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Effect of N, P and K Application on Yield and Nutrient Uptake 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 yield and nutrient uptake of machine transplanted rice." The results of the present investigation showed that application of graded levels of nitrogen only increased the growth, 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 yield (kg ha^{-1}) was recorded and rest of the interactions 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.

Key words: *Machine transplanted rice, yield, nutrient uptake, N, P, and K.*

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).United Nations General Assembly (UNGA) declared 2004 as "International Year of Rice" (IYR) whose theme is IYR 2004- "Rice is life"- reflects the importance of rice as primary food source and is drawn from an understanding that rice based systems are essential to everyone directly or indirectly for food security, livelihood improvement, cultural heritage and sustainable development.

The age old manual transplanting method is laborious and cumbersome. Machine transplanting in rice is found to be 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. There is a need to optimise N-P-K use ratio for a given region not only to maximise crop productivity but also to sustain it.

Accordingly, the need for evaluation and management of nutrients for its optimum recommended dose in machine transplanted rice is very much imperative. Hence the present study was conducted to know 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 an 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 randomized block design with factorial concept having 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 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 row 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% as basal and 50% at panicle initiation stage. Field operations such as, weeding, irrigation and plant protection measures were taken as per requirement. The uptake of N, P and K at harvest was calculated by multiplying the nutrient content with the dry matter at harvest and expressed as kg ha^{-1}. Data were analyzed using ANOVA and the significance was tested by Fisher's least significance difference (p= 0.05).

RESULTS AND DISCUSSION

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 ha^{-1}) and 120 and 90 kg N and K ha^{-1} (82.7). Similarly, significant interaction was observed where N and K that highest nitrogen uptake (89.8 kg ha^{-1}) was recorded in 120 and 60 kg N and K2O ha^{-1} respectively which was proved to be significantly superior to other treatments. This is because of the experimental soil is already have medium phosphorus availability and high in potassium and hence there was a positive interaction between N & P and N & K since nitrogen was applied externally. Similar, results were noted by Sandyarani *et al.* (2013).

Phosphorus Uptake (kg ha^{-1})

Grain uptake of phosphorus was increased with increased levels of N and K significantly but not with the levels of P. All the interactions between the nutrients were also found significant Highest phosphorus uptake (48.3 kg ha^{-1}) was recorded with 150 and 60 kg N and P2O5 ha^{-1} respectively followed by 150 and 90 kg N and P ha^{-1} (43.9 kg ha^{-1}). Similar, trend was observed with N and K where highest phosphorus uptake (51.6 kg ha^{-1}) was recorded in 150 and 60 kg N and K2O ha^{-1} respectively followed by 150 and 90 kg N and K2O ha^{-1} (40.6 kg ha^{-1}) respectively. The uptake was increased with increase in levels of nutrients which was apparent with yield attributes and yield. This might be due to combined effect of increased concentration and higher drymatter accumulation. The increase in the uptake of nutrients with the increasing doses of NPK might be owing to better availability of these nutrients of added and prolific root system developed by the balanced nutrient application, resulting in better absorption of water and nutrients as stated by Narendra Pandey *et al.* (2008).

Potassium Uptake (kg ha^{-1})

Grain uptake of potassium was increased with increased levels of N and P significantly but not with the levels of K. Highest potassium uptake was observed with 150 kg N ha^{-1} (45.0 kg ha^{-1}) and was significantly superior to 90 kg N ha^{-1} (31.3 kg ha^{-1}) and 120 kg N ha^{-1} (39.0 kg ha^{-1}). Potassium, which regulates various metabolic processes, is absorbed at a rate parallel to drymatter production but there is no marked translocation of this element from vegetative organs to the grains during ripening (Padmanabham *et al.,* 2006).

Addition of N P K fertilizers had a significant effect on the uptake of K by the grain

Table 1. Influence of nitrogen, phosphorus and potassium levels on yield and nutrient uptake (grain) of machine transplanted rice.

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	H.I. (%)	Nitrogen uptake (kg ha^{-1})	Phosphorus uptake (kg ha^{-1})	Potassium uptake (kg ha^{-1})
Nitrogen (kg ha^{-1})						
90	5220	5735	48.6	70.4	29.6	31.3
120	6687	7203	50.6	85.1	41.8	39.0
150	6413	7148	47.6	74.4	40.5	45.0
SEm±	83.9	106.8	0.7	3.2	0.6	0.6
CD (p=0.05)	246	314	NS	9.4	2.0	1.9
Phosphorus (kg ha^{-1})						
60	6010	6587	48.7	75.1	36.4	36.1
90	6203	6805	49.0	78.2	38.2	40.7
SEm±	68.5	87.2	0.6	2.6	0.5	0.5
CD (p=0.05)	NS	NS	NS	NS	1.6	1.6
Potassium (kg ha^{-1})						
60	6091	6439	49.0	74.4	37.4	38.7
90	6123	6952	48.7	78.8	37.3	38.2
SEm±	68.4	87.2	0.6	2.6	0.5	0.5
CD (p=0.05)	NS	NS	NS	NS	1.6	NS
INTERACTIONS						
N X P						
SEm±	188.2	151.1	1.1	4.5	0.9	0.9
CD (p=0.05)	NS	NS	NS	13.3	NS	2.8
P X K						
SEm±	96.9	295.2	0.8	3.7	0.7	0.7
CD (p=0.05)	NS	NS	NS	NS	2.3	2.3
N X K						
SEm±	188.7	151.1	1.1	4.5	0.9	0.9
CD (p=0.05)	348	443.0	NS	13.3	2.8	2.8
N X P X K						
SEm±	168.8	213.7	1.5	6.2	1.3	1.3
CD (p=0.05)	NS	NS	NS	NS	3.9	NS
CV (%)	4.8	5.6	5.2	12.0	6.3	6.0

influence of interaction between N and K only was observed but not in rest of the nutrient combinations. The results of the 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. This might be due to reductions in the productive tiller number and number of filled grains per panicle. Harvest index was not 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).

