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Growth and Yield Parameters of Rice (*Oryza sativa L.*) Influenced by Nitrogen and Phosphorus Levels

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ABSTRACT

Field experiment was conducted at Agricultural college farm, Mahanandi during *kharif,* 2011 to study the response of lowland rice to nitrogen and phosphorus levels in alfisols. The results indicated that highest values of growth parameters *viz.,* plant height, leaf area index and dry matter production and no. of total tillers were recorded with application of highest level nitrogen *viz.,* 240 kg N ha^{-1} but it was on a par with application of 200 kg N ha^{-1} and significantly superior to 160 kg N ha^{-1}. Higher no. of effective tillers m^{-2}, grain and straw yield were recorded with application of 240 kg N ha^{-1} and it was on a par with application of 200 kg N ha^{-1} and significantly superior to 160 kg N ha^{-1}. Among phosphorus levels highest values of growth parameters *viz.,* plant height, leaf area index, total tillers m^{-2} were recorded with application of 80 kg P_2O_5 ha^{-1} and lowest were recorded with control. Highest no. of effective tillers m^{-2}, grain and straw yield was recorded with application of 80 kg P_2O_5 ha^{-1} and it was on par with application of 60 kg P_2O_5 ha^{-1}.

Key words : Rice, Nitrogen and phosphorus levels, Growth parameters, Yield Parameters.

Rice is most important cereal crop in India. Rice fulfills the nutritional requirements of half of the world's population. It occupies a pivotal place in Indian agriculture as it is a staple food for more than 70 per cent of population and source of lively hood for about 120 to 150 million rural households. Nitrogen is the major nutrient which frequently limits the rice production. In low land rice ecosystems in wet season, usually nitrogen use efficiency is approximately 30- 40 per cent (Ramakrishna *et al.*, 2007) and rest of 60-70 percent being lost by way of denitrification, ammonia volatilization, leaching, runoff and immobilization. Phosphorus is a next major plant nutrient after nitrogen influencing the rice yields. It plays vital role in several physiological processes. But its availability in Indian soil is low to moderate. There is need to replenish it in the soil. Slow mobility of applied P and its marked fixation in soils results in low recoveries by crop to an order to that of 20 to 25 percent. Since phosphorus is an expensive nutrient as compared to nitrogen, there is a need to manage it properly for achieving of maximum benefit especially under submerged condition, where its availability increases. Hence, the present experiment was conducted to study the response of low land rice to levels of nitrogen and phosphorus in alfisols.

Field experiment was conducted during *kharif,* 2011 in Agriculture College farm, Mahanandi. The soil of experimental site was sandy loam in texture and it was slightly alkaline in reaction with a pH of 7.9, E C of 0.15 d S m^{-1}, low in organic carbon (0.46%), low in available nitrogen (209 kg ha^{-1}), medium in available phosphorus (24 kg P_2O_5 ha^{-1}) and high in potassium (765 kg K_2O ha^{-1}). The experiment was laid out in randomized block design with factorial concept and replicated thrice. The treatments consisted of three nitrogen levels *viz.,* N_1 (160 kg N ha^{-1}), N_2 (200 kg N ha^{-1}), N_3 (240 kg N ha^{-1}), and five phosphorus levels, *viz.,* P_0 (control), P_1 (20 kg P_2O_5 ha^{-1}), P_2 (40 kg P_2O_5 ha^{-1}), P_3 (60 kg P_2O_5 ha^{-1}), and P_4 (80 kg P_2O_5 ha^{-1}). Samba Mashuri (BPT- 5204) was the test variety. Nitrogen was applied in three equal splits. One third dose of nitrogen along with full dose of phosphorus and potassium were applied as basal at the time of transplanting. The remaining quantity of nitrogen was top dressed in two equal splits at active tillering and flowering stages of crop. Observations were recorded on growth parameters such as plant height, leaf area index, dry matter production, no. of tillers m^{-2} and yield attributes *viz.,* days to 50 per cent flowering, no. effective tillers m^{-2}, and number of total and filled grains panicle^{-1}, test weight, grain yield and straw yield.

Table 1. Effect of nitrogen and phosphorus levels on growth parameters of Rice.

