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Effect of Integrated Nutrient Management on Soil Fertility after Kharif Rice (Oryza sativa L.)

K. Shanthi[1*], P. Chandrasekhar Rao[2]

[1]Dept., of Agri., Science, Loyola Academy (Degree & P.G College), Alwal, Secunderabad – 500 010, India
[2]Dept., of Soil Science and Agricultural Chemistry, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad – 500 030, India

***Corresponding Author –** shanthi.kuchibhatla@gmail.com

ABSTRACT

The present investigation entitled "Effect of integrated nutrient management on soil fertility after Kharifrice (Oryza sativa L.)" was conducted at farmer's field, Devaryamjal village, near Hakimpet, Rangareddy district, Telangana during Kharif season 2014 to evaluate the use of inorganic fertilizers and organic manures on growth & yield.The experiment was laid out in randomized block design (RBD) with 11 treatments, each replicated 3 times. The treatments consisted of control (T_1), 100% RDFN (T_2), 75% RDFN + 25% N through VC, PM and FYM (T_3, T_6, T_9), 50% RDFN + 50% N through VC, PM and FYM (T_4, T_7, T_{10}), 100% RDN through VC, PM and FYM (T_5, T_8, T_{11}). Soil analysis revealed that treatment T_2 (100% RDFN) recorded lower values of Organic Carbon, available Nitrogen, Phosphorus and Potassium when compared to treatments which received 100% RDN through organic manures (T_5, T_8 and T_{11}). Among all the treatments, treatment T_5 (100% RDN – VC) recorded highest values of Organic Carbon (0.64%), available Nitrogen (285.8 kg ha^{-1}), Phosphorus (31.6 kg ha^{-1}) and Potassium (326.2 kg ha^{-1})

Keywords: Rice, INM, Organic Carbon, Available Nitrogen, Phosphorus, Potassium

INTRODUCTION

Rice is an important global food crop. Approximately 3 billion people depend on rice for survival and a high and stable rice yield is an important factor in human food security worldwide. Soil provides most of the nutrients including nitrogen, phosphorus, potassium and all minor nutrients required for sustained growth of crops. Fertilization is an effective way of improving soil fertility and increasing crop production. However incorrect fertilization can lead to decline in soil health and crop yield as well as series of environmental problems such as green house gas emissions and agricultural non-point source pollution (Wei and Ma, 2015). On one hand organic manures effectively increase crop yields and improve soil quality, but there are disadvantages such as low nutrient content, low efficiency, high application rate and no significant effect on increasing yield (Guo et al., 2016). On the otherhand inorganic fertilizers rapidly increase yield, have high nutrient content and are required in low quantities. In contrast to the disadvantages of organic manures and inorganic fertilizers when applied alone, their combination can not only improve soil fertility but also promote high and stable crop yields (Rui et al., 2015). In view of the above an experimental study has been taken up to study the effect INM on soil fertility.

MATERIALS & METHODS

The present investigation entitled "Effect of integrated nutrient management on soil fertility after Kharifrice (Oryza sativa L.) (Oryza sativa L.) was conducted at farmer's field, Devaryamjal village, near Hakimpet, Rangareddy district, Telangana during Kharif seasons 2014 and 2015 to evaluate the use of inorganic fertilizers and organic manures on soil available nutrient status.It is situated at an altitude of 536 m above mean sea level, $17^0 23^{`}$ N latitude and $78^0 28^{`}$ E longitude. It is classified as Southern Telangana agro-climatic zone of Telangana State. The experiment was laid out in randomized block design (RBD) with 11 treatments, each replicated 3 times. The treatments consisted of control (T_1), 100% RDFN (T_2), 75% RDFN + 25% N through VC, PM and FYM (T_3, T_6, T_9), 50% RDFN + 50% N through VC, PM and FYM (T_4, T_7, T_{10}), 100% RDN through VC, PM and FYM (T_5, T_8, T_{11}). Soil of the experimental field is a sandy clay loam (ultisol), slightly alkaline in reaction (pH : 7.60), non saline (EC : 0.39 dS m^{-1}), medium in organic carbon (0.51%), low in available N (235 kg ha^{-1}), medium in available P_2O_5 (23 kg ha^{-1}) and high in available K_2O (304 kg ha^{-1}). Rice (BPT 5204) was test crop grown during Kharif season with RDF applied as N : P_2O_5: K_2O @ 120 : 60 : 40 kg ha^{-1}. A uniform dose of 60 kg ha^{-1} P_2O_5 and 40 kg ha^{-1} K_2O was applied as basal to all the plots. The soil samples were collected from each plot treatment wise after harvest during 2014 and 2015 Kharif and average values were tabulated. The soil samples were analysed by following standard procedures. Organic carbon (%) was analysed by wet digestion method (Walkley and Black, 1934), available nitrogen (kg N ha^{-1}) by alkaline potassium permanganate method (Subbiah and Asija,

