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Effect of Different N and P Levels on Yield, Nutrient Uptake and N Use Efficiencies of Transplanted Rice (*Oryza sativa* L.) Under Canal Command of Irrigated Eco Systems

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A B S T R A C T

A field experiment was conducted at Agricultural Research Station, kampasagar, Nalgonda, Telangana during *kharif* 2011 and *kharif* 2012 to study the response of transplanted rice to four levels of Nitrogen (0, 120,160 and 200 kg N ha^{-1}) and four levels of Phosphorous (0,30,60 and 90 kg ha^{-1}). The experiment was designed in Randomized Block Design and replicated thrice. 120 kg N ha^{-1} recorded significantly higher tiller and panicle number, more filled grains panicle^{-1} and 1000 grain weight than 0 kg N ha^{-1} and on par with other higher doses.120 kg N ha^{-1} recorded significantly higher grain yield (4750 kg ha^{-1} and 5388 kg ha^{-1}) than 0 kg N ha^{-1} (3647 and 3812 kg ha^{-1}) and it was comparable with 160 kg N ha^{-1} (4937 and 5514 kg ha^{-1}) and 200 kg N ha^{-1} (5015 and 5591 kg ha^{-1}). Phosphorous applied at different levels did not influence significantly on yield attributes and grain yield during both the years. NPK uptake was significantly higher at 120 kg N ha^{-1} than 0 kg N ha^{-1} and identical with other higher doses in straw and grain. High NNG and NPE were attained at 120 kg N ha^{-1} and above doses than control. Reverse trend of NUEPG was obtained with increase in N doses from 0 to 200 kg N ha^{-1}

Introduction

Rice (*Oryza sativa*) is one of the most important cereal crops of the world. There are 111 rice-growing countries in the world that occupies about 146.5 million hectares more than 90% is in Asia (Anonymous, 1999). It is the staple food for more than two billion people in Asia and many millions in Africa and Latin America. About 95% of the world rice is consumed in Asia (Rotshield, 1996). It occupies a pivotal place in Indian agriculture as it is a staple food for more than 70% of population and source of livelihood for about 120 to 150 million rural households.

It accounts for about 43% of food grain production in the country. Intensive wetland rice cultivation is a common farming practice in Asian countries like India. With the expansion of irrigation facilities and the introduction of HYV rice, the use of chemical fertilizers for rice production has increased substantially over the last four decades.

Nitrogen, phosphorous and potassium are the primary plant nutrients on which nitrogen plays an important role in growth and yield of rice plant and the demand of this nutrient is more than other nutrients (Brady and weil, 2012). Nitrogen is the major nutrient that most frequently limits the rice production and is the key input in nutrient management. Proper fertilization is an important management practice which can increase the yield of rice. Yield increase 70-80% of field rice could be obtained by the application of nitrogen fertilizer (IFC, 1982). In low land rice ecosystems in wet season, usually nitrogen use efficiency is approximately 30-40% (Ramakrishna *et al.,* 2007) and rest of 60-70% being lost by way of denitrification, ammonia volatilization, leaching, runoff and immobilization, which in turn contributes substantially to environmental pollution. Inadequate N application adversely affects the grain production. From previous studies it was found that rice had optimum growth and development with optimum N applied gave maximum filled grain percentage, 1000-grain weight, grain and straw yield (Peng *et al.*, 1996).

Judicious and proper use of fertilizers can markedly increase the yield and improve the quality of rice (yoshida, 1981). Phosphorous is essential nutrient for plant life. Without adequate supply of phosphorous plants cannot reach its maximum yield. However, rice farmers usually do not apply balanced doses of N, P, potassium (K), and other fertilizers. Management of soil P in intensive irrigated rice ecosystem has rather received less attention than increasing cropping intensity and new cultivars, irrigation and fertilizer N (Dobermann *et al.,* 1998). Removal of P has markedly increased with the higher yields of new systems involving improved germ plasm and intensive fertilization; particularly under high N application. In the early years of green revolution, crop responses to fertilizer P and K were marginal (De Datta and Mikkelsen, 1985). With continuous intensive cropping, P became first deficient nutrient as revealed in long-term experiments. Relationships between nutrient supply, nutrient uptake, tissue concentration and its use efficiency in rice have been well documented by Dobermann *et al.,* (1998) mostly on the basis of long term experiments conducted at IRRI. As revealed from surveys worldwide, intensification of agriculture always meant intensive use of inorganic fertilizers, mainly of N, while P and K back seated. This led to imbalanced nutrition and became a hurdle in obtaining significant response to added nutrients. Nutritional imbalances may also prevent new cultivars from expressing their full yield potential. Interaction among nutrients is also considered as a key factor in deciding the agronomic efficiency of added nutrients in irrigated rice. In a long-term experiment at IRRI, large-scale interactions between N and P were reported by De Datta *et al.,* (1988). Both N response ratio and agronomic efficiency of N decreased drastically due to imbalanced nutrition of P as manifested by decreased uptake of P.

