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Evaluation of organic amendments using FYM for the improvement of physical properties of theri soil in Tamil Nadu, India

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ABSTRACT

A field experiment was conducted at Poochikadu village in Thuthukudi District of Tamil Nadu, South India to evaluate the effect of different organic amendments and their combinations on various physico-chemical and physical properties on theri soil and the resultant impact on groundnut crop. The treatments of this study were farm yard manure (FYM), composted coir pith (CP) and tank silt (TS). The experiment was laid out in randomized block design (RBD) with three replications. All the amendments were applied and after 30 days of drip irrigation, the soil samples were collected in each plot and analyzed. Groundnuts were grown and the soil was again analyzed, after the harvest of the crop. The yield of pods was high with the combination of F+CP in equal combinations with 12.5 t ha^{-1} which was 36.67 per cent higher than control. The pH, electrical conductivity (EC), bulk density (BD) and particle density (PD) had decreased in all plots other than control. NPK content, percentage of water holding capacity (WHC), pore space (PS) saturated moisture (SM), organic carbon (OC) content and organic matter (OM) had increased. Thus, application of amendments in the proper combination may be a good strategy to reclaim the theri soils.

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Key Words : Farm Yard manure, Amendment, Physical properties, Reclamation

INTRODUCTION

Red sandy dunal soil of Tamil Nadu is called Theri soil. The colour span of theri soils are due to the iron compounds present and the aerobic conditions prevailing confirm the occurrence of haematite mineral in the soil. Haematite is in a very fine dust form to adhere on the soil particles uniformly (Subramanian, 2004). The theri soils are made up of deep sand zones. The permeability of water is high. So it is not suitable for agriculture. It faces higher level of soil erosion. It has low nutrients and minerals. Its water holding capacity is less. They are susceptible to wind erosion. Theries have a semi-arid tropical climate. The mean annual rainfall of the area is between 610 to 700 mm (Jawahar *et al*., 1999 a). The Indian soils have rapidly degraded nutrients in their nutrient status Motsara (2002) estimated that 90 per cent of the soils are presently deficient in available N, 80 per centin P and 50 per cent in K. It is realized that organic manures are the vital sources to sustain the microbial activity and improved the physical constituents of the soil while they can partly substitute the requirement of N, P and K fertilizers.

Tanks ensure equity, groundwater sustainability, trap valuable sediment for recycling and thus, play an important role in enhancing productivity and profitability from rain-fed agriculture (Mohammed Osman, 2008). 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).

The groundnut which is also popularly known as peanut is one of the world's most popular and universal crops, cultivated in more than 100 countries on six continents. China and India are the largest producers of groundnut. Among different states producing groundnut, Tamil Nadu tops the list with 1500 kg ha^{-1}, which is half quintal more than the all India average (Patil.*et al*. 2009).

Coir pith has gained importance owing to its properties for use as a growth medium in horticulture. Because of wider carbon and nitrogen ratio and lower biodegradability due to high lignin content, coir pith is still not considered as a good carbon source for use in agriculture. Coir pith is composted to reduce the wider C: N ratio, reduce the lignin and cellulose content and also to increase the manorial value of pith. Composting of coir pith reduces its bulkiness and converts plant

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nutrients to the available form.

Chemical fertilizers have a short term effect on productivity but a longer term effect on the environment, where they remain for years after leaching and running of, contaminating ground water and water bodies. That is where organic farming comes in. Increased yield parameters 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 favorable effect on soil physical and biological properties.

RESEARCH METHODOLOGY

A field experiment was conducted at Poochikadu village which lies in 8°516' latitude and 78°052' longitude. Groundnut (*Arachis hypogea*.L) is grown in best in sandy loam and loam soils as light soils help in easy penetration of pegs, their development, and their harvesting. The variety chosen for cultivation was TMV-7 with duration of 105 days.

The ground was prepared by proper ploughing three to four times into a fine tilth and manuring before 30 days of cultivation. Thirteen plots each of 5x8mts where chosen. A control plot without applying organic manure was taken. In the next three plots FYM was applied @ 7.5, 12.5, 17.5 t ha^{-1} respectively. In the next six plots FYM+CCP, FYM+TS in equal combination with above 3 concentrations were taken. In other three plots FYM+CCP+TS in equal combination with above 3 concentrations were added. Therefore total treatments were 1+3+6+3=13 plots. In a similar way three replications were carried out in the field. The manures were completely mixed by *manvetti* and irrigated.