Treatment	Plant height (cm)			LAI			No. of tillers m^{-2}				Dry matter production g m^{-2}			
(kg/ha)	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	45 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	HARVEST
N_{160}	53.2	76.6	93.4	2.0	3.4	2.6	653.8	706.1	584.5	431.3	222.2	779.1	1484.6	1513.3
N_{200}	56.3	79.8	97.0	2.3	4.1	2.8	723.4	782.2	645.1	473.5	248.5	882.7	1588.3	1645.7
N_{240}	57.1	81.6	98.4	2.3	4.6	3.3	725.4	787.0	650.7	480.8	253.8	885.6	1627.8	1666.9
SE ±	1.1	1.4	1.2	0.1	0.2	0.2	30.2	28.2	23.9	12.3	11.5	42.3	42.5	63.2
CD 5%	2.4	3.0	2.5	0.2	0.5	0.2	61.0	57.9	57.0	25.3	23.5	86.8	87.2	129.6
P_0	53.0	77.5	94.1	2.1	3.3	2.5	635.8	716.5	580.4	428.6	225.7	785.2	1454.4	1545.1
P_{20}	53.6	78.7	95.3	2.2	3.5	2.6	692.0	748.0	605.6	445.8	234.9	816.2	1526.4	1589.4
P_{40}	55.3	79.3	95.8	2.2	4.1	2.9	713.0	755.3	632.0	458.6	246.1	846.1	1553.9	1641.9
P_{60}	56.6	79.6	97.6	2.2	4.5	3.1	729.3	780.2	64.0	479.8	252.3	886.9	1591.8	1677.8
P_{80}	57.3	81.5	98.8	2.3	4.8	3.4	737.7	792.3	654.8	483.8	248.4	876.1	1574.5	1664.7
SE±	1.5	1.9	1.5	0.1	0.3	0.2	38.9	36.9	30.0	15.9	14.8	51.7	54.5	81.6
CD 5%	NS	NS	NS	NS	0.6	0.6	NS	NS	NS	32.6	NS	NS	NS	NS
N x P														
SE±	2.6	3.2	2.7	0.2	0.5	0.5	67.5	36.4	53.5	27.6	25.7	94.7	95.2	141.5
CD 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

The plant height of rice measured at different growth stages *i.e.,* 30, 60 and 90 DAT increased progressively with advance in the age of crop. Maximum plant height was associated with 240 kg N ha^{-1} (N_3), which was on a par with 200 kg N ha^{-1} (N_2) and significantly superior to 160 kg N ha^{-1} (N_1) level. The minimum plant height was observed with the application of 160 kg N ha^{-1} (N_1) at all the growth stages of crop. Increase in the plant height of rice with increased level of nitrogen might be attributed to higher availability of nitrogen during all stages leading to increased cell multiplication, rapid cell elongation, improved metabolic activity, which in turn resulted in better growth of the plants. Results are confirmed with Sunil Kumar and Yashbir Singh Shivay, (2009). Regarding to phosphorus levels maximum plant height was recorded with application of 80 kg P_2O_5 ha^{-1} and lowest was with control, but there is no significant difference among treatments. Maximum leaf area index was recorded with application of 240 kg N ha^{-1} and lowest with application of 160 kg N ha^{-1}. This is due to production of more number of leaves coupled with longer leaf duration. Results are confirmed with Sunil Kumar and Yashbir Singh Shivay (2009). The LAI did not respond to the application of phosphorus at 30 DAT but increased with increased levels of phosphorus. However significant increase in LAI was observed at 60 and 90 DAT with increase in P levels. Highest LAI was recorded with application of 80 kg P_2O_5 ha^{-1} and lowest was with control. Jaspinder Singh Kolar and Harsharn Singh Grewal (1989) reported that increasing levels of phosphorus increased leaf area index.

Highest dry matter production was recorded with higher level of nitrogen of 240 kg N ha^{-1} (N_3), which was however, comparable with 200 kg N ha^{-1} (N_2) but significantly higher than that of 160 kg N ha^{-1} (N_1). This might be due to cumulative effect of better photosynthesis of taller plants with more number of tillers and larger leaf area. Results are confirmed with Somasundaram *et al.* (2002). Application of 240 kg N ha^{-1} resulted in the highest number of total tillers m^{-2} at different growth stages, which was on par with 200 kg N ha^{-1} and significantly superior to 160 kg N ha^{-1}. The significant increase in no. of tillers m^{-2} with increase in nitrogen levels was in close conformity with Devasenamma *et al.* (2001). Application of phosphorus also influenced the total tillers m^{-2} at later stages of crop growth after 90 DAT and effective tillers at harvest. At 90 DAT highest no. of tillers was noticed with application of 80 kg P_2O_5 ha^{-1} and it was on a par with application of 60 kg P_2O_5 ha^{-1} and lowest value recorded with control. This might be due to higher nutrient availability resulting in production of more no.of tillers. Significant increase in no. of tillers hill^{-1} was observed with increasing levels of phosphorus (Alam *et al.*, 2009).