A very few sporadic research studies were done under irrigated eco systems on effect of N and P on the yield, yield components and nutrient uptake of rice. Considering the above facts, the present experiment was undertaken to investigate the effect of N and P on the yield attributes, yield, and nutrient uptake of rice.

Materials and Methods

A field experiment entitled “Response of transplanted rice to different N and P levels under canal command of irrigated eco systems” was conducted at Agricultural Research Station, Kampasagar, Nalgonda district during *kharif* 2011 and *Kharif* 2012. The nursery of BPT 5204 a 145 duration variety was sown on 08-07-2011 and transplanted on 16-08-2011 during 1st year where as in 2nd year the sowing and transplanting dates were 20-07-2012 and 30-08-2012 respectively. The experimental soil was of sandy clay loam type with P^H of 6.9 and E C of 0.208 ds/m. The experiment was conducted in factorial RBD with 16 treatments combined with four N levels of 0, 120, 160 and 200 kg N ha^{-1} and four P levels 0, 30, 60 and 90 kg ha^{-1} and replicated thrice

The gross and net plot sizes of the treatments were 118.8 m^2 (12x9.9 m) and 104.16 m^2 (11.2x9.3 m) respectively during 2011 where as in 2012 the gross and net plot sizes were 50 m^2 (10x5 m) and 39.48 m^2 (9.4x4.2 m). A spacing of 20x15 cm was adopted with 2-3 seedlings per hill. N and P fertilizers were applied as per the treatments. Full dose of phosphorous, half dose of potassium and 1/3 rd of nitrogen was applied as basal, whereas remaining nitrogen was applied in two equal splits at tillering and panicle initiation stages. Along with last dose of nitrogen 20 kg K_2O ha^{-1} was also applied. The crop was managed well keeping free from weeds, pest and disease. Oxadiargyl was applied @ 90 g ha^{-1} 4th day after transplanting and further weed growth was checked by hand weeding at 20 and 35 days after transplanting. Irrigation, need based pest and disease management were done as per the recommendations.

Crop samples collected at harvest were utilized for chemical analysis. These samples were used for estimation for NPK content. Nitrogen was estimated by kelplus nitrogen analyser (Piper, 1966). Phosphorus was estimated by di acid digestion method (HNO_3 and $HCLO_4$ in the ratio of 9:1) and by using UV Visible spectro photo meter (Jackson, 1967). Potassium was estimated by di acid digestion method using Flame photometer (Jackson, 1967). The N, P and K contents were expressed as per cent. The N, P and K uptake was computed by multiplying the per cent content with grain and straw yield and expressed as kg ha^{-1}.

N Use Efficiency Indicators

N Needed by 100 kg Grain, NNG:

$$NNG= \frac{TN}{GY} x100$$

N Physiological Efficiency, NPE:

$$NPE= \frac{BIO}{GY}$$

N Use Efficiency of Producing Grain, NUEPG:

$$NUEPG= \frac{GY}{TN}$$

BIO is total aboveground dry weight on a dry weight basis (at 80°C),

TN is total plant N uptake at harvest time,

GY is grain yield

All of the above quantities expressed in kg ha^{-1}.

At harvest the yield and yield attributes were recorded and the data was analyzed statistically by the procedure outlined by Gomez and Gomez (1984).

