

Original Research Article

<https://doi.org/10.20546/ijcmas.2017.609.283>

## Effect of Rice Varieties on Growth, Yield and Economics at Varying Levels of Nitrogen under Direct Seeded Upland Condition Rewa Region

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### ABSTRACT

A field experiment entitled "Performance of rice varieties at varying levels of nitrogen under direct seeded upland condition" was conducted on silty clay loam soil with low in available nitrogen, medium in phosphorus and high in available potassium at neutral pH Agriculture College Farm, Rewa (M.P.) during *Kharif* season 2015. The treatments comprising 3 levels of nitrogen (N<sub>1</sub>, 40 kg/ha; N<sub>2</sub>, 80 kg/ha N<sub>3</sub>, 120 kg/ha) in main plots and 07 (seven) varieties (V<sub>1</sub> IET 23824, V<sub>2</sub> IET 24780, V<sub>3</sub> BPT 5204, V<sub>4</sub> Sahbhagi, V<sub>5</sub> Chittimuthyalu, V<sub>6</sub> Kalanamak and V<sub>7</sub> IR-64) assigned in subplot of split-plot design replicated three times. The variety IR – 64 gave higher values of most of the growth and yield component characters and resulted significantly highest grain yield (42.98q/ha) in the Rewa region. Application of 120 kg N/ha produced highest growth characters, yield attributing traits and grain yield (45.13 q/ha). The combination of variety IR-64 and 120 kg N/ha was found the best in respect of most of the growth and yield attributing characters along with grain yield (52.14 q/ha) followed by BPT 5204 sown with 120 kg N/ha (47.62q/ha). The net return as well as benefit cost ratio was also highest from the treatment N<sub>3</sub>V<sub>7</sub> (N level 120kg + IR-64) followed by treatment N<sub>3</sub>V<sub>3</sub> (N level 120kg + BPT-5204).

### Keywords

Rice, Varieties,  
Nitrogen, Grain  
yield, Economics.

### Article Info

#### Accepted:

23 July 2017

#### Available Online:

10 September 2017

### Introduction

In India rice is cultivated in an area of 44.6 million hectares with the production of 102.0 million tonnes and average productivity of 2286 kg/hectare more than half of the rice area is rainfed and distribution wise 80% of rainfed rice is in eastern India making its cultivation vulnerable to vagaries of monsoon (Anonymous 2014). Madhya Pradesh contributes 1.76 million hectares area under rice with an annual production of 3.02 million

tonnes and productivity is 1710 kg/ha (Anonymous, 2014).

The main reasons of such low productivity and profitability are vagaries of nature, low fertilizer use efficiency and poor crop management practices including adherence of farmers to the traditional costlier practices, besides low market price of farm produce especially in the recent past. After the

identification and release of high yielding rice varieties, it becomes imperative to make a comparative assessment of the growth parameters and their influence on grain yields under different nutrient combinations. In nutrient management, nitrogen plays an important role, because it is the major component for protein synthesis and involved in biochemical and physiological activities of plants (Savant and De Datta, 1982). In MP, rice is grown by direct seeding in rainfed uplands with very low productivity (0.6 to 0.9 t/ha) due to non-adoption of high yielding varieties and optimum N levels as compared to national average (1.9 t/ha). In M.P. nearly 17.6 lakh ha area is under rice cultivation of which 80% is under rainfed condition. The enhanced physiological efficiency of rice genotypes is an indication of their high yielding ability.

In Rewa region rice occupies an area of 135.80 thousand hectare with the production of 367.34 thousand tonnes and productivity is 2705 kg/ha (FW&ADD, 2014). Nitrogen is the key element in the production of rice and gives by far the largest response. It is also a fact that improper use of nitrogenous fertilizers, instead of giving yield advantage, may reduce the same. Again different varieties may have varying responses of N-fertilizer depending on their agronomic traits. Many workers have reported a significant response of rice to nitrogen indifferent soils in Bangladesh (Bhuiyan *et al.*, 2008). It is the most essential element in determining the yield potential and major inputs to rice production. Almost every farmer has tendency to apply costly N fertilizer in excess to get a desirable yield of Aman rice (Saleque *et al.*, 2004), but imbalance use of N fertilizer causes harm to the crop and decreases grain yield. Performance of different rice varieties to varying levels of N have not been evaluated under direct seeded upland rice in Rewa region of Madhya Pradesh.