The disturbed samples were obtained using V shaped cut at the depth of 15 cms, air-dried ground, mixed, passed through 2mm sieve and analyzed for their physico-chemical and physical properties. The experiment was laid down according to randomized block design. Groundnut crop was grown after proper weeding. At first weeds were removed 20 days after sowing (DAS). Second time weeds were removed 40 DAS. The soil was heaped over the root for the pegs to reach the soil easily. The crops were ready for harvest when the leaves started yellowing and begin to dry up. Development of brown colour inside the pods also indicates maturity of the crop. The pod yield in each plot was measured.

The pH and EC were measured with (1:2.5- soil: water) potentiometry method given by Jackson, (1973). Nitrogen content was measured using the method given by Subbiah *et al*. (1956), phosphorus by Olsen *et al*. (1954) and potassium by Hanway *et al*. (1952). The physical properties like PD, BD, WHC, PS and SM were analyzed by Keen Raczkowski (KR) box given by Keen *et al.* (1921). OC was measured using the laboratory method given by Walkley *et al.* (1934). The data were statistically analyzed using analysis of variance (ANOVA) as applicable to complete the randomized block design, and least significant difference (LSD) at P = 0.05 was used to test the differences between means of individual treatments (Gomez and Gomez, 1984).

RESEARCH FINDINGS AND ANALYSIS

The results of the present experiment as well as relevant discussions have been presented under following heads :

Physico chemical properties:

EC:

The EC of the soil amended with FYM results in decreased values compared to the control plot without applying the organic manure. In the present study for F+CP+TS @ 7.5 t ha^{-1} the EC value was at its lowest as 0.09 dsm^{-1}as shown in Table 1. EC was the maximum as 0.19 dsm^{-1} in the control plot. This is similar to Ramesh (2001) who revealed that the practice of addition of silty loam tank sediment to clay soils resulted in increased sand and silt content. Chemical properties indicated a decrease in soil pH and EC and increase in soil organic carbon, total and available N, P, K and micronutrients.

pH:

In the present study for F+TS combination @ 17.5 t ha^{-1} the value of pH was 6.8 which was the minimum. For the control plot the value 7.9 was the maximum. This is possible during microbial decomposition of incorporated organic manure, organic acid may have been released, which neutralized the alkalinity of the organic manure thereby leaving the pH of the soil almost what it was initially which, is favorable for a good crop production as revealed by Okwuagwu *et al*. (2003).

Chemical properties:

N:

The level of the nitrogen (N) content was maximum as 168 kg ha^{-1} for F+CP+TS plot @ 7.5 t ha^{-1}. N content was 41.67 per cent more than control after organic amendments. The results are in conformity with those of Mohankumar and Narase Gowda (2010) who stated that the highest available Nitrogen was recorded in recommended FYM applied plot which had 47.2 per cent

Table 1: Soil analysis results with various organic manure

Sr. No.	Manure	Plots	EC	pH	N	P	K	Yield
			ds m^{-1}		kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}
1.	F	T_1-A	0.18	7.8	160 a	31.3 de	363 d	2430 cd
2.	F	T_1-B	0.15	7.6	140 cd	36.3 d	313 e	2773 ce
3.	F	T_1-C	0.18	7.3	125 de	46.3 bc	288 f	2603 df
4.	F+CP	T_2-A	0.17	7.4	140 d	43.8 c	283 f	2210 g
5.	F+CP	T_2-B	0.12	7.5	160 b	50.0 bc	358 d	2945 ac
6.	F+CP	T_2-C	0.13	7.6	158 b	61.3 a	438 a	2123 bf
7.	F+TS	T_3-A	0.12	7.5	148 c	28.8 e	325 e	2690 ch
8.	F+TS	T_3-B	0.12	7.5	125 de	30.0 de	325 e	2498 e
9.	F+TS	T_3-C	0.14	6.8	160 ab	48.3 bc	413 b	2290 dg
10.	F+CP+TS	T_4-A	0.09	7.5	168 a	18.8 f	325 e	2935 ab
11.	F+CP+TS	T_4-B	0.16	7.3	133 d	18.8 f	283 f	2868 bd
12.	F+CP+TS	T_4-C	0.12	7.2	113 e	51.3 b	388 c	1995 cd
13.	Control	T	0.19	7.9	98 e	13.3 f	188 g	1865 i
	Grand Mean		0.1446	7.4667	140.6154	36.7923	329.9487	2479.0769
	Significance		NS	NS	**	**	**	**
	S.E.±		0.0405	0.5755	15.3278	3.4648	8.3753	151.3393
	C.D. (P=0.05)		0.0837	1.1878	31.6350	7.1509	17.2858	312.3498
	CV (%)		34.33	9.44	13.35	11.53	3.11	7.48

F – Farm yard manure CP – Composted coir pith TS – Tank silt
A – 7.5 t ha^{-1} B – 12.5 t ha^{-1} C – 17.5 t ha^{-1}

higher available N over the treatment.