Results and Discussion

Yield attributes

In both the years tiller number was significantly higher in 200 kg N ha^{-1} than the other N levels (Table 1). Tiller number was comparable between 120 and 160 kg N ha^{-1} and significantly higher than 0 kg N ha^{-1}. Hoque *et al.,* (2010) reported that 110 kg N ha^{-1} produced the highest number of tillers $hill^{-1}$ and 0 kg N ha^{-1} recorded the lowest total tillers $hill^{-1}$. The tiller number was comparable among 0, 30 and 60 kg P_2O_5 ha^{-1} and significantly higher than that of 90 kg P_2O_5 ha^{-1} during 2011. Where as in 2012 different P_2O_5 levels did not show any significant influence on tiller number.

During both the years, more number of panicles was recorded at 200 kg N ha^{-1}. It was significantly higher than 0 kg N ha^{-1} and 0 kg and 120 kg N ha^{-1} in 2011 and 2012 respectively. The panicle number recorded at 120 and 160 kg N ha^{-1} were on par with 200 kg N ha^{-1} during 2011, where as in 2012, the panicle number between 200, 160 kg N ha^{-1} and 120,160 kg N ha^{-1} were comparable. Enhanced tillering by increased nitrogen application might be attributed to more nitrogen supply to plant at active tillering stage and resulted in significantly higher number of panicles. Results are in conformity with the findings of Ombir singh *et al.,* (2007) who stated that increasing N application was effective in increasing the number of panicles. Islam *et al.,* (2008) reported maximum number of panicle m^{-2} in 100 kg N ha^{-1} than 0, 50 and 150 kg ha^{-1}. Heluf Gebrekidan and Mulugeta Seyoum (2006) stated in his report that application of N up to 120 kg ha^{-1} increased the number of panicles m^{-2} significantly apparently by increasing the number of productive tillers.

During 2011, panicle number at 0 kg P_2O_5 was significantly higher than that of 30 and 90 kg P_2O_5 ha^{-1} and comparable with 60 kg P_2O_5. The panicle number at 90 kg P_2O_5 significantly lower than that of 30 and 60 kg P_2O_5. The panicle number between 30 and 60 were comparable. Where as in 2012, different P_2O_5 levels did not show any significant influence on panicle number. Alam *et al.,* (2009) reported that application of 72 kg P_2O_5 ha^{-1} produced the highest number of effective tillers $hill^{-1}$ which was statistically at par with 96 kg P_2O_5 ha^{-1}. Plant grown without P fertilizer had the lowest effective tillers $hill^{-1}$ followed by 24 kg P_2O_5 ha^{-1}.

Neither N nor P_2O_5 showed any significant influence on panicle length during both the years. Filled grains $panicle^{-1}$ during 2011 did not influence significantly by N levels. Numerically higher values observed at 120 kg N ha^{-1}. Whereas in 2012, 200 kg N ha^{-1} recorded significantly more number of filled grains $panicle^{-1}$ than 0 kg N ha^{-1} and comparable with 120 and 160 kg N ha^{-1}. It is mainly due to an increase in panicle length and panicle number. Application of more than 120 kg ha^{-1} of N caused comparable number of grains per panicle which may be due to an increase in competition for metabolic supply among tillers thereby decreasing or stagnating the production of grains (Wu *et al.,* 1998) or possibly due to vigorous vegetative growth causing heavy drain on soluble carbohydrate resulting in reduced availability for grain formation (Hasegawa *et al.,* 1994). Kalita and Sharma (1992) showed that nitrogen had significant positive effect on number of grains $panicle^{-1}$. Islam *et al.,* (2008) recorded highest number of grains panicle m^{-2} in 150 kg N ha^{-1} than 0, 50 and 100 kg ha^{-1}. Filled grains were significantly higher at 0 kg P_2O_5 ha^{-1} than other levels during 2011 and significantly more filled grains at 0 kg P_2O_5 ha^{-1} than 30 and 60 P_2O_5 ha^{-1} and on par with 90 P_2O_5 ha^{-1}. Filled grains $panicle^{-1}$ in 2012 did not influence significantly by different P_2O_5 levels. Phosphorous at 72 kg P_2O_5 ha^{-1} produced the highest number of filled grains $panicles^{-1}$ and it was statistically identical with 96 kg P_2O_5 ha^{-1}. Control treatment produced the lowest number of filled grains which was 5.64% and 4.65% lower than 72 and 96 kg P_2O_5 ha^{-1} (Alam *et al.,* 2009).

