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Influence of organic manures on nutrients status of groundnut growing soils

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Abstract
Organic manures helps to improve soil physical, chemical and biological properties thus improve nutrient availability to crops. The present study was carried out to evaluate the beneficial effects of different sources of organic manures on nutrient status of groundnut growing soils during *Kharif*, 2016 in an ongoing long-term experiment at RARS, Tirupati since 2007. The results revealed that continuous application of various organic manures favourably improved the soil major nutrients (N, P, K), secondary nutrients (Ca, Mg and S) and micronutrients (Zn, Mn, Fe and Cu) compared to control plots. Among the various organic manures, pressmud cake @ 10 t $ha^{-1}$and farm yard manure @ 10 t ha^{-1}had greater influence on increased soil nutrient status followed by poultry manure @ 4 t ha^{-1}.

Keywords: Groundnut, soil nutrients, organic manures, poultry manure, farm yard manure

Introduction
Groundnut being a premier oil seed crop is also an important food legume and animal feed, but it is mostly grown under energy starved conditions of low soil fertility and rainfed situations. Continuous use of inorganic fertilizers under intensive cropping system leads to deterioration of soil health and productivity. Healthy soil is a 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) [17]. However, rebuilding soil quality and health through appropriate farming practices may take several years, especially in dryland areas, where limited moisture reduces biomass production and soil biological activity. Thus, the challenge is to identify soil management practices that promote soil organic matter formation and moisture retention, and ensure productivity and profitability for the farmers.

Organic farming in recent years gaining importance due to realization of inherent advantages it confers in sustaining crop production under aberrant rainfed farming situations and also maintaining dynamic soil nutrient status. The use of manures as organic fertilizer can benefit agriculture and can be potentially an inexpensive way for society to protect the environment and to conserve natural resources.

Organic manures acts as nutrient reservoir and upon decomposition produces organic acids, there by adsorbed ions are released slowly for the entire crop growth period leading to higher yields (Kumar *et al*., 2005) [7]. Hence the present investigation was taken with the objective to study the effect of continuous application of various organic manures on nutrient status of soils.

Materials and Methods
A long-term experiment was initiated in the year 2007 at Regional Agricultural Research Station, Tirupati and the same experiment was selected for the present study with prime objective to assess the changes in soil nutrient status as influenced by continuous application of organic manures. Experimental site is geographically situated at 13.5° N latitude and 79.5° E longitude with an altitude of 189.2 meters above mean sea level (MSL) in the Southern Agro-climatic Zone of Andhra Pradesh and according to Troll's classification, it falls under Semi-Arid Tropics (SAT). Groundnut crop is grown in *Kharif* season consisting of six treatments with four replications. The treatments include T_1 : Control (no manure and fertilizers), T_2 : RDF (20 Kg of N ha^{-1}, 40 Kg of P_2O_5 ha^{-1}, 50 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}. The chemical composition of organic manure used in study present in the Table.1.

The soil of the experiment fields was red sandy loamy in texture and samples were collected from each treatment at surface 0-15 cm before sowing and at harvest of crop during *kharif*, 2016 and were used for estimation of macro nutrients, secondary and micronutrients by following standard procedures as described by Jackson (1973) [5]. The soil of the experimental field was slightly acidic to neutral in reaction, non-saline in nature with low to medium in organic carbon content.

Results and Discussion

Major nutrients

Data indicated that application of organic manures recorded significantly higher nitrogen, phosphorus and potassium content over control (Table.2). Available nitrogen content in soil before sowing was varied 113 kg ha^{-1} to 166 kg ha^{-1} with mean of 132.04 kg ha^{-1}, while at harvest it was varied from 105 kg ha^{-1} to 221 kg ha^{-1} with a mean of 179.71 kg ha^{-1}. Among the

Table 1: Nutrient composition of organic manures used for experiment

Content (%)	FYM	PM	VC	PMC	Method	Reference
N	0.52	2.02	2.82	0.74	Micro kjeldhal method	(Piper,1966)
P	0.58	2.45	0.98	0.95	Wet digestion method	(Jackson,1973)
K	0.51	1.54	0.92	1.68	Wet digestion method	(Jackson,1973)

(FYM=Farm yard manure, PM=Poultry manure, VC=Vermicompost and PMC=Pressmud cake)

treatments, application of FYM recorded highest N, this might be due to mineralization and release of higher N to the soil labile pool during organic matter decomposition due to high enzymatic activities in soils increased transformation of nutrients to available form (Gopinath, *et al.*, 2009 [4] and Vidyavathi *et al.*, 2012) [16]. The results were similar to the findings of Singh *et al*. (2015) [13] in maize-wheat cropping sequence.

