2. Effect of various mixtures of farmyard and goat manure on chemical properties of theri soil

Treatment	pH	EC dsm ⁻¹	OC %	N Kg/ ha	P Kg/ ha	K Kg/ ha
Th+10%FG	7.34	0.946	0.55	84	26.72	384
Th+20%FG	7.31	1.045	0.56	89	28.63	389
Th+30%FG	7.28	1.052	0.58	91	29.46	394
Th+40%FG	7.25	1.058	0.59	94	31.35	395
Th+50%FG	7.23	1.073	0.61	96	34.56	411
Th+60%FG	7.21	1.078	0.62	98	39.42	419
Th+70%FG	7.18	1.085	0.65	101	41.25	422
Th+80%FG	7.15	1.089	0.67	104	43.84	426
Th+90%FG	7.13	1.092	0.69	109	46.73	429
Th+100%FG	7.11	1.106	0.71	112	50.22	432
Control	7.63	0.84	0.19	78	10.8	315

4. CONCLUSION

In the era of ever increasing population, it is vital to utilise each and every unit of soil scientifically and get the best out of it. In this context the uncultivated sand dune areas have to be identified and examined through scientific methods. This examination shows the poor pedogenesis due to constant movement of theri soil. There was poor retention of nutrients, loose and friable in nature, high Bulk density, high particle density, high pore space, low water holding capacity, low volume expansion due to severe wind erosion. So to improve this poor nutrient soil Organic farming (FYM+Goat manure) has to be introduced here, to increase the level of soil organic matter. Organic farming enhances water-retention capacity of the soil and hence the amount of water needed for irrigation is reduced. Further, organic farming can mitigate the climate change as it reduces emission of greenhouse gases, especially nitrous oxide, because no chemical nitrogen fertilizers are used. In the present study may be associated with the supply of essential nutrients by continuous mineralization of organic manures enhanced inherent nutrient supplying capacity of the soil and its favourable effect on soil physical, Physico-chemical and biological properties and to meet the nutrient requirement of crops for sustainable agriculture.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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