Table.1 Rice yield attributes influenced by different levels of N and P under canal commands of irrigated eco systems

Treatment	Tiller number m^{-2}		Panicle number m^{-2}		Panicle length (cm)		Filled grains $panicle^{-1}$		Unfilled grains $panicle^{-1}$		Spikelet sterility (%)		1000 grain weight (g)	
Nitrogen levels	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
0 kg ha^{-1}	293	277	279	274	19.2	17.6	152	122	32	19	17.4	13.5	12.3	14.3
120 kg ha^{-1}	338	398	319	381	20	17.8	166	131	23	12	12.2	8.4	12.6	14.4
160 kg ha^{-1}	344	403	325	386	19.5	18.4	159	140	20	9	11.2	6.0	12.7	13.9
200 kg ha^{-1}	366	433	333	407	19.7	18.1	160	141	19	7	10.6	4.7	13.1	14.4
SEm(±)	7	9	6	8	0.2	0.2	5	4	3	1	2	1.3	0.1	0.5
CD (P=0.05)	21	25	18	24	NS	NS	NS	13	9	4	6.0	3.8	0.3	NS
Phosphorous levels														
0 kg ha^{-1}	349	391	330	373	20.1	18.4	174	135	21	14	10.8	9.4	12.5	14.5
30 kg ha^{-1}	339	378	312	362	19.4	17.7	151	132	25	11	14.2	7.7	12.6	14.4
60 kg ha^{-1}	342	358	321	347	19.5	17.6	156	128	26	11	14.3	7.9	12.7	13.9
90 kg ha^{-1}	311	383	294	366	19.4	18.3	156	139	23	10	12.8	6.7	12.7	14.7
SEm(±)	7	8	6	8	0.2	0.2	5	4	3	1	2	1.3	0.1	0.4
CD (P=0.05)	21	NS	18	NS	NS	NS	15	NS	NS	NS	NS	NS	NS	NS
Interaction														
SEm(±)	15	17	12	17	0.5	0.4	11	9	6	3	4	2.6	0.2	0.7
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table.2 Rice grain and straw yield and harvest index influenced by different levels of N and P under canal commands of Irrigated eco systems

Treatment	Grain yield (kg ha^{-1})		Straw yield (kg ha^{-1})		HI	
Nitrogen levels	2011	2012	2011	2012	2011	2012
0 kg ha^{-1}	3647	3812	4995	4755	0.42	0.44
120 kg ha^{-1}	4750	5388	5657	6109	0.46	0.47
160 kg ha^{-1}	4937	5514	5471	6499	0.47	0.46
200 kg ha^{-1}	5015	5591	5415	6217	0.48	0.47
SEm(±)	123	92	127	146	0.006	0.006
CD (P=0.05)	356	266	360	421	0.02	0.02
Phosphorous levels						
0 kg ha^{-1}	4766	5103	4617	5815	0.51	0.47
30 kg ha^{-1}	4648	5076	5531	5929	0.46	0.46
60 kg ha^{-1}	4455	4990	5949	5874	0.43	0.46
90 kg ha^{-1}	4480	5137	6021	5961	0.43	0.46
SEm(±)	123	92	127	146	0.006	0.006
CD (P=0.05)	NS	NS	368	NS	0.02	NS
Interaction						
SEm(±)	349	261	360	412	0.012	0.012
CD (P=0.05)	NS	NS	NS	NS	NS	NS

Table.3 NPK uptake (kg ha^{-1}) in rice influenced by different levels of N and P under canal commands of irrigated eco systems

