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EFFECT OF VARIOUS ORGANIC MANURES ON SOIL PHYSICAL, PHYSICO CHEMICAL PROPERTIES AND PRODUCTIVITY OF RAINFED GROUNDNUT (*Arachis hypopaea* L.)

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ABSTRACT

The soil of the experimental field was red sandy loam (Haplustalf). The experiment had six treatments each replicated four times in a randomized block design and four different sources of organic manures viz., FYM @ 10 t ha^{-1}, vermicompost @ 2.5 t ha^{-1}, poultry manure @ 4 t ha^{-1} and pressmud cake @ 10 t ha^{-1}were evaluated and compared with recommended dose of fertilizers and control (without fertilizers). The physical properties *viz*., bulk density, porosity and water holding capacity were significantly influenced by application of various organic manures. FYM application @ 10 t ha^{-1} recorded the lowest bulk density (1.18 Mg m^{-3}), highest porosity (51.2 %) and highest water holding capacity (40.1 %) followed by pressmud cake application @ 10 t ha^{-1} and the lowest was recorded in control. The pH of the soil was significantly influenced by different treatments whereas the electrical conductivity of the soil was not influenced by the application of organic manures. The build up of organic carbon was recorded with the application of various organic manures. The highest organic carbon percent (0.51 %) was recorded in FYM application and the lowest was in control (0.30 %) and RDF (0.30 %). The pod yield was significantly influenced by the application of various organic manures. The higher pod yield was recorded in RDF (1531 kg ha^{-1}) which was on par with FYM (1470 kg ha^{-1}), poultry manure (1454 kg ha^{-1}), pressmud cake (1446 kg ha^{-1}) and vermicompost (1418 kg ha^{-1}) applications and the lowest was recorded in control (1188 kg ha^{-1}). The study indicated that FYM and pressmud cake applications were most effective in maintaining soil physical and physico-chemical properties apart from sustaining groundnut productivity and were on par with chemical fertilizers.

KEYWORDS: Organic manures, physical and chemical properties groundnut.

INTRODUCTION

Healthy soil is a basic requisite for the integrity of terrestrial ecosystems to remain intact and to recover from disturbances such as drought, climate change, pest infestation, pollution and human exploitation through agriculture. Deterioration of soil, and thereby soil health, is of great concern for human, animal and plant health (Wang and Chao, 1995). For centuries, organic manure has been recognized as a soil builder because of its contributions to improving soil quality. Organic manure applications improved soil physical properties through increased soil aggregation, improved aggregate stability, decrease in the volume of micropores while increasing macropores, saturated hydraulic conductivity and water infiltration rate, and soil water holding capacity at both field capacity and wilting point (Sulfab, 2013). Although, the accumulation of SOM through applied organic manures depends upon the rate of decomposition process. Organic manures and compost applications resulted in higher SOC content, soil pH and electrical conductivity (Sankaranarayanan, 2004).

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop of India. It is cultivated in 5.95 m ha with a production of 7.54 million tonnes at a productivity of 1268 kg ha^{-1} (Anonymous, 2015). Groundnut being a legume crop, leaves lot of residual fertility which inturn helps the succeeding crop under rainfed farming situations. Further, integration and incorporation of organic manures (farmyard manure, vermicompost etc.) helps to improve soil structure, soil microbial activity and soil moisture conservation, which inturn helps to stabilize the production and productivity of the crops (Lourduraj, 1999). Among the different agronomic management practices, use of organics is of prime importance under rainfed farming situations (Nagaraj *et al.,* 2001).Keeping the above aspects in view, an experiment on evaluation of different organic sources on different soil properties and yield of groundnut was chosen.

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MATERIAL AND METHODS

An experiment on evaluation of different organic manures on soil health and productivity of rainfed groundnut was started in the year 2007 at Regional Agricultural Research Station, Tirupati, Acharya N. G Ranga Agricultural University, Andhra Pradesh. The same experiment was selected for the present study during *kharif*-2016 with the prime objective of monitoring the soil health. The experiment involves six treatments each replicated four times in a randomized block design.The treatments include T_1 : Control (no manure or fertilizers), T_2 : RDF @ 20:40:50 N : P_2O_5 : K_2O kg ha^{-1}, T_3 : Vermicompost @ 2.5 t ha^{-1} , T_4 : Poultry manure @ 4 t ha^{-1}, T_5 : Farm yard manure @ 10 t ha^{-1} , T_6 : Pressmud cake @ 10 t ha^{-1}.

