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Short Term Effect on Physical Properties of Soil Using Organic Manure with Pearl Millet Crop

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***Abstract*--** This experiment was conducted at Perumalpuram of Tirunelveli District of Tamil Nadu, South India to evaluate the effect of different organic manures and their combinations on various physical properties of the soil and their impact on Pearl millet. The treatments of this study were Composted coir pith (CP), Farmyard manure (F) and Vermicompost (VC). The above manures were applied and after 30 days, the soil was collected in each sample area and analyzed. Pearl millets were grown and again soil samples were analyzed after the harvest of the crop. The yield was high as 4953 kg ha^{-1} with the combinations of VC+F in equal combinations @ 12.5 t ha^{-1} where as the control area had 2791 kg ha^{-1}. The Bulk density (BD) and Particle density (PD) had decreased in all the combinations other than control. Percentage of Water Holding Capacity (WHC), Pore Space (PS), Saturated Moisture and (SM) had increased. Thus organic manure is the best way for healthy crop and increased yield without environmental pollution.

***Key words*--** *Composted coir pith, vermicompost, amendments, and physical properties.*

I. INTRODUCTION

Pearl millet (*Pennisetum glaucum*) is a staple food in India, particularly in the states of Rajasthan, Gujarat, and Maharashtra. (Velu *et al*., 2008). Pearl millet is well adapted to growing areas characterized by drought, low soil fertility, and high temperature. It performs well in soils with high salinity or low pH. Pearl millet is one of the most extensively cultivated cereals in the world, after rice, wheat, and sorghum, and particularly in arid to semi-arid regions. India is the largest producer of pearl millet. Rajasthan is the highest producing state in India. Pearl millet is an important food across India.

Worldwide, especially in organic and sustainable agriculture, manure is used as a source of organic matter (OM) to improve soil quality as well as the traditional source of crop nutrients (Kumar *et al*., 2006). Soil quality and good soil management are vital components of sustainable crop production because soil supports the fundamental physical, chemical, and biological processes that must take place in order to support plant growth.

II. MATERIALS AND METHODS

This experiment was carried out at Perumalpuram of Tirunelveli district of Tamilnadu, South India in 2015.It is located at 8.689° latitude and 77.738° longitude.

The control sample was obtained as fine tilt without stubbles and weeds. While adding organic manure, care was taken to see that the individual treatments were mixed separately. Each sample was left without any disturbance and the experimental soil was levelled perfectly for uniform application. By using different organic manures of F, CP, and VC in different concentrations (7.5t ha^{-1}, 12.5t ha^{-1} and 17.5t ha^{-1}) the total treatment consists of 22 samples including control plot. The pod yield in each sample was measured.

A. Physical Properties

a. Bulk Density (BD)

Bulk density is defined as the mass (weight) per unit volume of a dry soil (volume of solid and pore spaces). It is expressed in gm cm^{-3}. Generally, in normal soils bulk density ranges from 1 – 1.60 gm cm^{-3}.

b. Particle Density (PD)

The weight per unit volume of the solid portion of soil is called particle density. It is also termed true density which is expressed in gm cm^{-3}. Generally, in the normal soils the particle density is 2.65 gm cm^{-3}.

c. Water Holding Capacity (WHC)

Water holding capacity is defined as the capacity of the soil to retain water is exceeded. At this point all soil pore spaces (micro and macro pore spaces) are filled up with water and the drainage is restricted.

d. Pore Space (PS)

Pore spaces (also called voids) in a soil consist of the portion of the soil volume not occupied by solids, either mineral or organic. The pore space under field conditions is occupied at all times by air and water. Pore spaces directly control the amount of water and air in the soil and indirectly influence the plant growth and crop production.

e. Saturated Moisture (SM)

At soil saturation, water fills completely in the pore spaces.

The physical properties like BD, PD, WHC, PS and SM were analyzed by Keen Raczkowski (KR) box given by Keen *et al.*, (1921). 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).

B. Research Findings and Analysis

a. Physical Properties

BD: Bulk density decreased positively with increasing organic matter source such as vermicompost. The maximum value (1.534gm cm^{-3}) was seen in the control plot as shown in Table 1. After different combination of organic amendments the bulk density has decreased till 1.015 gm cm^{-3} with the combination of VC+F @ 12.5 t ha^{-1}. This is in line with the findings of Shirani *et al*., (2002), who revealed that the effect of balanced fertilizer and VC manure application on bulk density of the surface soil (0-15 cm) was significant.

PD: The decrease in PD from the control was obvious with incorporation of organic manure. PD was the lowest as 1.708 gm cm^{-3} @ 17.5t ha^{-1} with VC. PD was the highest in control plot and with the amendment of manures; PD values have decreased to the greater extent. Similar results were revealed

by the studies of Melis *et al*., (2008) using composted tobacco waste and farm yard manure.