Treatment	N (kg ha^{-1})				P_2O_5 (kg ha^{-1})				K_2O (kg ha^{-1})			
	Straw		Grain		Straw		Grain		Straw		Grain	
Nitrogen levels	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
0 kg ha^{-1}	17.2	10.8	46.0	34.8	10.1	7.1	11.3	13.9	34.4	32.2	17.9	16.5
120 kg ha^{-1}	18.5	18.0	46.8	53.1	11.3	11.9	13.7	18.2	41.7	39.5	22.9	23.8
160 kg ha^{-1}	18.4	19.3	47.1	51.1	11.5	11.1	13.6	17.5	45.4	38.2	23.6	23.4
200 kg ha^{-1}	17.3	20.1	48.4	49.8	10.5	12.0	14.0	17.1	47.0	40.5	23.8	24.2
SEm(±)	0.8	0.8	1.8	0.9	0.5	0.3	0.4	0.4	2.0	1.1	1.1	0.4
CD (P=0.05)	NS	2.3	NS	2.8	NS	1.0	1.1	1.2	5.7	3.1	3.2	1.1
Phosphorous levels												
0 kg ha^{-1}	13.5	16.6	48.4	44.6	9.2	9.4	12.0	16.4	40.0	41.3	21.1	22.0
30 kg ha^{-1}	14.4	18.2	48.9	44.3	10.2	10.3	12.8	16.9	41.0	42.2	21.3	21.9
60 kg ha^{-1}	15.6	18.5	52.8	46.2	11.0	11.3	12.9	16.9	44.8	40.4	21.4	22.2
90 kg ha^{-1}	15.7	18.6	52.0	46.7	11.5	11.4	13.0	17.0	45.6	43.6	22.9	22.4
SEm(±)	0.8	0.8	1.8	0.9	0.5	0.3	0.4	0.4	2.0	1.1	1.1	0.4
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction												
SEm(±)	1.6	1.6	3.6	1.9	1.1	0.6	0.8	0.8	4.0	2.1	2.3	0.8
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table.4 Nitrogen Use Efficiency Indicators in rice influenced by different levels of N and P under canal commands of Irrigated eco systems

Treatment	NNG		NPE		NUEPG	
Nitrogen levels	2011	2012	2011	2012	2011	2012
0 kg ha^{-1}	1.33	1.20	2.18	2.25	77.3	83.8
120 kg ha^{-1}	1.38	1.32	2.22	2.14	74.3	76.9
160 kg ha^{-1}	1.46	1.28	2.24	2.18	69.6	78.3
200 kg ha^{-1}	1.48	1.32	2.22	2.11	68.2	76.5
SEm(±)	0.03	0.02	0.03	0.03	1.4	1.0
CD (P=0.05)	0.08	0.05	NS	0.08	4.0	3.0
Phosphorous levels						
0 kg ha^{-1}	1.30	1.23	2.28	2.15	79.4	81.7
30 kg ha^{-1}	1.48	1.20	2.17	2.18	68.4	83.7
60 kg ha^{-1}	1.42	1.37	2.22	2.18	71.6	74.5
90 kg ha^{-1}	1.45	1.33	2.21	2.17	70.0	75.6
SEm(±)	0.03	0.02	0.03	0.03	1.4	1.0
CD (P=0.05)	0.08	0.05	NS	NS	4.0	3.0
Interaction						
SEm(±)	0.06	0.03	0.06	0.06	2.7	2.0
CD (P=0.05)	0.16	0.10	NS	NS	8.0	6.0

During both the year's 200 kg N ha^{-1} recorded lower number unfilled grains and it is significantly lower than 0 kg N ha^{-1} in 2011 and 0 and 120 kg N during 2012. 120 kg N ha^{-1} recorded significantly lower no of unfilled grains $panicle^{-1}$ than 0 kg N ha^{-1} in both the years. Hoque *et al.,* (2010) reported that the highest number of unfilled grains $panicle^{-1}$ (19.11) was obtained from 0 kg N ha^{-1} and the lowest (16.81) from 110 kg N ha^{-1}. During both the years unfilled grains did not differ significantly among different P_2O_5 levels.

Sterility percentage significantly lower at 200 kg N ha^{-1} than 0 kg N ha^{-1} during both the years and it was on par with 120 and 160 kg N ha^{-1}. Significantly lower sterility percentage was observed at 120 and above and 160 and above levels during 2012 and 2011 than 0 kg N ha^{-1}. P levels did not show any significant effect on sterility percentage during both the years.

1000 grain weight does not differ significantly among different N and P_2O_5 levels during both the years. Heluf Gebrekidan and Mulugeta Seyoum (2006) in their findings reported that application of N fertilizer did not significantly improve 1000-grain weight of rice crop. The same was in agreement with the findings reported by Thakur (1993). Salahuddin *et al.,* (2009) stated that thousand grain weight remained unaltered due to N fertilizer application from 0 to 200 kg N ha^{-1}.