The importance of early maturing varieties becomes more relevant in context of multiple cropping under upland condition. The productivity of direct seeded upland rice is very low on account of inadequate and imbalance use of nitrogen fertilizers by the farmers, although, nitrogen fertilizers have played an important role in increasing agricultural production and sustainability in upland condition. The information pertaining to nitrogen requirement as well as physiological efficiency of recently available high yielding rice varieties are scanty.

### **Materials and Methods**

The experiment was carried out at the AICRIP research farm of College of Agriculture, JNKVV, Rewa (M.P.) during *kharif* season of 2015 to study the Performance of rice varieties at varying levels of nitrogen under direct seeded upland condition. The soil was low in available nitrogen (236 kg/ha), medium in phosphorus (18.5 kg/ha) and high in available potassium (352 kg/ha) along with 0.62 percentage of carbon/ha. The pH of the soil was nearly neutral. The field experiment was carried out in split plot design. Twenty one treatment combinations resulting from three nitrogen levels 3 levels of nitrogen (N<sub>1</sub>, 40 kg/ha; N<sub>2</sub>, 80 kg/ha N<sub>3</sub>, 120 kg/ha) in main plots and 07 (seven) varieties (V<sub>1</sub> IET 23824, V<sub>2</sub> IET 24780, V<sub>3</sub> BPT 5204, V<sub>4</sub> Sahbhagi, V<sub>5</sub> Chittimuthyalu, V<sub>6</sub> Kalanamak and V<sub>7</sub> IR-64) subplot and replicated thrice. Each of the nitrogen levels were applied through urea containing 46% N, in three split doses i.e. 50% as basal, 25 % at tillering and 25 % at panicle initiation stages as second and third top dressing, respectively. A uniform dose of 40 kg P<sub>2</sub>O<sub>5</sub>/ha through single super phosphate (16% P<sub>2</sub>O<sub>5</sub>) and 20 kg K<sub>2</sub>O/ha through murate of potash (60% K<sub>2</sub>O) was applied as basal in all the plots. The varieties were sown on 4<sup>th</sup> July, 2015 keeping a seed rate of 50 kg/ha

with row spacing of 20 cm. The total rainfall received during the crop season was 689.2 mm. Other packages of practices rather than treatments were followed as per recommendation for direct seeded rice crop.

### **Harvest index (%)**

It is expressed as the ratio of grain yield to biological yield. It was calculated as per following formula:

$$\text{Harvest index} = \frac{\text{Economic yields}}{\text{Biological yields}} \times 100$$

### **Economics of the treatments**

The cost of production incurred in each treatment was worked out by considering the prevailing market price of input used and the produce obtained (grain and straw) The net income was calculated by subtracting the cost of cultivation from the gross monetary return.

Different values were determined for each treatment as per details given below:

Gross monetary returns = Cost of grain + cost of straw

Net monetary returns = Gross monetary returns - Total cost of cultivation

Benefit: cost ratio = Gross return/Total cost of cultivation

### **Statistical analysis**

The data recorded on different observations were tabulated and analyzed statistically by using the techniques of analysis of variance (ANOVA) as suggested by Cochran and Cox (1967). Critical difference at 0.05 probability level was worked out to compare the treatments when F test was found significant.

## **Results and Discussion**

### **Effect of nitrogen**

Nitrogen levels significantly affected the various growth parameter of direct seeded rice at all growth stages of the crop. But variations were not similar in all the growth stages. Increasing levels of nitrogen increased the plant height at all the crop growth stages, and the increase was statistically significant due to 120 kg N/ha over both lower doses at each crop growth stages. More or less similar effects of nitrogen in accelerating the height of rice plant have been reported by Singh and Kumar (2012 and 2014). Other growth parameters like number of tillers/m<sup>2</sup> and leaves/plant were affected significantly or non-significantly by the doses of nitrogen at all the stages of crop growth. The maximum values of these parameters were recorded with the highest dose of nitrogen (120 kg N/ha) at all the stages of crop growth. Furthermore differences between any two adjoining levels of nitrogen in respect of these growth parameters were also found significant or non-significantly. The increasing number of tillers and with increasing leaves of nitrogen may be attributed to the fact that nitrogen seems to have played a vital role in the formation of new tissues which are dependent on the protoplasmic structure, cell division and cell elongation. Moreover increase of leaves/plant means increase in the photosynthesis surface area. In fact leaf is the factory for the conversion of energy into the chemical energy by the process of photosynthesis. These results are in agreement with the findings of Singh and Kumar (2014), Gohain (2014) and Tiwari *et al.*, (2015).

