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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT PRACTICES ON SOIL PHYSICAL PROPERTIES IN MAIZE-GROUNDNUT CROPPING SYSTEM.

PRABHAVATHI N*. PRASANNA KOLAR [1]., P NANDEESWARA RAO[2]., RAMESHA K[3]., RAMAKRISHNA G N[4]

* Assistant professor, KL Deemed to be university, KL College of Agriculture at Green Fields, Vaddeswaram Campus, Guntur District, -522 302 Andhra Pradesh, India.

[1]Assistant Professor, School of Humanities and Social Sciences, Jain (Deemed to be University), Bengaluru, KA, India.

[2]Assistant Professor, School of Humanities and Social Sciences, Jain (Deemed to be University), Bengaluru, KA, India.

[3]Associate Professor, School of Humanities and Social Sciences, Jain (Deemed to be University), Bengaluru, KA, India.

[4]Assistant Professor, School of Humanities and Social Sciences, Jain (Deemed to be University), Bengaluru, KA, India.

Corresponding Author (*): Prabhavathi N, Assistant professor, KL College of Agriculture at Green Fields, Vaddeswaram Campus, Guntur District, -522 302 Andra Pradesh, India

Corresponding Author (*): Prabhavathi N, Assistant professor, college of Agriculture, Koneru Lakshmaiah Education Foundation, Vaddeshswaram, Andra Pradesh, India

Email:nprabhavathi@kluniversity.in

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ABSTRACT

A field experiment entitled “Dynamics of soil carbon under integrated nutrient management practices in maize - groundnut cropping sequence" ” was carried out under field conditions during both *kharif* and *rabi* seasons of 2019-2020 and 2020-2021 at Field No. 50B of Wetland Farm, S. V. Agricultural College, Tirupati campus (under the judicatory of Acharya N. G. Ranga Agricultural University). Soil physical properties like bulk density, particle density and porosity of soil during both the years of study (*kharif* 2019-2020 and *rabi* 2020-2021) on maize-groundnut cropping sequence was not significantly affected by the levels of NPK while significantly affected by the application of organic sources. The pooled analysis results also showed similar trend. However, interaction effect was non significant between inorganic and organic sources during both the years.

Key words: *Maize, Groundnut, Kharif, rabi,* Soil bulk density, particle density and porosity, *FYM, Poultry manure, urban compost and NPK*

INTRODUCTION

Continuous application of fertilizers and manures influence various physical properties of the soil. The changes in soil properties that occur due to continuous use of fertilizers and manures assume great significance and sustainability of the cropping system. The interactions between organic and inorganic sources of nutrients are a key subject of research. Long-term application of fertilizer, FYM significantly affected soil BD and PD. The reduction in BD could be attributed to higher organic matter content of the soil, better aggregation and a consequent increase in volume of micro pores and increased root growth in the fertilizer, manure and lime treated plots. This is in conformity with findings of Hatti *et al.* (2008) and Ortas and Lal (2013).

Maize (*Zea mays* L.) – Groundnut (*Arachis hypogaea*) is one of the important cropping systems in Andra Pradesh of India and maintenance of optimum soil fertility is an important consideration for obtaining higher and sustainable yield. The responses of the succeeding crops in a cropping system are influenced greatly by the preceding crops and the inputs applied there in. Therefore, recently greater emphasis is being laid on the cropping system as whole rather than on the individual crops in a sequence. Maintaining sustained crop production, balanced manuring is essential to build up soil health. Wide use of short statured high yielding varieties and hybrids is common in maize. The organic sources will improve the nutrient use efficiency of added chemical fertilizers by reducing nutrient losses and enhancing nutrient availability to plant. Integration and incorporation of organic manure (FYM, poultry manure and urban compost) in the cropping system helps to improve soil structure, soil microbial activity and soil moisture conservation and which in turn helps to stabilize the production and productivity of the crops. Integrated nutrient management is also important for marginal farmers who cannot afford to supply crop nutrients through costly chemical fertilizers.

MATERIAL AND METHODS

The field experiment entitled **"Dynamics of soil carbon under integrated nutrient management practices in maize - groundnut cropping sequence"** was carried out under field conditions during both *kharif* and *rabi* seasons of 2019-2020 and 2020-2021 at Field No. 50B of Wetland Farm, S. V. Agricultural College, Tirupati campus. which is geographically situated at 13.5°N latitude and 79.5°E longitude with an altitude of 182.9 m above mean sea level in the Southern Agro Climatic Zone of Andhra Pradesh. According to Trolls classification, it come under the Semi-Arid Tropics (SAT).