Grain and Straw yield

In both the years, the grain yield was significantly higher in 120 kg N ha^{-1} than the 0 kg N ha^{-1} (Table 2). The grain yield at upper doses was comparable with that of 120 kg N ha^{-1}. N application upto 120 kg N ha^{-1} significantly increased the yield attributes like panicle number m^{-2}, panicle length, filled grains $panicle^{-1}$ and Nutrient uptake has resulted into significantly increased grain yield than control. Increased level of nitrogen up to 120 kg N ha^{-1} causes for higher availability of nitrogen during all stages leading to increased cell multiplication, rapid cell elongation, improved metabolic activity, which resulted in more tiller growth and marked improvement of yield attributes like panicles m^{-2}, panicle length, filled grains $panicle^{-1}$ and 1000 grain weight. Finally all which lead to increased grain yield at 120 kg N ha^{-1}. Beyond 120 kg N ha^{-1} the yield improvement was not that much significant due to more or less similar yield attributes of number of panicles m^{-2} and filled grains panicle and 1000 grain weight at higher doses. Results are supported by Srivastava *et al.,* (2006).

Significant increase in grain yield of rice might be due to increased photosynthesis and photosynthates translocation from leaf to grain leading to increased production as confirmed by Sudakar *et al.,* (2006). Significantly higher grain yield was observed in 100 kg N ha^{-1} than 0, 50 and 150 kg N ha^{-1} (Islam *et al.,* 2008). Salahuddin *et al.,* (2009) observed that grain yield of transplanted aman rice increased gradually with the increasing levels of nitrogen up to 150 kg N ha^{-1}, but at higher rates (200 kg ha^{-1}), grain yield tended to decrease. The highest grain yield (4.91 t ha^{-1}) was obtained at 150 kg N ha^{-1} and the lowest (3.31 t ha^{-1}) from 0 kg N ha^{-1}. Hoque *et al.,* (2010) reported that 110 kg N ha^{-1} produced the highest grain yield (3090 kg ha^{-1}) and the lowest (2020 kg ha^{-1}) from the control.

Different P_2O_5 levels did not show any significant difference on grain yield during both the years. But numerically higher grain yield was observed in 0 kg P_2O_5 ha^{-1} than other levels. Very typically rice yields were reduced by 2.6 and 6.3 % respectively when

90 kg P_2O_5 applied over no application, indicating the importance of site specific nutrition of Phosphorous. Alam *et al.*, (2009) reported that grain yield ha^{-1} increased linear with the increment of the fertilizer doses of P upto 72 kg P_2O_5 ha^{-1} and thereafter decreased.

Straw yield was significantly higher at 120 kg N ha^{-1} than 0 kg N ha^{-1} during both the years. Straw yield at higher doses were statistically similar with 120 kg N ha^{-1}. In 2011, straw yield was significantly increased with increment in P level up to 60 kg P2O5 ha^{-1}. Straw yield at 90 kg P_2O_5 ha^{-1} were comparable with 60 kg P_2O_5 ha^{-1}.

During 2011, Harvest Index was significantly higher in 200 kg N ha^{-1} than 120 and 0 kg N ha^{-1}. HI at 160 kg N ha^{-1} was comparable with both 120 and 200 kg N ha^{-1}. HI at 120 kg N ha^{-1} was significantly higher than 0 kg N ha^{-1}. Where as in 2012, 120 kg N ha^{-1} recorded significantly higher HI than 0 kg N ha^{-1}. The HI values at 160 and 200 kg N ha^{-1} were statistically identical with 120 kg N ha^{-1}. Alam *et al.*, (2009) documented that the maximum harvest index was obtained from the 72 kg P_2O_5 ha^{-1} and the lowest from the control plots.

Interaction effect on grain yield and yield attributes were found non-significant during both the years.