Nitrogen Uptake (kg ha^{-1})

Grain uptake of nitrogen was increased with increased levels of nitrogen significantly. Highest nitrogen uptake was observed with 120 kg N ha-1 (85.1 kg ha^{-1}) which was higher than 150 kg N ha^{-1} (74.4 kg ha^{-1}) which inturn, was in parity with 90 kg N ha^{-1} (70.4 kg ha^{-1}). However, the Phosphorus and potassium levels did not show any influence significantly N uptake.There was a significant interaction effect was observed between N & P and N & K but was not observed with P & K. Highest nitrogen uptake (88.1 kg ha^{-1}) was recorded in 120 and 60 kg N and P ha^{-1} respectively followed by 150 and 90 kg N and P ha-1 (82.9 kg

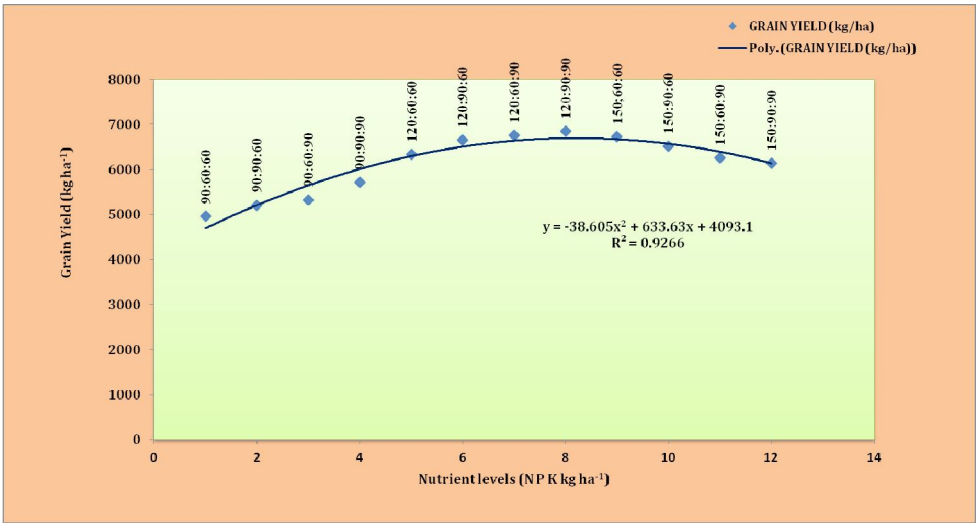

Fig. Response function of machine transplanted rice to N, P and K application.

and straw. The maximum amount of K was assimilated due to addition of N followed by P and K. It is therefore, evident that all the three fertilizer nutrients are essential for higher nutrient uptake by the rice crop. Similar results on N P K uptake were also Dutta *et al.* (2013).

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 machine transplanted rice crop. The multiple regression analysis between grain yield and N, P and K ($Y = 4093 + 633.6x - 38.60x^2$) with good estimate of coefficient of regression, $R^2 = 0.926$ revealed that the relationship was significant upto 120-90-90 kg N ha^{-1}. Hence, 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 in Maruteru area.

LITERATURE CITED

Balasubramanian P 2002 Response of hybrid rice (*Oryza sativa* L.) to levels and time of application of nitrogen. *Indian Journal of Agronomy,* 47 (2): 203-206

Dutta S Ghose T J and Dey P C 2013 Influence of potash levels on growth, yield, nutrient uptake and economics in irrigated summer rice of Assam *Oryza,*50 (4): 334-339

IRRI (International Rice Research Institute) 1997 *Annual report* 1996-97. Rice research: the way forward Los Banos. *International Rice Research Institute,* Philippines.

International Year of Rice 2004 Concept papers, International year of rice 2004. Food and Agricultural Organisation of United Nations

Moorthy B T S and Sanjoy Saha 2002 Bio-efficacy of certain new herbicide formulations in puddled-seeded rice *Indian Journal of Weed Science,* 34(1&2): 46-49.

Narendra Pandey Verma A K and Tripathi R S 2008 Evolution of different nutrient management practices on the performance of rice hybrid during dry season. *Oryza,* 44(4): 311-314

Padmanabham B Subbaiah G Mosha K and Seshagiri Rao M 2006 Plant density and N P K rates influence on the productivity of *rabi* rice M.Sc. (Ag) thesis submitted to Acharya N. G. Ranga Agricultural University (90-91)

Sandyarani K Malla Reddy M Uma Reddy R and Rao P V 2013 Influence of nitrogen and weed management on growth and yield of aerobic rice (*Oryza sativa* L.) *Journal of Research ANGRAU*, 41(1) 61-65

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