WHC: Water holding capacity was increased due to the addition of organic manure. In VC+CP+F amended plot WHC increased as 44.92, 50.79 and 56.73% for plots with organic manure @ 7.5, 12.5 and 17.5 t ha^{-1} respectively and the control had the value of 28.42%. Similar results were obtained by Dong *et al*., (2006).

Table 1: Physical properties of organically amended soil before harvest

S.NO	MANURE	SAMPLE	BD	PD	WHC	PS	SM	YIELD
			gm cm^{-3}	gm cm^{-3}	%	%	%	Kg ha^{-1}
1	VC	T3A	1.054a	2.295	49.21d	54.54a	37.89e	3341
2	VC	T3B	1.072a	1.943	53.10b	46.34cd	48.69a	4481
3	VC	T3C	1.121ab	1.708	47.06e	35.21g	40.60c	3145
4	VC+CP	T5A	1.256bc	2.014	40.08g	40.95f	31.98g	3459
5	VC+CP	T5B	1.132ab	1.910	41.90g	47.15c	39.98d	3656
6	VC+CP	T5C	1.223bc	2.325	47.21e	54.31a	36.07	3852
7	VC+F	T6A	1.404de	2.042	40.83g	33.10h	36.01ef	3341
8	VC+F	T6B	1.015a	1.969	46.57e	42.91e	35.21f	4953
9	VC+F	T6C	1.385cd	2.626	32.05h	47.87bc	27.27h	4285
10	VC+CP+F	T7A	1.053a	2.461	44.92f	53.25a	34.52f	3333
11	VC+CP+F	T7B	1.155ab	2.070	50.79c	49.27b	45.76b	3727
12	VC+CP+F	T7C	1.313cd	1.821	56.73a	45.10d	47.18a	4010
13	CONTROL	T8	1.534e	2.819	28.42i	27.65i	24.73i	2791
Grand mean			1.2186	2.1100	44.5723	44.4854	37.3049	3701.58
Significance			**	NS	**	**	**	**
SEd			0.0706	0.4638	0.7480	0.7294	1.0269	7.0912
CD (0.05)			0.1456	0.9572	1.5437	1.5055	2.1195	200.387
CV (%)			7.09	26.92	2.06	2.01	3.37	3.21

VC-Vermicompost CP-Composted coir pith F-Farmyard manure

A-7.5 t ha^{-1} B-12.5 t ha^{-1} C-17.5 t ha^{-1}

BD-Bulk Density PD-Particle Density WHC- Water Holding Capacity

SM-Saturated Moisture PS-Pore Space

PS: The pore space was increased as 40.95, 47.15 and 54.31% in VC + CP amended plot @ 7.5, 12.5 and 17.5t ha^{-1} respectively. PS was the maximum as 54.54% in VC plot @ 7.5 t ha^{-1} which was higher than the control with 27.65%. According to Jeyamangalam (2015) the increase of 14.89% than control was noticed in the F+CP+TS plot @ 12.5 t ha^{-1}.

SM: It is a property which is endowed with the ability to retain soil moisture. The slow release in moisture enhances crop yields. It has the maximum as 48.69% in VC amended plot @ 12.5 t ha^{-1}. SM was the lowest in the control plot with the value 24.73%.

Yield:

The Yield was maximum as 4953 kg ha^{-1}, the most superior treatment with equal combination of F+VC @ 12.5 t ha^{-1}as shown in fig.1. The control yielded 2791 kg ha^{-1}. It is an unusually hardy food crop, and consequently there is a progressive increase in the use of these grains as a major food staple, especially among subsistence farmers and the rural poor in large areas of India and sub-Saharan Africa (Vom Brocke *et al*., 2012).

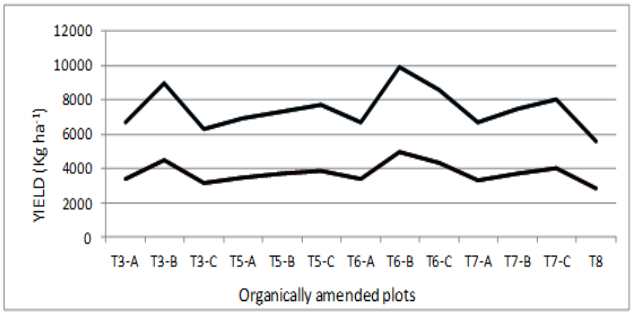

Figure 1: Yield of pearl millet in organically amended plots

CONCLUSION

It is concluded that, for the improvement of low nutrient soils, recycled organic wastes have various positive effects on soil attributes and increased yield of pearl millet pods. Considering the salient findings, perspective organic farming

favourably influenced the soil physical, chemical and physico-chemical properties of the soil 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 soils and to improve the health.

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