The increasing levels of nitrogen reflected in increased panicles/m<sup>2</sup>, panicle length, grains/panicle, number of filled grains/panicle and test weight.

**Table.1** Growth, yield and economics of rice varieties as influenced by nitrogen levels

Treatments	Plant population /m <sup>2</sup> length (15 DAS)	Plant height (At harvest)	Tiller/m <sup>2</sup> (At Harvest)	Leaves /plant (At Harvest)	No. of panicles/m <sup>2</sup>	Panicle length (cm)	Weight panicle (g)	Grains/ panicle	Filled grains /panicle	Test weight (g)	Grain yield (q/ha)	Net income (Rs./ha)	B:C ratio
<b>Nitrogen levels (kg/ha)</b>													
40	46.68	88.59	296.62	26.41	232.36	299.52	1.63	109.24	92.48	22.54	30.19	20209.61	1.86
80	47.10	95.17	360.38	37.26	238.30	353.48	1.72	111.90	95.29	22.83	36.06	28226.45	2.17
120	47.61	98.83	450.81	46.12	246.18	444.19	1.81	119.43	102.57	22.99	45.13	40861.82	2.66
S.E.(m)	0.25	0.19	6.81	0.38	0.11	6.84	0.04	2.15	2.40	0.09	0.30	-	-
CD (p=0.05)	0.76*	0.58*	20.43	1.13*	0.32*	20.51	0.11*	6.45*	7.20*	NS	0.91*	-	-
<b>Varieties</b>													
I	46.87	101.16	364.78	36.00	237.54	362.89	1.71	111.44	97.22	23.11	36.53	28908.18	2.20
II	47.03	95.48	379.22	37.43	238.24	377.44	1.77	115.89	101.89	23.31	37.96	30958.02	2.28
III	47.72	85.25	390.44	38.52	242.33	388.56	1.83	119.67	102.22	23.13	39.08	32462.45	2.34
IV	47.42	91.93	358.44	35.36	240.43	356.44	1.68	110.00	91.78	22.82	35.89	28045.40	2.16
V	46.91	91.09	345.56	24.12	237.64	343.44	1.61	105.11	87.00	22.37	34.59	26236.25	2.09
VI	45.11	106.54	328.00	32.38	228.63	326.11	1.53	103.11	81.11	21.38	32.84	23750.63	1.99
VII	48.84	87.90	418.44	42.38	247.82	405.22	1.90	129.44	116.22	23.39	42.98	38000.78	2.56
S.E.(m) ±	0.61	0.23	6.26	0.26	0.24	8.40	0.04	2.20	2.07	0.34	0.22	-	-
CD (p=0.05)	1.85*	0.69*	18.77	0.79*	0.73*	25.21	NS	6.60*	6.22*	1.01	0.65*	-	-
Remarks: The details of variety were taken for research experiment and denoted as roman No. are I- IET 23824, II- IET 24780, III- BPT 5204, IV- Sahbhagi, V- Chittimuthyalu, VI- Kalanamak, VII- IR-64													

Therefore the highest level of 120 kg N/ha was registered with the maximum number of panicles/m<sup>2</sup> (444.19), panicle length (22.41 cm), number of grains/panicle (119.43), weight of panicle (1.81 g) and number of filled grains/panicle (102.57); which might be due to increased accumulation of photosynthetic from the source to the sink. It is conformity with the findings of Gohain (2014) and Tiwari *et al.*, (2015) who reported the response of rice crop to nitrogen in augmenting the yield attributing characters.

