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Effect of N, P and K Application on Growth and Yield of Machine Transplanted Rice

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ABSTRACT

A field experiment was conducted during *kharif* 2014 under canal irrigation at Andhra Pradesh Rice Research Institute & Regional Agricultural Research Station, Maruteru, West Godavari (Dist.) of Godavari agroclimatic zone, to study "Effect of N, P and K application on growth and yield of machine transplanted rice." The experiment was laid out in factorial randomized block design and replicated thrice. The results of the present investigation showed that application of graded levels of nitrogen only increased the growth, yield attributes and yield of rice but not with the application of phosphorus and potassium. Increase in level of nitrogen significantly increased the grain and straw yields of rice upto 120 kg N ha^{-1}.While, further increase to 150 kg N ha^{-1} resulted in significant reduction in yields. A significant interaction between N and K on yield attributes and yield (kg ha^{-1}) and rest of the interactions were remained non significant. Among the nutrient combinations tested, application of 120- 90-90 kg N-P_2O_5-K_2O ha^{-1} followed by 120- 90-60 kg N-P_2O_5-K_2O ha^{-1} for machine transplanted rice will be more beneficial in achieving higher grain yield and profitability.

Key words : Machine transplanted rice, Nutrient, N, P, and K, Rice, Yield.

Rice is the staple food for more than half of the world's population and plays a pivotal role in food security of many countries. More than 90% of the global production and consumption of rice is in Asia (IRRI, 1997). In India, rice is grown in an area of 45.5 M ha with annual production of 92.32 M t and a productivity of 2,185 kg ha^{-1} (Ministry of Agriculture, Directorate of Economics and Statistics, 2013-14). In Andhra Pradesh, rice is grown in an area of 41.9 lakh ha with a production of 97.46 lakh tonnes and a productivity of 2,930 kg ha^{-1} in *kharif* (Ministry of Agriculture, 2013-14).

The age old manual transplanting method is laborious and cumbersome. Machine transplanting in rice is found to be as an alternative technique to transplanting in irrigated and rainfed low lands, since it saves labour, time and energy as well as minimizes drudgery, early crop maturity, ensures efficient water use and benefit: cost ratio (Moorthy and Saha, 2002). This condition provides enough space for growth of the crop and further demands higher fertilizer dose which is the kingpin of agricultural inputs. As such appropriate recommendations for machine transplanted rice was not specified properly. Hence the present study highlights the fertilizer recommendations for machine transplanted rice crop.

MATERIAL AND METHODS

A field experiment was laid out at Andhra Pradesh Rice Research Institute & Regional Agricultural Research Station, Maruteru, West Godavari district in Godavari zone of Andhra Pradesh during *kharif* 2014. Maruteru is located at 81.44^0 E longitude, 26.38^0 N latitude, and at altitude of 5m above MSL. The soil of experimental field was sandy clay loam in texture, with pH 8.13, low in available nitrogen (188.2 kg ha^{-1}), medium in phosphorus (34.4 kg ha^{-1}) and high in available potassium (271.5kg ha^{-1}). The mean maximum and minimum temperatures during crop growth period ranged from 31.0 °C and 24.9°C respectively. The experiment was laid out in a factorial randomized block design with twelve treatments and replicated thrice. The treatments consisted of three levels of nitrogen (90, 120 and 150 kg N ha^{-1}), two levels of phosphorus (60 and 90 kg P_2O_5 ha^{-1}) and two levels of potassium (60 and 90 kg K_2O ha^{-1}) with a total of twelve treatments viz., 90:60:60 kg N, P and K ha^{-1} (T_1), 90:90:60 kg N, P and K ha^{-1} (T_2), 90:60:90 kg N, P and K ha^{-1} (T_3), 90:90:90 kg N, P and K ha^{-1} (T_4), 120:60:60 kg N, P and K ha^{-1} (T_5), 120:90:60 kg N, P and K ha^{-1} (T_6), 120:60:90 kg N, P and K ha^{-1} (T_7), 120:90:90 kg N, P and K ha^{-1} (T_8), 150:60:60 kg N, P and K ha^{-1} (T_9), 150:90:60 N, P

Table 1. Influence of graded levels nitrogen, phosphorus and potassium on growth, yield attributes and yield of machine transplanted rice.

Treatment	No. of tillers (m^{-2})	Drymatter accumulation (kg ha^{-1})	Productive tillers m^{-2}	No. of filled grains $panicle^{-1}$	Test weight (g/1000 grains)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	H.I. (%)
Nitrogen (Kg Ha^{-1})								
90	398	4609	250	132	19.2	5220	5735	48.6
120	472	6603	276	153	20.3	6687	7203	50.6
150	518	8623	257	141	20.9	6413	7148	47.6
Sem±	4.2	81.2	3.9	2.7	0.3	83.9	106.8	0.7
CD (P=0.05)	13	239	12	8	NS	246	314	NS
Phosphorus (Kg Ha^{-1})								
60	460	6645	256	142	20.0	6010	6587	48.7
90	466	6578	266	145	20.2	6203	6805	49.0
Sem±	3.4	66.1	3.8	2.2	0.25	68.5	87.2	0.6
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Potassium (Kg Ha^{-1})								
60	456	6410	262	139	19.9	6091	6439	49.0
90	468	6813	260	145	20.3	6123	6952	48.7
Sem±	3.4	66.1	4.7	2.2	0.25	68.4	87.2	0.6
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Interactions								
N X P								
Sem±	5.9	114.8	4.61	3.76	0.4	188.2	151.1	1.1
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
P X K								
Sem±	4.8	93.8	5.32	3.07	0.4	96.9	295.2	0.8
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
N X K								
Sem±	5.9	114.8	6.52	3.76	0.4	188.7	151.1	1.1
CD (P=0.05)	NS	NS	19	12	NS	348	443	NS
N X P X K								
Sem±	8.4	162.4	9.22	5.31	0.6	168.8	213.7	1.5
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	3.1	4.2	6.3	6.5	5.2	4.8	5.6	5.2