NPK uptake

In straw and grain, N uptake was not influenced significantly by different N levels during 2011 (Table 3). Where as in 2012, N uptake was significantly higher at 120 kg N ha^{-1} than 0 kg N ha^{-1} and 0 and 200 kg N ha^{-1} in straw and grain respectively and comparable with 160 kg N ha^{-1} in grain and on par with 160 and 200 kg N ha^{-1}in straw. During both the years, Phosphorous applied at 90 kg ha^{-1}, N uptake in straw was significantly higher than 0 and 30 kg P_2O_5 ha^{-1} and on par with 60 kg P_2O_5 ha^{-1}. In 2012, N uptake at 60 and 30 kg P_2O_5 ha^{-1} were comparable. During 2011, N uptake in grain was significantly higher at 30 kg P_2O_5 ha^{-1} than the 0 kg ha^{-1}. 60 and 90 kg ha^{-1} were on par with 30 kg ha^{-1}. Where as in 2012, N uptake was significantly more at 90 kg P_2O_5 ha^{-1} than the 0 and 30 kg ha^{-1} and comparable with 60 kg ha^{-1}.

In straw neither N nor P influence significantly the P_2O_5 uptake during both the years. K_2O uptake in grain and straw during both the years was significantly higher at 120 kg N ha^{-1} than 0 kg N ha^{-1} and all other levels are comparable with 120 kg N ha^{-1}. K2O uptake in grain and straw did not influence significantly by different P levels during both the years.

Increases in yield components are associated with better nutrition, plant growth and increased nutrient uptake (Kumar and Rao, 1992; Thakur, 1993).

N use efficiency indicators

During both the years, high NNG and NPE were attained at 120 kg N ha^{-1} and above doses than control. Reverse trend of NUEPG was obtained with increase in N doses (Table 4). NUEPG was higher at control than 120 kg N ha-1 and above levels.

Therefore, the in- crease of NNG and NPE could be at the expense of N application. These results indicated that excessive N application in China might be inconsistent with the physiological requirement of the rice, thereby leading to low N use efficiency indexes (NUEPG) and high NNG and NPE.

Similar finding reported by G.Y. Song *et al.*, (2013) regarding NNG, NPE and NUEPG indices among different genotypes under varying N levels.

References

Ahmad, S., and Hasanuzzaman, M., 2012 Integrated effect of plant density, N rates and irrigation regimes on the bio mass production, N content, PAR use efficiencies and water productivity of rice under irrigated semi-arid environment. Not Bot Horti Agrobo, 2012, 40 (1): 201-211.

Aide, M. and J. Picker, 1996. Potassium and Phosphorus Nutrition in Rice. Information from Missouri Rice Research Update.

Alam, M.M., Ali, M.H., Ruhul Amin, A.K.M., and Mirza Hasanuzzaman. 2009. Yield attributes, yield and harvest index of three irrigated rice varieties under different levels of phosphorus. Advances in Biological Research 3 (3-4): 132-139.

Anonymous, 199. Feeding the world, facts and figures. http//www.riceweb.org.

Brady, N.C. and R.R. Weil, 2002. The nature and Properties of Soil. 13 Edition. Pearson Education Asia, New Delhi.

De Datta, S.K. and D.S. Mikkelsen. 1985. Potassium nutrition of rice. Pages 665-695. In Potassium in Agriculture. ASA, CSSA, SSSA, Madison, Wisconsin, USA.

De Datta, S.K., R.J. Buresh, M.I. Samson, and Wang Kai-Rong. 1988. Nitrogen use efficiency and Nitrogen-15 balances in broadcast-seeded flooded and transplanted rice. Soil Sci. Soc. Am. J. 52:849-855.

Dobermann, A., Cassman, K.G., Mamaril, C.P., and Sheehy, J.E., 1998. Management of phosphorous, potassium and sulfur in intensive, irrigated lowland rice. Field Crops Research March 56, 113-138.

Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research (2nd edn). International Rice Research Institute, John Willey and Sons, Inc. Singapore, pp: 139-240.

Guiyun Song, Zhengjin Xu and Hengshan Yang 2013. Effects of N rates on N uptake and yield in erect panicle rice. Agricultural Sciences. 4(9): 499-508.

Hasegawa, T., Koroda, Y., Seligma, N.G. and Horie, T. 1994. Response of spikelet number to plant nitrogen concentration and dry weight in paddy rice, Agron J. 86:673-676:

Heluf Gebrekidan and Mulugeta Seyoum 2006. Effects of mineral N and P fertilizers on yield and yield components of flooded lowland rice on vertisols of forega plain, Ehiopia. 107 (2):161-176.