The direct seeded rice produced the lowest grain (30.19 q/ha) and straw (65.29 q/ha) when nitrogen was given at 40 kg N/ha. But grain and straw yields were significantly maximum (45.13 q/ha) grains and 100.52 q/ha straw yields) in plots receiving 120 kg N/ha over 80 and 40 Kg N/ha. Furthermore, increasing doses of nitrogen upto 120 kg/ha was apparently associated 120 kg per hectare dose of nitrogen was decidedly the best as compared to lower doses. Nitrogen is an integral constituent of photo synthetically active pigment, the chlorophyll by virtue of which plants are able to utilize the light, energy and enzyme nucleotides, which play an important role in cell development. Vigorous growth of crop plants with increased fertility is associated with higher sink capacity. Nitrogen fertilization increases photosynthetic activity and translocation of photosynthates which might have promoted the growth and resulted in better partitioning of photosynthates in yield attributes and eventually produced larger sized and more grains of higher weight that ultimately increased the yield. Many workers like G Singh *et al.*, (2008), Singh and Kumar (2012), Singh and Kumar (2014) and Tiwari *et al.*, (2015) have also recorded significant increase in grain yield of rice due to N application. Harvest index varied from 31.19 to 31.83 percent under different levels of nitrogen without significant margin.

### **Effect of varieties**

The growth parameters like plant height, number of tillers/m<sup>2</sup> and leaves /plant were significantly influenced by varieties at all the growth stages. At harvest stage the varieties IR – 64, BPT-5204 and IET 24780 produced significantly highest number of tillers and leaves/plant over rest of the varieties. Significantly lowest number of tillers/m<sup>2</sup> along with dwarf plants was produced by variety BPT-5204 and IR-64. However, variety Kalanamak resulted in significantly tallest plant (106.54 cm) over rest of the varieties. At final stage of the observations, variety IR – 64 and Kalanamak attained the maximum and minimum values of these parameters, respectively. The differences in growth characters due to genotypes may be attributed to their inherent characteristics. The findings corroborate with those of Sumreen *et al.*, (2011) and Thomas and Lal (2012). Yield attributing characters viz. number of panicle/m<sup>2</sup>, panicle length, grains/panicle, weight of panicle and number of filled grains/panicle varied significantly due to varieties. Variety IR – 64 produced maximum number of panicles/m<sup>2</sup> (405.22), panicle length (23.55 cm), number of grains per panicle (129.44), weight of panicle (1.90 g), number of filled grains per panicle (116.22) and test weight (23.39) while variety Kalanamak attained minimum value of these yield attributing characters. Number of unfilled grains/panicle was significantly lowest (13.58 to 14.61) in IR – 64 and BPT-5204 varieties over other varieties. Variety IR 64 being at par with BPT-5204 resulted in significantly highest grain yield (42.98 q/ha) which was 9.07, 11.68, 15.01 and 16.49 percent higher than that produced by BPT-5204, IET 24780, IET 23824 and Sahbhaghi, respectively. Straw yield was significantly highest (105.81 q/ha) over rest of the varieties. Kalanamak produced the lowest straw. The variety Chittimuthyalu gave the

maximum harvest index (33.80%) followed by Anjali (33.61%), while minimum value (28.94%) observed from IR – 64. These results are in agreement with the findings of Singh and Kumar (2014), Gohain (2014) and Tiwari *et al.*, (2015) (Table 1).

### Economics of treatments

The variety IR – 64 with 120 kg N/ha gave highest gross and net return along with B: C ratio (Rs. 88644.35/ha Rs. 50667.35/ha and 3.03 respectively), followed by BPT 5204 fertilized with same dose of nitrogen (Rs. 79923.00/ha, Rs. 44304.00/ha and 2.79 respectively).

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### How to cite this article:

Kuldeep Dangi, S.K. Singh, D.K. Malviya, A. Gautam, N. Kanapuriya and Balvendra Kumar. 2017. Effect of Rice Varieties on Growth, Yield and Economics at Varying Levels of Nitrogen under Direct Seeded Upland Condition Rewa Region. *Int.J.Curr.Microbiol.App.Sci.* 6(9): 2313-2318. doi: <https://doi.org/10.20546/ijcmas.2017.609.283>