and K ha^{-1} (T_{10}), 150:60:90 kg N, P and Kha^{-1} (T_{11}) and 150:90:90 kg N, P and K ha^{-1} (T_{12}).

Variety MTU 1064 (Amara) was used as test variety. "YANMAR" 8 rowed transplanter was used for transplanting. Tray nursery was used to raise the seedling for transplanting. Normally, 80-85 trays are sufficient for one acre. Tray preparation with uniform density 150-180 grams/ tray is most important aspect of the nursery raising. This is to get uniform seedlings per hill and least (3) number of seedlings per hill. Moreover, uniform density is also necessary for clog free transplantation with machine. Based on the variety, 8-15 kg of seed is necessary. For small seeded varieties 8-10 kg, medium sized varieties 10-12 kg and for bold seeded varieties 12-15 kg of seed is sufficient.

The main field was ploughed with tractor drawn cultivator, puddled twice and perfectly levelled by a laser guided leveller. A thin film of water was maintained for smooth sliding of transplanter. Application of fertilizers in the form

of urea, single super phosphate (SSP) and muriate of potash (MOP) was done as per the treatments. Entire phosphorus was applied basally to all the treatments. Nitrogen was applied in 3 split doses of 50% basal and 25% each at active tillering and panicle initiation stages and potash supplied in two splits 50% at basal and 50% at panicle initiation stage. Need based field operations such as, weeding, irrigation and plant protection measures were taken as per requirement. Data were analyzed using ANOVA and the significance was tested by Fisher's least significance difference (p= 0.05).

RESULTS AND DISCUSSION

Growth parameters

In the present study, tiller production (m^{-2}) drymatter accumulation (kg ha^{-1}) significantly increased with graded levels of nitrogen only. However, interactions between the nutrients did not show any significant influence on tiller production as well as drymatter production. Highest number of tillers and drymatter accumulation was recorded with 150 kg N ha^{-1} which was significantly superior to 90 and 120 kg N ha^{-1}. The increase in tiller production and drymatter accumulation was due to increased nitrogen availability which is responsible for growth and further, machine transplanted conditions provide more space for profused tillering and hence, the higher drymatter accumulated. Similar results were also reported by Sheeja Raj *et al.* (2012) and Munnaf *et al.* (2014).

Yield attributes

The productive tillers m^{-2} and number of filled grains $panicle^{-1}$ are significantly differed with increased levels of nitrogen only but not with the levels of phosphorus and potassium as observed in case of growth parameters. The interaction between N and K productive tillers and number of filled grains per panicle with 150 kg N ha^{-1} and 60 kg K_2O ha^{-1} was significant which was on a par with 150 kg N ha^{-1} and 90 kg K_2O ha^{-1}. The effect of nitrogen on seed filling is a primary function of assimilate accumulation and in turn, facilitating higher N assimilation with adequate supply of photosynthates to grain. Number of productive tillers and filled grains per panicle were 120 kg N ha^{-1} than 150 and 90 kg N ha^{-1}. This was in conformity with Dutta *et al.* (2013). Test weight is mostly a genetically fixed factor by an individual variety and is not much influenced by nitrogen levels and further interaction effect had no significant effect on test weight as reported by Swarna *et al.* (2014).

Grain and straw yield (kg ha^{-1})

Graded levels of nitrogen had increased the grain and straw yields significantly. Higher grain yield (6687 kg ha^{-1}) was recorded with 120 kg N ha^{-1} which was on a par with 150 kg N ha^{-1} (6413 kg ha^{-1}). Higher straw yield (7203 kg ha^{-1}) was recorded with 120 kg N ha^{-1} which was on a par with 150 kg N ha^{-1} (7148 kg ha^{-1}). Significant influence of interaction between N and K only was observed but not in rest of the nutrient combinations. The results of the present investigation showed that increase in level of nitrogen significantly increased the grain yield of rice upto 120 kg N ha^{-1}. While further increase to 150 kg N ha^{-1} resulted in significant reduction in grain yield. Harvest index did not showed any influence by nutrient application. The increase in grain yield and straw yield was cumulative effect of improvement of all the yield attributing characters due to increased nitrogen application as reported by Balasubramanian (2002).

Conclusions

Application of graded levels of nitrogen only increased the grain and straw yields. Interaction between the nutrients N and K was only influenced the yield attributes, and yield of machine transplanted rice crop. Among the nutrient combinations tested, application of 120- 90-90 kg N-P_2O_5-K_2O ha^{-1} followed by 120- 90-60 kg N-P_2O_5-K_2O ha^{-1} for machine transplanted rice is more beneficial in registering higher grain yield.

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