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Influence of Nitrogen Management Practices on Uptake and Soil Nutrient Status in Rice (*Oryza sativa L.*)

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ABSTRACT

A field experiment was conducted for two consecutive years (2014-15 and 2015-16) on sandy clay loam soils at Regional Agricultural Research Station, Chintapalli, Visakhapatnam district, Andhra Pradesh to study the influence of integrated nitrogen management practices of rice on nitrogen uptake and post harvest soil available nutrients status. The experiment was laid out in randomized block design with three replications. The experimental results indicate that supply of 100% recommended dose of nitrogen through fertilizer and green manure *in-situ* has recorded the significantly higher nitrogen uptake and post harvest soil available nutrients in the soil. The next best treatment was 100% recommended dose of nitrogen through fertilizer + FYM @ 5 t ha^{-1}. The lowest values were recorded with 100% recommended dose of nitrogen through fertilizer alone.

Key words: *Integrated nitrogen, Nitrogen uptake, Post harvest soil available nutrients, Rice.*

The emerging food grain demand of 300 million tonnes by 2030 (Ganesh *et al*., 2012) to meet the requirement of burgeoning population depicts an important challenge in the present agricultural scenario. Green revolution of the 1960's that sustained for over 3 decades got jeopardized, and the future increase of food supplies must come primarily from crop intensification and enhanced productivity rather than through area expansion alone. Agricultural scientists on various forums have been emphasizing for improving soil productivity through diversified practices like organic farming, integrated nutrient management, and biodiversity. Rice productivity of 3 - 4 t ha^{-1} achieved with the application of nitrogen at the rate of 80-100 kg ha^{-1} during 1960's and to maintain the same level of productivity that dosage has been increased 3 - 4 times which is causing both soil and environmental degradation. Food security in terms of production totals is meaningless if the agricultural resource base that produces the gains itself is threatened. There are several reasons for decreasing trend in productivity, the major being the drastic decline in soil nutrients, particularly in areas where fertilizers are being used in increasing quantities year after year, without adequate supplementation of organic matter.Keeping in view, the present study was carried out to assess the soil fertility changes under various nitrogen management practices employed to rice.

MATERIALS AND METHODS

A field investigation was carried outat Regional Agricultural Research Station, Chintapalli Visakhapatnam district, situated at 17.6 °N latitude, 82.3 °E longitude and at an altitude of 839.0 m above the mean sea level in the High Altitude and Tribal Zone of Andhra Pradeshduring *kharif* 2014-15 and 2015-16. The soil of the experimental field was sandy clay loam in texture, slightly acidic with a pH of 6.3, low in organic carbon (0.33) and low in available nitrogen (180.6 kg ha^{-1})and high in available phosphorus (25.63 kg ha^{-1}) and available potassium (332.5 kg ha^{-1}). A total amount of 943.4 mm rainfall was received in 64 rainy days during 2014-15 and 1214.0 mm in 70 rainy days during 2015-16 period of investigation. The experiment was laid out in randomized block design with three replications. The treatments comprised of seven integrated nitrogen management practices *viz.,* T_1) 100% recommended dose of nitrogen (RDN) through fertilizer (FN_{100}), T_2) 125% recommended dose of nitrogen (RDN) through fertilizer (FN_{125}), T_3) 150% recommended dose of nitrogen (RDN) through fertilizer (FN_{150}), T_4) 100% RDN through fertilizer + FYM @ 5 tha^{-1} (FN_{100} + FYM N_{25}), T_5) 125% RDN through fertilizer + FYM @ 5 tha^{-1} (FN_{125} + FYM N_{25}), T_6) 100% RDN through fertilizer + BGA @10$kgha^{-1}$ (FN_{100}+BGA) and T_7) 100% RDN through fertilizer + Green manure *in-situ* (FN_{100} + GM). The recommended dose of nitrogen for rice is 80 kg N ha^{-1}. Three organic manures on equal nitrogen basis were applied to respective treatments. Farm yard manure was added to the soil and thoroughly incorporated, 15 days prior to transplanting of rice crop. Rice crop was transplanted on 23.07.2014 and 13.06.2015 during the period of two years of investigation.Blue green alga was applied in rice field at the rate of 10 $kgha^{-1}$ 10 days after transplanting.Sunhemp (*Crotalaria juncea*)

