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Effect of Integrated Nitrogen Management on Growth Components, Yield and Nutrient uptake of rice

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ABSTRACT

An experiment was conducted at Agricultural College Farm, Bapatla, during *kharif* 2015-16 to study the integrated nitrogen management practices in transplanted rice on growth, yield and nutrient uptake by the crop. Organic manures *viz*., poultry manure, FYM and neemcake were used in this experiment. Among all the treatments tested combined application of inorganic fertilizer and poultry manure @ 125 per cent RDN recorded significantly highest growth components yield and nutrient uptake of rice which was statistically at par with 125 and 100 per cent RDN through inorganic fertilizers alone.

Key words*: Growth, Nutrient uptake Organic manures, Transplanted rice, Yield.*

Rice (*Oryza sativa* L.) is the prime source of food for nearly half of the world's population and it is one of the most important food crops, that play a key role for food security. In India, it is cultivated in an area of 43.86 M ha with a production of 105.80 million tonnes and productivity of 2.7 t ha^{-1}. In Andhra Pradesh, it is grown in an area of 38.09 L ha with a production of 11.56 M t and productivity of 2.9 t ha^{-1} (Ministry of Agriculture, Government of India, 2014-2015). Among the various factors known to augment the crop production, fertilizer aided with suitable agronomic practices play a pivotal role to boost up the crop yield. Nitrogen, an essential primary nutrient promotes the growth and development and also influences the availability of other nutrients. Indiscriminate use of high analysis chemical fertilizers is leading to development of several problems like decline in soil organic matter, increase in salinity, soil pollution and reduction of soil productivity (Chakraborthi and Singh, 2004). At this juncture, as rice is important food crop, it is necessary to reduce the use of chemical fertilizers by following management strategies like combined use of organic and inorganic sources of nutrients.

MATERIAL AND METHODS

A field experiment was conducted at Agricultural College Farm, Bapatla during *kharif* 2015-16. Initial soil characteristics of the experimental site were: texture was clay, pH 7.70, electrical conductivity 0.42 dS m^{-1}, organic carbon 0.61 per cent, available nitrogen 240 kg ha^{-1}, available phosphorous 41 kg ha^{-1} and potassium 452 kg ha^{-1}. The treatments consisted of T_1 -75 per cent recommended dose of nitrogen i.e. 90 kg ha^{-1}, T_2 -100 per cent recommended dose of nitrogen i.e. 120 kg ha^{-1}, T_3 -125 per cent recommended dose of nitrogen i.e. 150 kg ha^{-1}, T_4 -50 per cent N of T_1 through inorganic fertilizer + 50 per cent N of T_1 through FYM, T_5 -50 per cent N of T_1 through inorganic fertilizer + 50 per cent N of T_1 through poultry manure, T_6 -50 per cent N of T_1 through inorganic fertilizer + 50 per cent N of T_1 through neemcake, T_7 -50 per cent N of T_2 through inorganic fertilizer + 50 per cent N of T_2 through FYM, T_8 -50 per cent N of T_2 through inorganic fertilizer + 50 per cent N of T_2 through poultry manure, T_9 -50 per cent N of T_2 through inorganic fertilizer + 50 per cent N of T_2 through neemcake, T_{10} -50 per cent N of T_3 through inorganic fertilizer + 50 per cent N of T_3 through FYM, T_{11} -50 per cent N of T_3 through inorganic fertilizer + 50 per cent N of T_3 through poultry manure, T_{12} -50 per cent N of T_3 through inorganic fertilizer + 50 per cent N of T_3 through neemcake. The experiment was replicated thrice using randomized block design. Nitrogen content of FYM, poultry manure and neemcake was 0.5 per cent nitrogen, 1.5 per cent and 1.8 per cent, respectively used as organic sources and these

Table 1. Growth components and yield of rice as influenced by combined use of organics and inorganics in transplanted rice.

Treatments	Plant height at maturity (cm)	Total number of tillers m^{-2} at maturity	Grain yield (kg ha^{-1})
T_1	66.5	267	3313
T_2	98.8	460	5530
T_3	100.0	473	5604
T_4	58.0	227	2641
T_5	59.4	240	2752
T_6	60.5	243	2835
T_7	66.0	264	3180
T_8	76.5	332	4126
T_9	76.4	330	4024
T_{10}	77.7	335	4196
T_{11}	100.0	469	5680
T_{12}	88.4	398	4870
SEm±	3.38	20.9	224.9
CD (0.05)	9.9	61	660
CV (%)	7.5	10.8	10.0

were applied as per the treatment combinations ten days before transplanting. Fertilizers used were urea (46 % N), SSP (16 % P) and MOP (60 % K). Entire quantity of phosphorus (60 kg P_2O_5 ha^{-1}) and potassium (40 K_2O ha^{-1}) and one third of the N were applied as basal at the time of transplanting. Remaining N was applied in two equal splits, one at active tillering stage and the other at panicle initiation stage. Thirty two days old seedlings were transplanted in experimental plots keeping two seedlings per hill by adopting a spacing of 20 cm x 15 cm. Recommended agronomic practices and plant protection measures were followed. The rice crop was harvested in the second week of January.