1956), available phosphorus (kg P_2O_5 kg^{-1}) by Olsen's method (Olsen et al., 1954),available potassium (kg K_2O ha^{-1}) by Neutral normal Ammonium acetate method (Jackson, 1973)

RESULTS AND DISCUSSION

Effect of integrated nutrient management on soil fertility after Kharifrice.

The data presented on chemical properties of soil viz., organic carbon, soil available nitrogen, phosphorus and potassium are presented in the Table 1.

Organic carbon, available nitrogen, phosphorus and potassium contents of soil after harvest of rice were significantly influenced by INM treatments. Conjunctive use of fertilizers with organic manures rendered the soil to retain substantially large quantities of N, P, K than their initial nutrient status.

Organic Carbon (%)

The organic carbon content of the soil varied from 0.46 to 0.64% with a mean value of 0.57%. Maximum organic carbon content was recorded with treatments T_5 and T_8 which were on par with treatments T_4, T_7 and T_{11} and significantly superior with treatments T_1, T_2, T_3, T_6, T_9 and T_{10}.

Available Nitrogen (kg ha^{-1})

The available nitrogen varied from 211.5 to 285.8 kg ha^{-1} with a mean value of 258.1 kg ha^{-1} while initial value was 235.0 kg ha^{-1}. The treatment T_5 (100% RDN-VC) recorded maximum nitrogen content of 285.8 kg ha^{-1}which was on par with the treatments T_8 and T_{11} and significantly superior compared to rest of all other treatments. The minimum available nitrogen content was recorded with treatment T_1 (control).

Available Phosphorus – P_2O_5 (kg ha^{-1})

The mean available phosphorus contents of soil was 27.6 kg ha^{-1}. The range varied from 17.7 to 31.6 kg ha^{-1} while initial value was 23.0 kg ha^{-1}. Minimum and maximum values were recorded in T_1 (control) and T_5 (100% RDN-VC) respectively. The treatment T_2 (100% RDFN) recorded available phosphorus content of 21.9 kg ha^{-1}which was significantly lower that rest of all the treatments except T_1.

Available Potassium – K_2O (kg ha^{-1})

The available potassium varied from 286.3 to 326.2 kg ha^{-1} with a mean value of 315.1 kg ha^{-1} while initial value was 304.0 kg ha^{-1}. The treatment T_5 (100% RDN-VC) recorded maximum potassium content of 326.2 kg ha^{-1}which was on par with rest of INM treatments and significantly superior to treatments T_1 and T_2.

The lower values of OC, available N, $P_2O_5$and K_2O in 100% RDFN treatment (T_2) when compared to INM treatments i.e., the combined treatments at the time of harvest of rice may be attributed to the maximum utilization of applied nutrients by the crop which are in the most available form. However, the loss of N and fixation of P are less when organic alone, inorganic and organic sources are applied in combination. This is due to slow release of nutrients from organic sources. Among the other treatments OC, available N, P_2O_5& K_2O contents were more in treatments with higher level (100%) of organic N (T_5, T_8, T_{11}) than in the treatments with lower level (50%) of organic N (T_4, T_7, T_{10}) and 25% organic N (T_3, T_6, T_9).