was sown @25 kg ha^{-1} before rice crop and incorporated at 50 days after sowing and decomposed for 15 days. The test variety of rice was MTU 1075 (Pushyami) and spacing of 20 X 10 cm was adopted. Plant samples were collected to estimate the nitrogen uptake at periodical intervals during the crop growth *i.e.* at active tillering, Panicle initiation, flowering and harveststageof rice crop. The oven dried plant samples used for dry matter estimation were chopped and ground into fine powder using Willey mill and were analysed for N, P, K by adopting the standard procedures. Immediately after the harvest of the rice crops during both the annual cropping cycles, soil samples were drawn from individual plots from all the replications and analysed for available N, P and K by following standard procedures. Statistical analysis was done following the analysis of variance for randomised block design as suggested by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Nitrogen uptake

Nitrogen uptake estimated at various growth stages of rice *viz*., active tillering, panicle initiation, flowering was non-significant except at harvest by integrated nitrogen management practices during first year (2014-15) of study (Table 1). A steady and progressive increase in the nitrogen uptake was noticed with advance in age of the crop upto harvest.

Combined application of 100% RDN through fertilizer + green manure *in-situ* recorded significantly highest N uptake from active tillering to harvest stage of crop growth during second year (2015-16) of investigation, which was however comparable with the supply of 100% RDN through fertilizer + FYM @ 5 t/ ha. The treatments T_5, T_6, T_2 and T_3 did not differ among them but superior to T_1. Supply of 100% RDN through fertilizer (FN_{100}) has resulted in the lowest nitrogen uptake by rice, which was lower than any other N management practices, during both the years of study.

The higher N uptake with FN_{100}+ GM and FN_{100} + FYM_{25} might be due to increased supply of N accruing directly through organic and inorganic sources to the crop, as well as, due to the indirect effect resulting from reduced loss of nutrients in the presence of organic matter. With judicious application of organic matter, the fixing of nutrients subjected to chemical fertilizer application could be reduced and moreover combined application of organic and inorganic nutrients can sustain soil fertility. Integrated use of organic manures and inorganic fertilizer sources are effective in arresting the loss of available nitrogen. Similar results were also reported by Manish kumar *et al*., (2003), Singh *et al.,* (2006), Ubaid Khan *et al*., (2006), Senthivelu and Surya Prabha (2007) and Kavitha *et al*., (2008).

Post harvest soil available nitrogen:

The availablenitrogen status in soil after *kharif* rice was significantly influenced by integrated nitrogen management practices. The highest soil available N after harvest of rice (268.7 kg ha^{-1} and 263.3 kg ha^{-1} in 2014 and 2015, respectively) was recorded with application of 100% RDN through fertilizer and green manure *in-situ* (FN_{100}+GM), however it was on a par with those that received 100% RDN through fertilizer + FYM @ 5 t ha^{-1} (FN_{100}+FYM_{25}) and 125% RDN through fertilizer + FYM @ 5 t ha^{-1} (FN_{125}+FYM_{25}), but significantly superior to 100% RDN through fertilizer + BGA, 125% RDN through fertilizer (FN_{125}) and 150% RDN through fertilizer (FN_{150}). Supply of 100% RDN through fertilizer (FN_{100}) recorded the lowest soil available nitrogen which was significantly inferior to all the other N management practices during both the years of study.

The highest soil available N in the treatments where both organic and inorganic sources of N were used might be due to enhanced multiplication of microbes with *in-situ* green manuring or FYM incorporation and conversion of organic bound N to inorganic form. The favourable soil conditions due to application of organic sources of N might have helped in mineralization of soil N leading to the buildup of higher available nitrogen. These results are in accordance with the findings of Vinay Singh (2006) and Upadhyay *et al*., (2011).