Fully decomposed organic manures were applied to the plots as per the treatments before sowing. Fertilizers *viz.,* N @ 20 kg ha^{-1} as urea, P_2O_5 @ 40 kg ha^{-1} as single super phosphate and K_2O @ 50 kg ha^{-1} as murate of potash were applied to the RDF treatment in lines at a depth of 5 cm in the furrows made with hand hoes 5 cm away from the seed rows. Surface soil samples were collected before sowing and at harvest of the crop. The collected soil samples were mixed separately, dried under shade, pounded to pass through 2 mm sieve and labelled and were analysed for soil properties (Table 1). The crop was harvested andpod yield, haulm yield, harvest index, 100 pod weight, 100 kernel weight, shelling percentage and plant population were recorded at harvest. The soil bulk density, porosity and water holding capacity was determined by Keen Raczkowski method (Baruah and Barthakur, 1997). The soil pH, EC and organic carbon were determined by Jackson(1973), Richards *et al.* (1954) and Walkley and Black (1934) wet oxidation method respectively. Data was analyzed statistically for test of significance following the Fisher's method of analysis of variance as outlined by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

The results on effects of application of various organic manures on soil physical and physico-chemical properties are discussed and presented in Table 1.

Soil bulk density, porosity and water holding capacity at harvest were significantly influenced by the application of different organic manures. The bulk density of the soil at harvest ranged from 1.18 to 1.29 Mg m^{-3} with an overall mean of 1.25 Mg m^{-3}. Soil bulk density decreased with the application of organic manures. Significantly lower bulk density (1.18 Mg m^{-3}) was recorded in FYM application @ 10 t ha^{-1} than control and RDF and was found on par with pressmud cake application @ 10 t ha^{-1}(1.20 Mg m^{-3}). Highest bulk density was recorded in control (1.29 Mg m^{-3}).The lower bulk density in FYM and pressmud cake applications might be due to increased organic matter addition, which binds the soil particles together and increases the porosity which inturn increases soil volume. The results were in accordance with Prakash *et al*. (2002) reported in an Alfisol that soil bulk density decreased in treatment with FYM as compared to the treatments with vermicompost, processed compost, control and chemical fertilizers. They also reported that the decrease in bulk density with FYM was higher in second year compared to previous year.

Porosity of the soil at harvest ranged from 45.6 % to 51.2 % with an overall mean of 48.9 %. Soil porosity increased with the application of organic manures and significantly higher porosity (51.2 %) was recorded in FYM application than control and RDF and was found on par with pressmud cake application (50.2 %). The lowest porosity was recorded in control (45.6 %) followed by RDF (47.2), poultry manure @ 4 t ha^{-1}(49.7 %) and vermicompost @ 2.5 t ha^{-1} application (49.2 %). The higher porosity in FYM and pressmud cake applied treatments might be due to increased organic matter addition, which binds the soil particles together and increases the porosity. The results were in accordance with Mahimairaja *et al*. (1986). Rasool *et al*. (2008) reported that FYM significantly increases the porosity when compared with control and RDF treatment.

Water holding capacity of the soil at harvest ranged from 28.1 to 40.1 % with an overall mean of 33.5 %. The water holding capacity increased with the application of organic manures. Significantly higher water holding capacity was recorded in FYM application (40.1 %) than control and RDF and was found on par with pressmud cake application (37.6 %). Lowest water holding capacity was recorded in control (29.02 %) followed by RDF (28.1 %), poultry manure (35.8 %) and vermicompost applications (30.2 %).The higherwater holding capacity in FYM and pressmud cake applied treatments might be attributed to increased organic matter, increased porosity and decreased bulk density as the water holding capacity is determined by these factors. Brown and cotton (2011) reported that water holding capacity increases 1.57 times

Table 1. Effect of application of various organic manures on soil physical and physico-chemical properties at harvest of groundnut during current crop season

(Mean value of four replications)

Treatments	B.D ($Mg\ m^{-3}$)	Porosity (%)	WHC (%)	pH	EC ($dS\ m^{-1}$)	OC (%)	Pod yield ($kg\ ha^{-1}$)
Control	1.29	45.60	29.02	6.42	0.06	0.30	1188
RDF @ (20:40:50 N:P:K kg ha^{-1})	1.28	47.20	28.10	6.52	0.07	0.30	1531
Vermicompost @ 2.5 t ha^{-1}	1.27	49.20	30.20	6.80	0.07	0.34	1418
Poultry manure @ 4 t ha^{-1}	1.25	49.70	35.80	7.20	0.09	0.45	1454
FYM @ 10t ha^{-1}	1.18	51.20	40.10	7.13	0.11	0.51	1470
Press mud cake @ 10 t ha^{-1}	1.20	50.20	37.60	6.88	0.06	0.48	1446
Mean	1.25	48.90	33.50	6.82	0.08	0.40	1417
SE.m.±	0.01	0.40	0.97	0.06	0.01	0.02	95
C.D (p = 0.05)	0.03	1.20	2.92	0.18	NS	0.06	269

in all treatments receiving organic manures when compared with control in a treatment conducted on changes in soil properties and carbon content following compost application.