The results of the initial soil experimental sample were analysed at 0-15 cm depth was collected and tested for different physical, physico-chemical, chemical and biological properties and the results were texture was sandy clay loam with BD (1.48 g cm^{-3}), PD (2.65 g cm^{-3}), pH of 7.68, Electrical conductivity 0.85 dSm^{-1}, indicated that the experimental soil is sandy clay loam in texture, neutral in reaction, non saline, medium in organic carbon low in available nitrogen, high in available phosphorus and medium in available potassium. The experiment was laid out in a split plot design for both the years with three main plots (M_1)125%, (M_2) 100%, (M_3) 75% RDF and four sub plots (S_1) control, (S_2) FYM 10 t ha^{-1}. (S_3) Poultry manure 5 t ha^{-1} and (S_4) urban compost 5 t ha^{-1} , total 12 treatments consisting of combinations

of three replications. In *kharif*, maize hybrid (Kavery-55K) and in *rabi*, groundnut (K6) was sown on both (*kharif* 2019-20 and r*abi* 2020-21) adopting a spacing of 60 x 20 cm and 22.5 x 10 cm in maize and groundnut crops respectively. In the present study, density of soil decreased significantly due to application of FYM to the soil as compared to inorganic fertilizer treated plots. Many scientists have reported that the decomposition products of organic materials would usually helps in granulation of soil particles and thus increase the porosity of the soil; this in turn would quite naturally lower the bulk density of the soil.

RESULTS AND DISCUSSION

Soil bulk density

Soil bulk density (BD), during both the years of study (*kharif* 2019-2020 and *rabi* 2020-2021) on maize-groundnut cropping sequence was not significantly affected by the levels of NPK while significantly affected by the application of organic sources. The pooled analysis results also showed similar trend. However, interaction effect was non-significant between inorganic and organic sources during both the years.

Among the levels of NPK, M_1 (125 % RDF) recorded lowest bulk density (1.35, 1.32 and 1.38, 1.32 g cm^{-3} in *kharif*, 2019-2020 and *rabi*, 2020- 2021, respectively) over all other treatments and the higher bulk density was recorded in M_3 (75 % RDF) during both the years. However, significant differences were observed among the organic sources. The treatment, S_2 (FYM @ 10 t ha^{-1}) recorded significantly the lower bulk density (1.43, 1.37 and 1.38, 1.33 g cm^{-3} in *kharif* 2019-20 and *rabi*, 2020-21, respectively) and on par with S_3 (Poultry manure @ 5 t ha^{-}) and S_4 (Urban compost @ 5 t ha^{-1}) and the highest was recorded (1.46, 1.40 and 1.40, 1.36 g cm^{-3}) in S_1 (control). Pooled analysis data on bulk density in maize – groundnut cropping sequence also followed the similar trend.

The interaction effect between inorganic and organic sources (INM) over two years (*kharif*, 2019-20 and *rabi*, 2020-21,) in maize-groundnut cropping sequence was non significant. Bulk density was lower on application of 125 % RDF with FYM @ 10 t ha^{-1} over all other treatments. Kharche *et al*. (2013) reported that bulk density was considerably reduced from initial value of 1.32 to 1.20 Mg m^{-3} due to integration of chemical fertilizers with organics which was significantly lower as compared to that of control and only chemical fertilizers. The reduction in bulk density of soil under integrated nutrient management is due to better aggregation, increased porosity and improvement in soil structure caused due to increase in soil organic matter.

Soil particle density

Soil particle density (PD), during both the years of study (*kharif* 2019-2020 and *rabi* 2020-2021) on maize-groundnut cropping sequence was not significantly affected by the levels of NPK while significantly affected by the application of organic sources. The pooled analysis results also showed similar trend. However, interaction effect was non significant between inorganic and organic sources during both the years.

Among the levels of NPK, M_1 (125 % RDF) recorded lowest particle density (2.54, 2.45 and 2.54, 2.45 g cm^{-3} in *kharif*, 2019-2020 and *rabi*, 2020- 2021, respectively) over all other treatments and the higher was recorded in M_3 (75 % RDF) during both the years. However, significant differences were observed among the organic sources. The treatment S_2 (FYM @ 10 t ha^{-1}) recorded significantly the lowest particle density (2.69, 2.58 and 2.55, 2.41g cm^{-3} in *kharif* 2019-20 and *rabi*, 2019-20, respectively) and on par with the treatments S_3 (Poultry manure @ 5 t ha^{-1}) and S_4 (Urban compost @ 5 t ha^{-1}) and the highest PD was recorded (2.69, 2.67 and 2.60, 2.57 g cm^{-3}) in S_1 (control). Pooled analysis data on bulk density in maize – groundnut cropping sequence also followed the similar trend.

The interaction effect between inorganic and organic sources (INM) over two years (*kharif*, 2019-20 and *rabi*, 2020-21, in maize-groundnut cropping sequence was non significant. PD was high on application of 125 % RDF with FYM @ 10 t ha^{-1}.