Post harvest soil available phosphorus status:

Significantly maximum soil available phosphorus was found with FN_{100}+GM during first year (2014-15) of study, but was non significant during second year (2015-16) of experimentation. Supply of 100% RDN through fertilizer (FN_{100}) recorded the lowest soil available phosphorus during both the years of study. Increase in available P with FN_{100}+GM during 2014-15 might be due to P solubilising capacity of green manure. Organic acids and CO_2 liberated during the decomposition of green matter might have formed complex substances with metal ions and increased the concentration of phosphorus. Similar results were reported by Mahadev Pramanick *et al.,* (2007).

Post harvest soil available potassium:

Combined supply FN_{100}+GM has recorded highest soil available potassium during 2015-16, which was superior to all other treatments, but distinctly superior to 125% RDN through fertilizer (FN_{125}) and 150% RDN through fertilizer (FN_{150}). However, the difference among the combinations of FN_{100} + $FYM_{25,}$ FN_{125} + FYM_{25} and FN_{100} + BGA was not statistically significant. Supply of 100% RDN through fertilizer (FN_{100}) was significantly inferior to all other N

Table 1: Nitrogen uptake (kg ha^{-1}) of rice as influenced by integrated nitrogen management practices during Kharif2014 and 2015

Treatments	2014-15				2015-16			
	Active Tillering Stage	Panicle Initiation Stage	Flowering Stage	Harvest Stage	Active Tillering Stage	Panicle Initiation Stage	Flowering Stage	Harvest Stage
T_1 FN_{100}	39.5	66.4	96.4	107.6	41.1	68.4	91.1	100.9
T_2 FN_{125}	40.2	70.1	100.5	114.2	42.4	70.5	100.1	106.3
T_3 FN_{150}	42.3	74.1	100.8	108.4	41.2	71.1	98.9	104.9
T_4 $FN_{100+}FYM_{N25}$	44.5	76.8	103.8	122.6	47.9	77.9	103.2	118.5
T_5 $FN_{125+}FYM\ N_{25}$	44.5	72.2	102.2	120.4	43.9	72.4	105.1	116.5
T_6 FN_{100} + BGA	42.1	72.8	102.1	116.4	45.2	71.1	101.1	113.7
T_7 FN_{100} + GM	47.3	79.8	105.1	128.4	48.6	78.5	107.9	121.1
SME±	1.79	3.24	3.29	4.22	1.73	2.13	3.03	3.65
CD(P=0.05)	NS	NS	NS	13.01	5.34	6.56	9.35	11.25
CV (%)	7.21	6	5.59	6.26	6.78	5.06	5.2	5.66

Table 2: Post Harvest soil fertility status (Kg ha -1) after rice (kharif) as influenced by intigrated nitrogen management practices during kharif 2014 and 2015

Treatments	2014-15			2015-16		
	N	P	K	N	P	K
Initial status	180.6	25.63	232.5	250.2	35.4	314.7
After Kharit						
T_1 FN_{100}	190.1	38.5	260.8	183.3	39.9	316.4
T_2 FN_{125}	226.9	41.1	261.9	213.3	47.8	329.7
T_3 FN_{150}	195.4	43.5	267.0	190.0	46.2	327.2
T_4 $FN_{100+}FYM_{N25}$	264.4	46.1	291.7	26.0	49.1	345.8
T_5 $FN_{125+}FYM\ N_{25}$	249.1	45.6	279.4	226.7	48.9	344.9
T_6 FN_{100} + BGA	205.8	45.0	274.0	196.7	45.9	344.5
T_7 FN_{100} + GM	268.7	46.2	312.1	263.3	53.5	367.7
SME±	12.7	2.68	14.5	9.69	2.63	14
CD(P=0.05)	39.1	8.27	NS	29.8	NS	43.1
CV (%)	9.63	7.77	9	7.61	9.61	7.12

management practices, which resulted in the lowest soil available potassium status in both the years of study.

Application of green manuring registered significantly higher K availability in soil due to easy decomposition of mineral constituents and their effect on dislodging the exchangeable K in to the soil solution. These results are in conformity with those of Maiti *et al*., (2006) and Sathesh Kumar *et al*., (2007).

CONCLUSION

From the above study, it can be concluded that the nitrogen uptake by rice crop can be enhanced and post harvest soil NPK status can be improved by the integrated use 100% recommended dose of nitrogen supplied through fertilizer and green manure *in-situ* to rice crop during *kharif* season.

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