The grain yield of rice was significantly influenced by nitrogen and phosphorus levels. The highest grain yield was recorded with 240 kg N ha^{-1} but it was on a par with 200 kg N ha^{-1} which was significantly superior to 160 kg N ha^{-1}. Lowest grain yield was recorded with application of 160 kg N ha^{-1}. The Significant improvement in grain yield might be due to marked improvement in yield attributes like effective tillers, panicle length, and no. of filled grains panicle^{-1}. Results are in support of Srivastava *et al.* (2006). Also 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 Sudhakar *et al.* (2006). Highest grain yield of rice was recorded with application 80 kg P_2O_5 ha^{-1} but it was on a par with application of 60 kg P_2O_5 ha^{-1}, whereas lowest grain yield was a recorded with control and there was significant increase in grain yield up to 20 kg P_2O_5 ha^{-1} and it was on a par with application of 40 kg P_2O_5 ha^{-1}. According to Rao (2003), increased yield due to an adequate supply of P in soil might have favoured efficient use of P which in turn brought higher grain yield. The highest straw yield was recorded with 240 kg N ha^{-1} (N_3), which was significantly superior to 200 kg N ha^{-1} and significantly lowest straw yield was recorded with application of 160 kg N ha^{-1} (N_1). The highest straw yield recorded with application of 240 kg N ha^{-1} (N_3) was due to better vegetative growth of plants with higher N (Srivastava *et al.,* 2006). Application of phosphorus to rice crop significantly influenced the straw yield of rice crop. Numerically highest straw yield of rice was recorded with application of 80 kg P_2O_5 ha^{-1} and it was on a par with 60, 40, 20 kg P_2O_5 ha^{-1} and was significantly superior to crop without phosphorus fertilizer. Highest straw yield

Table 2. Yield attributes, grain yield, straw yield and harvest index of rice as influenced by different levels of nitrogen and phosphorus.

Treatment	Days to 50 per cent flowering	Effective tillers m^{-2}	Panicle length(cm)	Number of grains $panicle^{-1}$		Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index
				Total	Filled				
N_{160}	111.56	369.76	20.49	174.62	166.32	14.44	5767	8776	39.67
N_{200}	111.46	424.38	21.05	184.25	173.76	14.44	6205	9145	40.40
N_{240}	111.06	431.90	21.14	188.63	179.58	14.56	6284	9463	40.51
SE ±	0.67	17.20	0.33	8.73	7.86	0.08	49.59	175.85	0.45
CD 5%	NS	35.10	NS	NS	NS	NS	102	360.22	NS
P_0	112.22	346.53	20.36	173.51	162.35	14.22	5813	8786	39.69
P_{20}	112.00	392.10	20.75	175.46	165.53	14.37	6016	9112	39.78
P_{40}	110.55	431.30	20.94	179.77	172.17	14.46	6101	9116	39.80
P_{60}	110.26	420.95	21.08	188.17	180.06	14.57	6194	9276	39.83
P_{80}	110.09	432.26	21.33	195.58	185.97	14.66	6201	9351	40.53
SE±	0.87	22.12	0.43	11.27	10.15	0.1	64.03	227.02	0.58
CD 5%	NS	45	NS	NS	NS	NS	131.16	465.04	NS
N x P									
SE±	1.50	38.36	0.75	19.52	17.58	0.18	110.9	805.48	1.01
CD 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

due to higher bio mass production varied with increased phosphorus levels (Alam *et al.,* 2009). With respect to nitrogen higher value of harvest index was associated with application of 240 kg N ha^{-1} and lowest harvest index was observed with application of 160 kg N ha^{-1}. With regard to phosphorus levels harvest index was increased with increased application of phosphorus. Highest harvest index value was associated with application 80 kg P_2O_5 ha^{-1} and lowest was observed in control treatment but difference between treatments was non significant.

LITERATURE CITED

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

Alam M M, Mirza Hasanuzzaman and Kamrun Nahar 2009 Tiller dynamics of three irrigated rice varieties under varying phosphorus levels. *American- Eurasian Journal of Agronomy,* 2 (2): 89-94.

Devasenamma V, Reddappa Reddy M and Soundarajan M S 2001 Effect of varying levels of nitrogen on yield and yield components of hybrid rice. *Journal of Research ANGRAU,* 29 (1): 1-3.

Jaspinder Singh Kolar and Harsharn Singh Grewal 1989 Phosphorus management of a rice-wheat cropping system. *Nutrient Cycling in Agro ecosystems,* **20** (1): 27-32.

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 Journal of Agronomy,* 52 (2): 102-106.

Rao C P 2003 Nutrient utilization efficiency of rice influenced by different sources and levels of phosphorus and rates of zinc. *Annals of Agricultural Research,* 24 (1): 7-11.

Somasundaram E, Sathiyavelu A and Rangaraj T 2002 Response of hybrid rice CORH 2 to nitrogen levels in sodic soil conditions. *Madras Agriculture Journal,* 89 (4-6): 343-345.

Srivastava V K, Govind Sharma, Bohra J S, Avijit Sen Singh J P and Gouda S K 2006 Response of hybrid rice to the application of nitrogen, magnesium and boran. *Annals of Agricultural Research,* 27 (4): 392-396.

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 Journal of Agronomy,* 51 (3): 186-189.

Sunil Kumar and Yashbir Singh Shivay 2009 Effect of eco friendly modified urea materials and nitrogen levels on growth and productivity of aromatic hybrid and an aromatic high yielding variety of rice. *Annals of Agricultural Research,* 30 (1&2): 4-8.

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