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Influence of Different Sources of Nutrients on Physico-chemical and Physical Properties of Soil in Rice Crop

Mohana Rao Puli, P R K Prasad, P Ravindra Babu, K L Narasimha Rao and G Subbaiah
Department of Soil Science and Agricultural Chemistry, Agricultural College, Bapatla 522 101, A P

ABSTRACT

A field experiment was conducted for two consecutive years (2011-2012 and 2012-2013) on fine texture soils of Agricultural college farm, Bapatla. The experiment was laidout in a randomized block design in *kharif* season with four treatments and replicated five times. The treatments consisted of M_1 (RDF - Control), M_2 (10t FYM ha^{-1} + RDF), M_3 (1.5t vermicompost ha^{-1} + RDF), M_4 (Green manuring + RDF). Data collected on soil properties after harvest of rice crop viz., physic – chemical properties and physical properties were relatively improved with the application of 100%NPK in combination with FYM @10t ha^{-1}. However, it was on par with that of green manuring together with 100% NPK during both the years of the study.

Key words : Organic sources, Physico-chemical properties and Physical properties

The balanced fertilization through integrated use of manures and fertilizers has been found useful in various crops. In order to investigate the influence of different sources of nutrients on soil properties in rice crop on fine textured soil.

MATERIAL AND METHODS

Experiment was conducted in the field number 49A and 49B of the Agricultural College Farm, Bapatla, during the years 2011-12 and 2012-13, respectively. Prior to preparatory cultivation of the experimental site, soil samples from 0 to 15 cm depth were collected at random and a composite soil sample during both the years was analyzed for different physico-chemical and physical properties. The results of the soil analytical data indicated that the experimental soil is clay and sandy clay during first and second year, respectively in texture, slightly alkaline in reaction, high in available phosphorus low in organic carbon (0.52 and 0.50% during first and second year, respectively) and available nitrogen (175.6 and 159.8kg ha^{-1} during first and second year, respectively), and (95.3 and 93.9 kg P_2O_5 ha^{-1} during first and second year, respectively) and potassium (960.0 and 925.6 kg K_2O ha^{-1} during first and second year, respectively).

The experiment consisted of four treatments *viz*., M_1 (RDF - Control), M_2 (10t FYM ha^{-1} + RDF), M_3 (1.5t vermicompost ha^{-1} + RDF), M_4 (Green manuring + RDF). The experiment is laid out in RBD and replicated five times. The recommended fertilizer dose was applied as 160:40:40 kg N, P_2O_5 and K_2O ha^{-1}. The organics applied in the study was analyzed before start of the experiment and results were given in the table 3 and 4

A popular super fine rice cultivar BPT 5204 (Samba Mashuri) was selected for *kharif* season. It is a cross between (GEB-24 x TN-1) and Mashuri. FYM and vermicompost were added 7 days before transplanting of rice on dry weight basis. Dhaincha crop was raised with the seed rate of 60kg ha^{-1} in individual plots and it was incorporated 7 days before transplanting of rice as green manure at flowering stage. Nitrogen was applied in the form of urea in three splits, first split at the time of transplanting, second split at 30 DAT and third split at 60 DAT. Phosphorus was applied in the form of SSP as basal dose before transplanting. Potassium was applied in the farm of MoP in two splits, first split as basal before transplanting and second split at 60 DAT.

Plot wise surface (0-15) soil sample were collected immediately after harvest of rice. The soil samples were air dried in shade, ground and screened through 2mm sieve and used for laboratory analysis. Soil reaction (pH) was measured by using glass electrode pH meter in 1:2.5 ratio of soil water suspension (Jackson, 1973), Conductivity is measured with supernant liquid of

1:2 soil water suspensions by using electrical conductivity meter (Jackson, 1973). To estimate the Cation exchange capacity (CEC) the procedure described by Bower *et al.* (1952) was followed. Bulk density was estimated by core method as per the procedure given by Dastane, 1967. Water holding capacity was estimated by Keen cup method as described by Sankaram (1966). Infiltration rate was estimated by double ring method as described by Black (1965).