P content in all treatments were significantly superior over control. Available phosphorus content in soil before sowing was varied from 28 kg ha^{-1} to 67 kg ha^{-1}, while at harvest it was ranged from 26 kg ha^{-1} to 97 kg ha^{-1}. Among the treatments, poultry manure (T_4) recorded highest P content might be due to solubilization of insoluble phosphate in soil through release of various organic acids (Swarup and Yadhuvanshi, 2000) [15]. Similar results was reported by Onwu *et al*. (2014) [9].

Table 2: Effect of long term application of organic manures on soil available macronutrients (kg ha^{-1}) status before sowing and at harvest of groundnut crop

Treatments	Available N (kg ha^{-1})		Available P_2O_5 (kg ha^{-1})		Available K_2O (kg ha^{-1})	
	Before sowing	Harvest	Before sowing	Harvest	Before sowing	Harvest
T_1: Control	113	105	28	26	140	121
T_2: RDF	119	179	36	56	143	211
T_3: Vermicompost 2.5 t ha^{-1}	124	184	46	72	169	243
T_4:Poultry manure 4 t ha^{-1}	129	176	57	97	170	289
T_5:Farm yard manure 10 t ha^{-1}	141	221	51	77	191	310
T_6:Press mud cake 10 t ha^{-1}	166	200	67	82	210	348
GM	132.04	179.71	50.79	68.38	170.5	253.67
SE.m.±	2.09	16.17	1.98	2.74	3.36	8.81
C.D (p= 0.05)	6.30	48.73	5.97	8.25	10.14	26.56

Recommended dose of Fertilizer (RDF): 20:40:50 kg ha^{-1} N, P_2O_5, K_2O

All the treatments significantly increased potassium content over control. Available potassium content of field before sowing was ranged from 140 kg ha^{-1} to 348 kg ha^{-1}.This was due to potassium present in organic manures, on solubilization action certain organic acids produced during decomposition, where the fixation of potassium was minimized by complex formation with organic ligands and increased ammonium ions in soil. The results of the experiment are in accordance with the findings of Ghulam *et al*., (2010) [3].

Secondary Nutrients

Results indicated that continuous application of organic manures significantly increased secondary nutrients (Table.3). Among the treatments pressmud cake significantly increased Ca content in soil over control and RDF. This might be due to the fact that pressmud cake intially contain high Ca content, might have also solubilizing native Ca by effect of organic acids produced during decomposition increased the calcium availability in soil (Paul *et al*., 2005) [10]. The results are similar to the findings of Khan (2011) [6] in a wheat growing soils. Exchangeable Mg of field before sowing was ranged from 0.5 cmol (p+) kg^{-1} to 2.4 cmol (p+) kg^{-1} with a mean of 1.27 cmol (p+) kg^{-1}, while at harvest it was ranged from 0.3 cmol (p+) kg^{-1} to 3.1 cmol (p+) kg^{-1} with a mean of 1.71 cmol (p+) kg^{-1}. However higher magnesium content was recorded in poultry manure applied treatment compared to control and RDF. Available sulphur in soil is signigicantly higher in all treatments compared to control. Among various organic manures, pressmud cake recorded highest amount of sulphur. This might be due to contribution of sulphur from soil through microbial oxidation. Increased values of available sulphur with organics were reported by Sinha and Sakal (1993) [14] in groundnut.

Table 3: Effect of long term application of organic manures on soil secondary nutrients status before sowing and at harvest of groundnut crop

Treatments	Exchangeable Ca (cmol p^+ kg^{-1})		Exchangeable Mg (cmol p^+ kg^{-1})		S (mg kg^{-1})	
	Before sowing	Harvest	Before sowing	Harvest	Before sowing	Harvest
T_1: Control	2.5	2.3	0.5	0.3	6.2	5.9
T_2: RDF	2.4	2.7	0.8	1.3	6.5	6.8
T_3: Vermicompost 2.5 t ha^{-1}	2.9	3.1	0.9	1.6	7.0	7.9
T_4:Poultry manure 4 t ha^{-1}	3.3	4.2	2.4	3.1	6.9	8.2
T_5:Farm yard manure 10 t ha^{-1}	3.5	4.5	1.1	1.6	8.1	8.5
T_6:Press mud cake 10 t ha^{-1}	3.9	4.7	1.9	2.4	11.0	11.5
GM	3.08	3.55	1.27	1.71	7.64	8.13
SE.m.±	0.20	0.26	0.18	0.23	0.22	0.20
C.D (p= 0.05)	0.60	0.78	0.54	0.69	0.65	0.61