Hoque, M.A., Akter, M., Chowdhury, M.A.K., and Chowdhury, M.A.H., 2010 Effect of N and P on the yield, yield attributes and protein content of aromatic rice (cv. BRRI dhan 34) J. Agrofor. Environ. 4 (2): 173-176, 2010.

IFC (International Fertilizer Correspondent) 1982. FAO/FAIC working party on the economics of fertilizer use. 23(1):7-10.

IRRI (International Rice Research Institute). 1993. “Rice Research in a Time of Change: IRRI's Medium-Term Plan for 1994-1998”. International Rice Research Institute, Manila, Philippines. 79 pp.

Islam. M.S., Hossain M.A., Chowdhury, M.A.H., and Hannan., M.A. 2008. Effect of nitrogen and transplanting date on yield and yield components of aromatic rice. Journal of Bangladesh Agricultural University. 6 (2): 291-296.

Jackson, M.L. 1967. Soil Chemical Analysis. Prentis Hall of India Pvt. Ltd., New Delhi.

Kalita, M. C. and Sharma, N. N. 1992. Effect of nitrogen level and mulch on yield and yield attributing characters of summer rice (*Oryza sativa*) under the rainfed condition. India J. Agron. 37 (4): 690-693.

Kumar, K. and Rao, K.V.P., 1992. Nitrogen and phosphorous requirement of upland rice in Manipur Oryza, 29: 306-309.

Ombir Singh, Prempal Singh and Sandeep Kumar (2007). Maximization of rice (Oryza sativa) yield through heavy fertilization and its residual effect on wheat (*Triticum aestivum*) under rice-wheat cropping system. Ann.Agric. Res. 28: 137-40.

Peng S, Garcia FV, Gines HC, Laza RC, Samson MI, Sanico AL, Visperas RM, Cassman KG. 1996. Nitrogen use efficiency of irrigated tropical rice established by broadcast wet-seeding and transplanting. Fert. Res. 45: 29-96.

Piper, C. (1966). Soil and Plant Anlysis. Hans publishers, Bombay.

Ramakrishna, Y., Subedar Singh and Prihar, S. S. (2007). Influence of irrigation regime and nitrogen management on productivity, nitrogen uptake and water use by rice (*Oryza sativa*). Indian J. Agron. 52: 102-06.

Rotshield, G.H.L., 1996. Perspectives for rice production in Asia. Crop research in Asia: Achievements and perspectives. Proceedings of the 2nd Asian crop science conference. Asian Crop Sci. Assoc., Fukui, pp: 12-17.

Sahrawat, K.L., M.K. Abekoe, S. Diatta, G. Tian, F. Ishida, D. Keatinge, R. Carsky and J. Wendt, 2001. Application of inorganic phosphorus fertilizer. In: Proc. Symp. Sponsored by the American Soc. Agron. USA. 5-9 November 2000, pp: 225-246.

Salahuddin, K.M., Chowdhury, S.H., Munira, S., Islam, M.M., and Parvin, S. 2009 Response of nitrogen and plant spacing of transplanted aman rice. Bangladesh Journal of Agricultural Research. 34 (2): 279-285.

Srivastava, V. K., Sharma, Govind, Bohra, J. S., Sen, Avijit, Singh, J. P. and Gouda, S. K. (2006). Response of hybrid rice to the application of nitrogen, magnesium and boron. Ann. Agric. Res. 27: 392-96.

Sudhakar, P. C., Singh, J. P., Yogeshwar Singh and Raghavendra Singh 2006. Effect of graded fertility levels and silicon sources on crop yield, uptake and nutrient use efficiency in rice (*Oryza sativa*). Indian J. Agron. 51: 186-89.

Thakur, R.B. 1993. Performance of summer rice (*Oryza sativa*) to varying levels of nitrogen. Indian J Agron: 38(2): 187-190.

Wu, G., Wilson, L.T. and Mc Clung, A.M. 1998. Contribution of rice tillers to dry matter accumulation and yield: Agron J.90: 317-323.

Yoshida, S., 1981. Fundamental of rice crop science. Intl. rice res. Inst., Los Banos, Philippines.

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