The level of organic carbon (OC) is the indication of soil fertility and its production potential. OC is one of the most important fertility parameter that determines the quality of soils. The increase in OC might be due to addition of organic matter, subsequent decomposition of these materials might have resulted in enhanced organic C content of soil. Similar results were reported by (Barik et al, 2008, Virdia and Mehta, 2009).

The increase in available N due to application of organic manures (VC/PM/FYM) may be attributed to the release of nutrients as a result of decomposition of organic matter by increased microbial activity and also reduction in losses of N by forming organic mineral complexes. Further addition of N through organic manures will narrow down C/N ratio of organic manures which enhances rate of mineralization and results in rapid release of nutrients.

The results indicated that 100% N applied through organic manures had a significant positive influence on the status of available P. This may be due to production of organic acids during decomposition which might have solubilised the unavailable forms of P. The influence of organic anions on P availability can be ascribed to the phenomenon that the organic anions function as ligands which can increase occurrence of P in solution by replacing P sorbed at metal hydroxide surface through ligand exchange reactions or by dissolving metal oxide surfaces that sorb P or by complexing metals in solution and thus preventing precipitation of metal phosphates.

Decomposition of organic matter releases appreciable quantities of CO_2 which might have been responsible for increase in available P. The CO_2 released during decomposition of organic matter forms carbonic acid which solubilises certain primary minerals too.

Moreover applied organic matter forms a protective coating on sesquioxide and thus reduces phosphate fixing capacity of soil. Increase in available K_2O due to organic manures may be due to reduction of K fixation and release of K due to interaction of organic matter with clay besides addition of K to the available pool. These findings are in close agreement with the

findings of (Barik et al, 2008. Mithun Saha et al., 2007, Singh et al., 2005, Banik and Ranjita Bejbaruah, 2004, Bhikane et al., 2007).

The contents of available N, P_2O_5 and K_2O due to application of different manures were of the order VC > PM > FYM. VC showed superiority over PM and FYM even though it contained slightly lower contents of N, P and K than PM. This indicates that application of VC improves the availability of nutrients though it could not increase the total amounts of nutrients in the soil.

CONCLUSION

From the above discussion, it can be inferred that application of organic manures significantly increase the available N, P and K status of soil when compared to application of N solely through chemical fertilizer. This can be ascribed to slow decomposition of organic manures, which inturn increases nutrient availability through enhanced microbial activities, enzyme activity and release of nutrients from the exchange sites.

Table 1 Effect of integrated nutrient management treatments on soil fertility after *Kharif* rice

Treatments			Organic Carbon (%)	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})
T_1	-	Control (No RDFN)	0.46	211.5	17.7	286.3
T_2	-	100% RDFN	0.52	232.7	21.9	301.9
T_3	-	75% RDFN + 25% N-VC	0.55	250.4	28.4	316.4
T_4	-	50% RDFN + 50% N-VC	0.59	270.2	29.2	322.5
T_5	-	100% RDN-VC	0.64	285.8	31.6	326.2
T_6	-	75% RDFN + 25% N-PM	0.55	248.2	28.3	314.8
T_7	-	50% RDFN + 50% N-PM	0.59	267.5	28.9	320.3
T_8	-	100% RDN-PM	0.64	282.4	31.3	324.7
T_9	-	75% RDFN + 25% N-FYM	0.54	245.9	28.2	311.9
T_{10}	-	50% RDFN + 50% N-FYM	0.57	264.9	28.7	318.6
T_{11}	-	100% RDN-FYM	0.63	280.0	29.9	322.4
SEm±			0.02	5.2	1.25	6.3
CD (P=0.05)			**0.06**	**15.4**	**3.68**	**18.7**
CV (%)			6.50	3.5	7.81	3.5
Mean			**0.57**	**258.1**	**27.6**	**315.1**
Initial value			0.51	235.0	23.0	304.0
			medium	low	medium	high

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