Ojeniyi *et al*. (2013) reported that soil temperature and particle density were reduced as application rate of poultry manure increased from 0 to 10 t ha^{-1} while porosity and moisture content were increased. Verma *et al.* (2010) recorded under long-term fertilizer experiments in sandy loam soil after harvest of maize as well as wheat that the treatments receiving FYM alone @ 20 t ha^{-1} exhibited significantly lower bulk density and particle density compared to all chemical fertilizers and control but 100% NPK and FYM @ 10t ha^{-1} was on par with FYM alone @ 20t ha^{-1}. Long-term application of fertilizer, FYM significantly affected soil BD and PD. The reduction in BD could be attributed to higher organic matter content of the soil, better aggregation and a consequent increase in volume of micro pores and increased root growth in the fertilizer, manure and lime treated plots. This is in conformity with findings of Hatti *et al.* (2008) and Ortas and Lal (2013).

Table 1. Effect of INM practices on soil physical properties after harvest of maize

Treatments	**Bulk density (g cm^{-3})**			**Particle density (g cm^{-3})**		
	2019	**2020**	**2019**	**2020**	**2019**	**2020**
Main plots						

M_1= 125 % RDF	1.35	1.32	1.35	2.54	2.45	2.49
M_2= 100 % RDF	1.39	1.35	1.37	2.58	2.50	2.54
M_3= 75 % RDF	1.38	1.35	1.36	2.58	2.56	2.57
SEm±	**0.002**	**0.003**	**0.001**	**0.006**	**0.006**	**0.004**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Sub plots						
S_1 = Control	1.46	1.40	1.45	2.69	2.67	2.68
S_2 = FYM @ 10 t ha^{-1}	1.43	1.37	1.40	2.59	2.58	2.58
S_3 = Poultry manure @ 5 t ha^{-1}	1.41	1.39	1.40	2.65	2.58	2.61
S_4 = Urban compost @ 5 t ha^{-1}	1.40	1.40	1.40	2.67	2.56	2.61
SEm±	**0.002**	**0.002**	**0.002**	**0.006**	**0.006**	**0.004**
CD (P=0.05)	**0.005**	**0.007**	**0.005**	**0.015**	**0.017**	**0.012**
Interaction						
Sub at same level main (S x M)						
SEm±	**0.005**	**0.007**	**0.005**	**0.017**	**0.017**	**0.013**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Main at same or different level sub (M x S)						
SEm±	**0.029**	**0.039**	**0.027**	**0.090**	**0.089**	**0.066**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 2. Effect of INM practices on soil physical properties after harvest of groundnut

Treatments	**Bulk density (g cm^{-3})**			**Particle density (g cm^{-3})**		
	2019	**2020**	**2019**	**2020**	**2019**	**2020**
Main plots						
M_1= 125 % RDF	1.38	1.32	1.35	2.54	2.45	2.49
M_2= 100 % RDF	1.39	1.35	1.37	2.58	2.50	2.54
M_3= 75 % RDF	1.38	1.35	1.36	2.58	2.56	2.57
SEm±	**0.002**	**0.003**	**0.001**	**0.006**	**0.006**	**0.004**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Sub plots						
S_1 = Control	1.40	1.36	1.38	2.60	2.57	2.58
S_2 = FYM @ 10 t ha^{-1}	1.38	1.33	1.35	2.55	2.41	2.47
S_3 = Poultry manure @ 5 t ha^{-1}	1.38	1.34	1.36	2.55	2.48	2.52

S_4 = Urban compost @ 5 t ha^{-1}	1.40	1.36	1.38	2.57	2.56	2.57
SEm±	**0.002**	**0.002**	**0.002**	**0.006**	**0.006**	**0.004**
CD (P=0.05)	**0.005**	**0.007**	**0.005**	**0.015**	**0.017**	**0.012**
Interaction						
Sub at same level main (S x M)						
SEm±	**0.005**	**0.007**	**0.005**	**0.017**	**0.017**	**0.013**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Main at same or different level sub (M x S)						
SEm±	**0.029**	**0.039**	**0.027**	**0.090**	**0.089**	**0.066**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

CONCLUSION

Higher results were found with respect to soil physical, physico - chemical among different treatments observed in levels of NPK, M_1 (125 % RDF) followed by M_2 (100% RDF) were significantly higher than M_3 (75% RDF). Among the organic treatments significantly highest NPK was recorded S_2 (FYM @ 10 t ha^{-1}) on par with the other treatments S_3 (poultry manure @ 5 t ha^{-}) and S_4 (urban compost @ 5 t ha^{-1}) and lowest content of NPK was found in S_1 (control). There was no significant changes among the treatments and their interaction between inorganic and organic combination (INM) during the two years.

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