RESULTS AND DISCUSSION

Growth components

In the inorganic treatments, significantly higher plant height and total number of tillers (Table.1) were recorded in T_3 treatment when compared to T_1 which was comparable with T_2 which might be due to the supply of sufficient quantity of N at peak growth stages and quick release of nutrients leading to more availability of nitrogen. Nitrogen is associated with increase in protoplasm, cell division and cell enlargement resulting in taller plants (Tisdale et *al*., 1985). Increased availability of nitrogen which would have created favorable environment in the rhizo-ecosytem of low land rice leading to increase in number of tillers m^{-2} and the chemical fertilizers offer nutrients which are readily soluble in soil solution and there by instantaneously available to plants. Similar results were also reported by Sujathamma and Srinuvasulureddy, (2004) and Vijayan and Krishnasamy (2014).

Increased growth components *viz*., plant height and total number of tillers m^{-2} recorded in poultry manure combination treatment T_{11} (Table.1) might be due to its higher content of N that was readily available to the crop and combined use of organic sources along with urea might have maintained the nitrogen status in soil throughout the crop growth resulting in quick vegetative growth leading to taller plants. The results are in agreement with the findings of Suvarnalatha and Sankararao (2001).

Table 2. Nutrient uptake (kg ha^{-1}) at harvest of rice as influenced by combined use of organics and inorganics in transplanted rice.

Treatments	Nitrogen uptake at harvest (kg ha^{-1})			Phosphorus uptake at harvest (kg ha^{-1})			Potassium uptake at harvest (kg ha^{-1})		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_1	40.4	23.5	63.9	37.4	18.3	55.7	22.9	83.4	106.3
T_2	62.7	42.9	105.6	55.5	29.5	85.0	37.6	117.3	154.9
T_3	64.3	43.3	107.7	56.6	30.4	87.0	38.6	119.8	158.4
T_4	30.8	19.2	50.0	28.8	12.5	41.3	14.2	80.3	94.5
T_5	31.9	19.9	51.8	30.8	13.7	44.5	15.5	82.6	98.1
T_6	30.7	21.8	52.5	32.0	15.1	47.1	17.0	84.1	101.1
T_7	38.7	24.8	63.5	36.7	17.8	54.5	22.3	88.7	111.0
T_8	49.2	30.8	80.0	45.9	23.4	69.3	30.7	100.7	131.4
T_9	48.6	30.7	79.4	45.0	22.6	67.6	29.2	99.8	129.0
T_{10}	50.3	31.2	81.5	46.2	23.7	69.9	30.5	102.2	132.7
T_{11}	65.0	43.0	108.0	56.3	30.3	86.6	38.9	118.8	157.7
T_{12}	55.5	35.7	91.2	48.3	25.3	73.6	31.5	106.9	138.4
SEm±	2.40	1.91	-	2.39	1.44	-	1.94	3.45	-
CD (0.05)	7.0	5.6	-	7.0	4.2	-	5.7	10.1	-
CV (%)	8.8	10.9	-	9.5	11.4	-	12.2	6.0	-

Grain Yield (kg ha^{-1})

The grain yield of paddy was significantly influenced by the nitrogen management through combined application of organics and inorganics and the data on grain yield is presented in table. 1

Application of 125 per cent RDN (T_3) recorded the highest grain yield (5604 kg ha^{-1}) of rice, which was significantly superior to T_1 and on par with T_2 in the inorganic treatments tested. In the combination of organic and inorganic treatments, T_{11} recorded significantly the highest grain yield of 5680 kg ha^{-1} as compared to all other combination treatments. It was closely followed by 50 per cent N of T_3 through inorganic fertilizer + 50 per cent N of T_3 through neemcake (T_{12}) with 4870 kg ha^{-1}. The highest yield obtained with poultry manure combination might be due to quick decomposition, the nutrients present in the poultry manure were readily available to the crop, which might have resulted in increased yield attributes. The findings are in complete agreement with the findings of Vennila and Jayanthi (2007). Generally, poultry manure is acidic in nature and the experimental plot was slightly alkaline in condition which would have helped in increasing the availability of nutrients.

The lower grain yield recorded in treatments which received 75 per cent N *viz*., T_6, T_5 and T_4, might be due to less availability of nutrients at initial stages of crop growth period and unavailability of nutrients at later stages of crop growth.

Nutrient uptake (kg ha^{-1})

Maximum uptake of N, P and K were recorded with T_3 treatment followed by T_2 in the inorganic treatments and in the combination treatments T_{11} recorded the highest nutrient uptake. However these were,

on par with each other and proved significantly superior to the rest of the treatments. This might be due to greater mineralization and availability of nutrients at the initial stages. This superiority with these treatments might be attributed to ready availability of comfortable level of instantly usable nitrogen by rice crop, which would have created favorable environment of nitrogen nutrition in the ecosystem of low land rice. Such situation favors optimum nitrogen uptake by rice crop at different growth stages. Comfortable level of plant nitrogen content would have manifested elevated level of growth and yield structure, resulting in superior performance of rice crop (Sujathmma and Srinuvasulureddy, 2004). Increased supply of nutrients directly through organics and inorganics to the crop as well as indirectly through reducing the loss of nutrients from the soil solution resulted in better growth, higher biological yield as well as more nutrient concentration (Mohanty *et al.* 2013). These results are in conformity with the findings of Siddaram *et al.* (2011) and Gopakkali *et al.* (2012).

CONCLUSION:

It can be concluded that combined application of inorganic and organic source i.e poultry manure @ 125 per cent (at 50 per cent each) were more effective in realizing higher growth components, grain yield and nutrient uptake of rice followed by 125 and 100 per cent RDN through application of inorganics alone when compared to rest of the treatments tried.

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