RESULTS AND DISCUSSION

Soil reaction (pH)

Soil pH is the single soil characteristic, which elucidates an overall picture of the medium for plant growth including nutrient supply trend, fate of added nutrients, salinity/sodicity status, soil aeration and soil mineralogy.

In the present investigation the soil pH was assessed under various treatments during both the years. The pH of soil was not influenced statistically by various treatments. Sharma *et al.* (2007) also reported insignificant results in soil pH. The data presented in table 1 indicated that the use of manures and fertilizer slightly lowered the pH. These results were in conformity with the findings of Sarwar *et al.* (2008).

The addition of organics in the form of FYM @ 10t ha^{-1} green manuring and vermicompost 1.5t ha^{-1} could able to reduce or maintain the pH over initial value (7.57). Kumar and Singh (2010) after 6 cycles of rice-wheat observed the decreased soil pH from its initial value of 8.5 particularly when green manuring and organic manures were added. This could be ascribed to the release of organic acids during the process of decomposition of the organic compounds. Application of FYM, vermicompost and green manuring in combination with chemical fertilizer reduced the soil pH as compared to RDF after harvesting rice. Smiciklas *et al.* (2002) also observed a decrease in soil pH after the use of organic materials. The production of organic acids during mineralization of organic materials by heterotrophs and nitrification by autotrophs would have caused this decrease in soil pH (Sarwar *et al.* 2009).

Electrical conductivity

Data as regards the effect of various treatments on electrical conductivity during both the seasons are presented in table 1. Electrical conductivity varied from 0.46 to 0.52 and 0.40 to 0.45dS m^{-1} during 2011 and 2012, respectively.

Conspectus, the data pertaining to electrical conductivity indicated that electrical conductivity of all the treatments were increased over initial (0.39 and 0.41 in 2011 and 2012, respectively). The findings were in consonance with the results reported by Sharma *et al.* (2007).

Even use of organics showed higher values for electrical conductivity than initial but not much higher, which might probably be due to solubilising effect of organic acids on various compounds in soil. The decomposition of organic materials released acids or acid forming compounds that reacted with the sparingly soluble salts already present in the soil and either converted them into soluble salts or at least increased their solubility (Sarwar *et al.*, 2009). Similar results could also be quoted from the literature (Niklasch and Joergensen, 2001; Sarwar *et al.*, 2003) which indicated the EC increased in soil when organic materials of different nature were applied. But the increase in Soil EC was not much it might be due to good infiltration rate of soil which could able to mitigate the increase in soil EC. These results were in agreement with the findings of Tandon (2000).

Soil Physical Properties

Bulk density

Data as regards the effect of various treatments on physical properties of soil during both the seasons are presented in table 2 indicated that the treatment effect was non significant.

Bulk density varied from 1.27 to 1.31 and 1.26 to 1.31Mg m^{-3} during 2011 and 2012, respectively. The bulk density recorded in the treatment M_1 was increased over initial whereas, organic amended treatments were maintained the values of initial, which, might be due to deterioration of soil structure by inorganic fertilizer and under decomposition organic manure produced polysaccharides, polyuronoids, cellulose and humus, which were responsible for firm binding between soil particles, resulting in more stable aggregates

Table 1. Effect of different organics on physico-chemical properties of soil after harvest of rice.

Treatment	2011-2012			2012-2013		
	pH	EC (dSm^{-1})	CEC (cmol (p+) kg^{-1})	pH	EC (dSm^{-1})	CEC (cmol (p+) kg^{-1})
M_1 - RDF (Control)	7.68	0.52	42.12	7.86	0.45	34.32
M_2 - FYM 10t ha^{-1} + RDF	7.56	0.48	48.74	7.53	0.43	40.21
M_3 - Vermicompost 1.5t ha^{-1} + RDF	7.60	0.51	48.14	7.65	0.44	39.88
M_4 - Green manuring + RDF	7.20	0.46	48.44	7.65	0.40	39.56
Initial	7.57	0.39	43.45	7.88	0.41	33.60
SEm ±	0.247	0.024	1.526	0.182	0.025	0.969
CD (P: 0.05)	NS	NS	4.70	NS	NS	2.99
CV (%)	7.3	11.0	7.3	5.3	13.0	5.6

Table 2. Effect of different sources of nutrients on physical properties of soil after harvest of rice.