Recommended dose of Fertilizer (RDF): 20:40:50 kg ha^{-1} N, P_2O_5, K_2O

DTPA Extractable Micronutrients

DTPA extractable micronutrients (Zn, Mn, Fe and Cu) in soil before sowing and at harvest of crop was presented in Table.4. Available zinc content in soil before sowing was ranged from 3.13 mg kg^{-1} to 4.37 mg kg^{-1} with a mean of 3.69 mg kg^{-1}, while at harvest of crop was varied from 2.89 mg kg^{-1} to 4.94 mg kg^{-1} with an average of 3.98 mg kg^{-1}. All treatments significantly increased zinc content over control. Among the treatments FYM recorded highest Zn content because of the complexing properties of FYM might have prevented precipitation and fixation of Zn and increased its availability in soil. Similar results were also reported by Mathur (1997) [8] in a long term experiment in sandy loam soils.

Furthermore results showed that the available manganese content in the soil was significantly affected by organic manures compared to control. The Mn content in the soil was ranged from 6.30 mg kg^{-1} to 9.20 mg kg^{-1} with a mean of 8.04 mg kg^{-1}, while at harvest it was varied from 6.02 mg kg^{-1} to 10.40 mg kg^{-1} with a mean of 8.88 mg kg^{-1}. Among the treatments, pressmud cake (T_6) recorded higher values of manganese compared to other manures. The reduced soil pH in this treatment might have increased solubility of Mn ultimately and its availability in soil. The results were in accordance with findings of Mathur (1997)[8] in a long term experiment in sandy loam soils.

Table 4: Effect of long term application of organic manures on soil DTPA-extractable macronutrients (mg kg^{-1}) before sowing and at harvest of groundnut crop

Treatments	Zn (mg kg^{-1})		Mn (mg kg^{-1})		Fe (mg kg^{-1})		Cu (mg kg^{-1})	
	Before sowing	Harvest	Before sowing	Harvest	Before sowing	Harvest	Before sowing	Harvest
T_1: Control	3.13	2.89	6.30	6.02	5.42	4.50	0.45	0.42
T_2: RDF	3.45	4.01	8.35	8.51	6.16	6.42	0.40	0.57
T_3: Vermicompost 2.5 t ha^{-1}	3.21	3.52	8.10	9.34	5.64	6.48	0.54	0.65
T_4:Poultry manure 4 t ha^{-1}	4.10	4.24	7.38	8.93	5.85	6.56	0.52	0.59
T_5:Farm yard manure 10 t ha^{-1}	4.37	4.94	9.20	10.10	6.40	7.89	0.67	0.78
T_6:Pressmud cake 10 t ha^{-1}	3.90	4.30	8.9	10.40	6.27	6.94	0.64	0.73
GM	3.69	3.98	8.04	8.88	5.96	6.42	0.53	0.62
SE.m.±	0.05	0.09	0.62	0.19	0.05	0.13	0.04	0.01
C.D (p = 0.05)	0.17	0.26	1.87	0.58	0.14	0.38	0.12	0.04

Recommended dose of Fertilizer (RDF): 20:40:50 kg ha^{-1} N, P_2O_5, K_2O

Highest available iron content was observed in FYM treatment than control and RDF. Addition of organics might have increased microbial populations in turn these microbes helped in release of chelating agents, which have prevented micronutrient from precipitation, oxidation and leaching (Bellakki and Badanur, 1997) [1]. The results of the present investigation are in accordance with the findings of Rangaraj *et al*. (2007) [12] who observed effect of organic wastes on soil available iron.

Available copper content in soil before sowing was varied from 0.40 mg kg^{-1} to 0.67 mg kg^{-1} with a mean of 0.53 mg kg^{-1}, while at harvest of the crop was ranged from 0.42 mg kg^{-1} to 0.78 mg kg^{-1} with a mean of 0.62 mg kg^{-1}. Continuous application of all these organic manures significantly increased the Cu content. Increased available Cu with increased organic carbon content was reported by Chhabra *et al.* (1996) [2] and was attributed to the formation of Cu-chelates.

Conclusion

The results obtained revealed that groundnut crop grown on red sandy loam soils responds well to the application of various organic manures. The long term application of organic manures has a significant effect on available nutrient status in soil (N, P, K, Ca, Mg, S, Zn, Mn, Fe, Cu). Among the manures pressmud cake and FYM was found to be more effective in supplying all the essential nutrients in sufficient amounts in balanced ratio during crop growth and resulted in better yield.

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