P:

The P content increased as concentration of the dosage increased. This was noticed in the combination of amendments. In FYM @ 7.5, 12.5 and 17.5 t ha^{-1} the value of P content was 31.3, 36.3, 46.3 kg ha^{-1} respectively. P content was maximum as 61.3 kg ha^{-1} in F+CP combination @ 17.5 t ha^{-1}. It was 78.30% higher than control. P was minimum as 13.3 kg ha^{-1} in the control plot. The results are in accordance with those of Singh *et al.* (2002).

K:

The value of Potassium (K) was high as 438 Kg ha^{-1} in F+CP combination at 12.5 t ha^{-1}. It was low as 188 kg ha^{-1} in the control plot. For F+CP combination the K content increases as 283, 358 and 438 kg ha^{-1} as the concentration of organic manure increases @ 7.5, 12.5 and 17.5 t ha^{-1} respectively. Rangaraj *et al.* (2007) conformed the fact that K availability found to be higher due to addition of organics like press mud, composted coir pith and FYM each @12.5 t ha^{-1} compared to non application of organics similar to the present study.

Pod yield:

The yield of pods (Groundnut-TMV-7) was maximum as 2945 kg ha^{-1} the most superior treatment with the combination of F+CP in equal combinations with 12.5 t ha^{-1}. Yield was 36.67 per cent higher than control. Here the pod yield was high in all the plots than control as shown in the graph. The most inferior treatment was the control plot without applying organic manure with the yield of 1865 kg ha^{-1}. Similar increased yield was got from FYM amended plots and sediment from well as experimented by Eyasu Mekkonen *et al.* (2010). According to Binitha (2006) the level of tank silt at the rate of 20 t ha^{-1} recorded significantly between 20 t ha^{-1} of tank silt, 10 t ha^{-1} and no silt at 90 DAS and at harvest superior number of pods, pod yield, haulm yield and shelling percentage.

Physical properties:

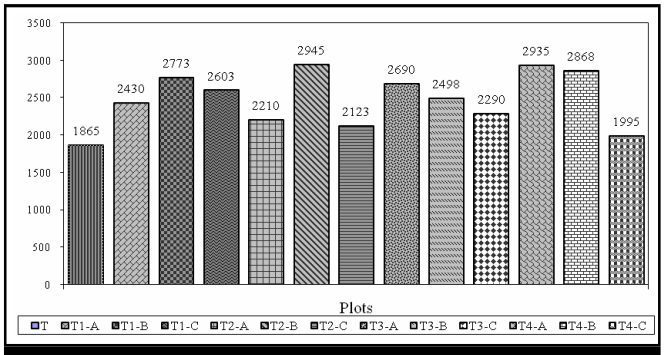

Fig. 1: Yield of groundnut pods in various organically amended Theri soil (kg ha^{-1})

Table 2: Physical properties of theri soil with FYM along with CP & TS

Sr. No.	M	Plots	BD	PD	WHC	PS	SM	OC	OM
			gm cm^{-3}	gm cm^{-3}	%	%	%	%	%
1.	F	T_1-A	1.496	2.3724	24.9251	39.6471	27.7778	0.1845 c	0.3182 c
2.	F	T_1-B	1.5874	2.4610	25.4371	38.2115	21.1843	0.1053 de	0.1815 de
3.	F	T_1-C	1.5136	2.4785	27.9049	42.5246	28.4518	0.3339 a	0.5757 a
4.	F+CP	T_2-A	1.4791	2.4351	26.5089	40.5890	28.2586	0.1713 c	0.2953 c
5.	F+CP	T_2-B	1.4328	2.4904	30.5381	43.6790	31.0897	0.0838 de	0.1444 ef
6.	F+CP	T_2-C	1.4402	2.2528	26.7416	38.1900	27.6134	0.1270 d	0.2189 d
7.	F+TS	T_3-A	1.4958	2.1903	23.0088	35.8094	23.5005	0.1270 d	0.2189 d
8.	F+TS	T_3-B	1.5264	2.3430	23.9751	36.9504	25.1407	0.1270 d	0.2189 de
9.	F+TS	T_3-C	1.5798	2.4552	24.2997	44.2663	31.5682	0.0625 e	0.1078 f
10.	F+CP+TS	T_4-A	1.5038	2.3542	26.1920	40.3846	28.4861	0.1713 c	0.2953 c
11.	F+CP+TS	T_4-B	1.4310	2.2532	25.8507	37.5752	26.5408	0.1053 de	0.1815 de
12.	F+CP+TS	T_4-C	1.5179	2.4686	23.0564	39.9510	25.9903	0.2627 b	0.4527 b
13.	Control	T	1.6014	2.4995	22.2104	35.5537	23.1482	0.0713 e	0.1229 ef
	Grand mean		1.5159	2.3436	24.9231	38.9744	26.2564	0.1446	0.2523
	Significance		NS	NS	NS	NS	NS	**	**
	S.E		0.3168	0.2370	4.8815	3.5996	3.7279	0.0224	0.0329
	C.D. (P=0.05)		0.6538	0.4891	10.0750	7.4293	7.6941	0.0462	0.0678
	CV %		25.59	12.38	23.99	11.31	17.39	18.94	15.95