Soil pH and organic carbon content were significantly influenced by the application of various organic manures whereas electrical conductivity was not significantly influenced. Soil pH at harvest stage ranged from 6.42 to 7.20 with an overall mean of 6.82. The pH increased with the application of organic manures. Significantly higher pH was recorded in poultry manure application (7.20) than control and RDF and was found on par with the FYM application (7.13). lowest pH was recorded in control (6.42) followed by RDF (6.52), vermicompost (6.80) and pressmud cake applications (6.88).The mechanism responsible for this increase in soil pH was due to ion exchange reactions which occur when terminal OH^- of Al or Fe^{2+} hydroxyl oxides are replaced by organic anions which are decomposition products of the manure such as malate, citrate and tartrate (Bessho and Bell, 1992; Van *et al*., 1996; Pocknee and Summer, 1997; Hue and Amiens, 1989). Magagula *et al*. (2010) found that soil pH was highest in poultry manure application (5.7) and it was on par with FYM application (5.66), when compared with control (5.5) and RDF (5.2) while evaluating effects of chicken manure on soil properties under sweet potato culture in Swaziland.

EC of the soil at harvest ranged from 0.06 to 0.11 dS m^{-1} with an overall mean of 0.08 dS m^{-1}. EC was not significantly increased with the application of organic manures. However, slight increase in EC was recorded with the treatments receiving organic manures. Highest EC was recorded in FYM application (0.11 dS m^{-1}) followed by poultry manure (0.09 dS m^{-1}) and vermicompost applications (0.07 dS m^{-1}) which was on par with RDF (0.07 dS m^{-1}). The lowest EC was reported in control(0.06 dS m^{-1}) and pressmud cake application (0.06 dS m^{-1}).The slight increase in EC might be due to organic manures does not contain salts and hence there was no influence of organic manure salt accumulation in soil (Bajpai *et al*., 1980). The results were in accordance with Verma *et al*. (2015) who reported that the variation between treatment means was not statistically significant from low to standard EC. EC did not differ significantly with the application of different sources and doses of organic manures, including FYM (Chawala and Chhabra, 1991; Stalin *et al*., 2006).

Soil organic carbon of the soil at harvest ranged from 0.30 % to 0.51 % with an overall mean of 0.40 %. The organic carbon content increased in the soil with the application of organic manures. Significantly higher organic carbon was observed in FYM application (0.51 %) than control and RDF and was found on par with the pressmud cake (0.48 %) and poultry manure applications (0.45 %). Lowest organic carbon content was reported in control (T_1) (0.30 %), RDF(0.30 %) and vermicompost applications (0.34 %).This might be due to the residual effect of organic manures on soil which increases organic carbon content as reported by Wong *et al*. (1999). The increase in soil organic carbon was quite obvious due to reason that carbonaceous materials contribute to soil organic carbon after their decomposition (Basita *et al*., 2013).Gathala *et al*. (2007) reported that the application of FYM @ 20 t ha^{-1} recorded highest organic carbon content when compared with same quantities poultry manure and vermicompost.

The yield attributes viz., 100 pod weight, 100 kernel weight, shelling percentage and plant population of groundnut of the experimental field were not significantly influenced by the application of organic manures.

The pod yield of groundnut at harvest was significantly influenced by the application of different organic manures. Pod yield of groundnut at harvest ranged from 1188 to 1531 kg ha^{-1} with a mean value of 1417 kg ha^{-1}. Significantly higher pod yield of groundnut was recorded in RDF (1531 kg ha^{-1}) than control and was found to be on par with vermicompost (1418 kg ha^{-1}), poultry manure (1454 kg ha^{-1}), FYM (1470 kg ha^{-1}) and pressmud cake applications (1446 kg ha^{-1}). Lowest pod yield was recorded in control (1188 kg ha^{-1}). The higher pod yield obtained with RDF treated plot might be attributed to the adequate and balanced supply of the nutrients like N, P, K to meet the nutritional requirements of crop growth. Bhosanle and Pisal (2017) reported that recommended dose of fertilizers (RDF) shows significantly increased pod yield (35.42 q ha^{-1}) followed by FYM (33.01 q ha^{-1}), vermicompost (27.92 q ha^{-1}) and the lowest was recorded control (22.30 q ha^{-1}) in the study conducted on effect of nutrient management strategies on productivity of summer groundnut.

CONCLUSION

From this experiment, it could be concluded that organic manures *viz.,*FYM and pressmud cake applications were found most effective in maintaining soil physical and physico-chemical properties and sustaining groundnut productivity on par with chemical fertilizers. Depending on the availability, any of the organic manures *viz.,* FYM or pressmud cake @ 10 t ha^{-1} can be recommended for maintaining pod yield and soil health to promote organic farming in groundnut crop.

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