Treatment	2011-2012			2012-2013		
	pH	EC (dSm^{-1})	CEC (cmol (p+) kg^{-1})	pH	EC (dSm^{-1})	CEC (cmol (p+) kg^{-1})
M_1 - RDF (Control)	7.68	0.52	42.12	7.86	0.45	34.32
M_2 - FYM 10t ha^{-1} + RDF	7.56	0.48	48.74	7.53	0.43	40.21
M_3 - Vermicompost 1.5t ha^{-1} + RDF	7.60	0.51	48.14	7.65	0.44	39.88
M_4 - Green manuring + RDF	7.20	0.46	48.44	7.65	0.40	39.56
Initial	7.57	0.39	43.45	7.88	0.41	33.60
SEm ±	0.247	0.024	1.526	0.182	0.025	0.969
CD (P: 0.05)	NS	NS	4.70	NS	NS	2.99
CV (%)	7.3	11.0	7.3	5.3	13.0	5.6

Table 3. Nutrient content in organics applied during 1st year (2011-12).

Organics	%C	%N	$\%P_2O_5$	$\%K_2O$	%Ca	%Mg	Fe (ppm)	Mn (ppm)	Cu (ppm)	Zn (ppm)	C:N
FYM	26.60	0.71	0.25	0.54	0.90	0.50	1100	208	10	70	35.47
Vermi compost	12.54	1.80	0.81	0.72	2.38	0.67	627	262	180	45	6.97
Dhaincha	36.50	3.40	0.41	2.07	1.60	0.25	1008	144	22	42	10.74

Table 4. Nutrient content in organics applied during 2nd year (2012-13).

Organics	%C	%N	$\%P_2O_5$	$\%K_2O$	%Ca	%Mg	Fe (ppm)	Mn (ppm)	Cu (ppm)	Zn (ppm)	C:N
FYM	26.00	0.65	0.20	0.74	0.84	0.47	1202	200	14	79	40.63
Vermi compost	13.00	1.80	0.79	0.81	2.29	0.67	651	275	207	56	7.22
Dhaincha	40.00	3.30	0.40	2.67	1.63	0.25	1120	142	20	49	12.12

and porosity causing decline in bulk density (Bellakki and Badanur, 1997).

Water holding capacity (WHC)

WHC of the soils varied from 45.50 to 46.98% and 38.82 to 40.95% during first and second years of study, respectively and did not vary significantly among the treatments (Table 2). The increase in WHC was mainly due to decrease in bulk density due to organic manure amended treatments (Talathi *et al.* 2010).

Water holding capacity (WHC) of soil after harvest of rice increased over initial value during both the years of study except M_1 during second year of the study. The WHC was the highest (46.98 and 40.92% in 2011 and 2012, respectively) in plots receiving 100% NPK + FYM. This could be ascribed to the improvement in structural condition of soil due to the application of FYM with inorganics (Selvi *et al.* 2005). The higher WHC of the added organic matter in turn might have increased the WHC of soil.

Infiltration rate

Perusal of the data presented in the table 2 revealed that infiltration rate increased but not at significant level with integrating organic manures with chemical fertilizers. Integrated nutrient management during rice season had marked influence on the infiltration rate. It increased to as high as 19.64 and 20.78 mm hr^{-1} in the treatment M_2 from the initial value of 17.50 and 19.5mm hr^{-1} during first and second year respectively. These results were in agreement with the findings of Bajpai *et al.* (2006). This could be due to improvement in soil structure and formation of channels after the decay of roots of the green manuring crop (Sharma *et al.*, 1987).

Conclusion

Residual fertility status of soil in terms of Physico chemical (pH, EC, CEC), physical properties (Bulk density, Water holding capacity and infiltration rate) after harvest of rice crop was relatively improved in the treatments those received organics along with 100% NPK imposed than that of 100% NPK alone.

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