BD - Bulk density PD - Particle density WHC - Water holding capacity
PS – Pore space SM – Saturated moisture OC – Organic carbon OM- Organic matter

BD:

After different combination of organic amendments the bulk density decreased to the control plot. On decrease of the value of BD, soil becomes more porous and effective for root respiration and water permeability. In the present study BD was lowest in F+CP+TS plot @ 12.5 t ha^{-1} as 1.4310 gm cm^{-3}. It was maximum as 1.6014 gm cm^{-3} in the control plot which is shown in Table 2. The results are in conformity with those of Muhammed Osman (2008) who concludes that the clay content of the tank silt ranged from 60 per cent to 80 per cent while its application to the field reduced the bulk density of the soil from 1.5 to 1.25 g cc^{-1}.

PD:

PD had the minimum value as 2.1903 gm cm^{-3} in F+TS plot with 7.5 t ha^{-1}. It was 12.26 per cent less than control which had the value 2.4995 gm cm^{-3}. Generally in the normal soil the particle density is 2.65 gm cm^{-3} with an increase of organic matter from the soil as particle density decreases (Dilip Kumar Das, 1999).

WHC:

For FYM amended plot WHC increases as 24.9251, 25.4371 and 27.9049 per cent. Similarly it increases as 23.0088, 23.9751 and 24.2997 per cent for F+TS with different concentrations of organic manure. Here in theri soil due to different organic amendments the WHC and PS had increased than the control plot. WHC was maximum as 30.5381 per cent in F+CP @ 12.5 t ha^{-1}. It was 27.26 per cent more than control. More of tank silt can improve the WHC to the desired level which can make the soil cultivable to any extent. Similar results were obtained by Dong *et al.* (2006).

PS:

The pore space was increased proportionally as 35.8094, 36.9504 and 44.2663 per cent, respectively in F+TS amended plot. PS was maximum as 44.2663 per cent in F+TS plot at 17.5 t ha^{-1} which was 19.68 per cent higher than control. It was the lowest in the control plot with the value 35.5537 per cent. There is an inverse relationship between bulk density and porosity. Therefore a decrease in the value of farmer, results in the increase of later (Hussain *et al.* 2001).

SM:

The value of SM increases as 23.5005, 25.1407 and 31.5682 per cent for F+TS plot @ 7.5, 12.5 and 17.5 t ha^{-1}, respectively. It has the maximum as 31.5682 in F+TS @ 17.5 t ha^{-1}. SM was lowest in the control plot with the value 23.1482 per cent. Suganya, (2006) concluded that vermiculite or FYM or bentonite at the rate of 1 per cent (or) 20 t ha^{-1} or humic acid at 20 kg

ha^{-1} could bring out similar large scale improvement in the moisture retention and fertility of sandy soils ensuring better yield of crops.

OC:

OC was maximum as 0.3339 in FYM amended plot at 17.5 t ha^{-1} which was 78.64 per cent higher than control. According to Saha *et al.* (2010) in the soil-quality concept, soil physical attributes were given attention because they have close relationships with soil organic carbon (SOC) and organic matter. Thus, any soil-management system that improves soil organic matter has direct bearing on soil physical properties and microbial biomass.

Conclusion:

It could be concluded that for the improvement of theri soils, it is necessary to recycle organic wastes which in this study proved to have various positive effects on soil attributes and increased yield of groundnut pods. The above finding revealed that organic farming would able to sustain the soil fertility for a longer period by meeting the demands of present and future generation. Considering the salient findings in perspective organic farming favourably influenced the soil physical, chemical and biological fertility over the inorganic, which in turn paved way for better crop yield and quality. Thus, application of organic amendments in the proper combination may be a good strategy to reclaim the theri soils.

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