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Performance of rice varieties in relation to nitrogen levels under irrigated condition

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The field experiment was conducted at the research farm College of Agriculture, JNKVV, Rewa M.P. during *kharif* season 2011 to study the performance of rice varieties and relation to nitrogen level under irrigated conditions. Twenty one treatment combinations, comprising three nitrogen levels (40, 80 and 120 kg ha^{-1}) allotted to the main plots and seven varieties (IET 21288, Jaldidhan, Varalu, IET 21296, IET 21278, Aditaya and Dantensavari) to the subplots, were tested in split-plot design with three replications. Application of 120 N kg ha^{-1} proved significantly superior to 40 kg N and produced maximum grain yield (49.88 q ha^{-1}), straw yield (93.10 q ha^{-1}) and net income (Rs. 30836 ha^{-1}) over 80 N kg ha^{-1}. Among different rice varieties, Dantensavari produced significantly higher grain yield (45.56 q ha^{-1}), straw yield, fetched highest net return (Rs. 32037.46 ha^{-1}) and B: C ratio during the study; While, the rest of the varieties remained differed for different traits. The other promising varieties for the region were IET 21278, Varalu, and IET 21278. The treatment combination of Dantensavari with 120 N kg ha^{-1} was found to be best in producing grain yield (58.39q ha^{-1}), followed by IET 21278 (56.78 q ha^{-1}) and obtained net income Rs. 40871 ha^{-1} and Rs. 38983 ha^{-1}, respectively.

Key words: Nitrogen, varieties, rice, grain yield, straw yield.

INTRODUCTION

Nitrogen is the key element in the production of rice and gives by far the largest response. It is the most essential element in determining the yield potential of rice and nitrogenous fertilizer is one of the major inputs to rice production (Mae, 1997). Almost every farmer has the tendency to apply costly N fertilizer 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. It is also a fact that improper use of nitrogenous fertilizer, instead of giving yield advantage, may reduce the same.

Nitrogen fertilization and proper time of its application is the major agronomic practice that affects the yield and quality of rice crop which requires as much as possible at

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an early and mid tillering stages to maximize panicle numbers and during reproductive stages to produce more number of spikelets per panicle and percentage filled spikelets (Lampayan et al., 2010). Different varieties may have varying responses to N-fertilizer depending on their agronomic traits.

The introduction of high yielding varieties of crops and utilization of various chemical fertilizers has brought a revolution in the crop production. In M.P. rice is grown in the area of about 15.59 lakh ha with production of 14.62 lak ha tons and productivity 989 kg ha^{-1} which is far below than the average national productivity (2,010 kg ha^{-1}).

In Madhya Pradesh around 5,000 ha is under hybrid rice particular in under irrigated production system (Anonymous, 2012). Now a days the identification and release of high yielding rice varieties, it becomes imperative to make a comparative assessment of the growth studies and their influence on grain yield under different nutrient combination. Of the mineral nutrients, nitrogen plays a major role in utilization of absorbed light energy and photosynthetic carbon metabolism in many biochemical and physiological activities of plant (Kato et al., 2003; Huang et al., 2004). Its deficiency or excess application may adversely affect these processes and ultimately reduces crop yield. Keeping these points in view the present research was taken up.

MATERIALS AND METHODS

The field experiment was conducted at the research farm JNKVV College of Agriculture, Rewa M.P. during *kharif* season 2011. The soil of the experimental site was clay-loam in texture with pH 7.7, low nitrogen, medium phosphorous and high in potash. Twenty one treatment combinations, comprising three nitrogen levels (40, 80 and 120 kg ha^{-1}) allotted to the main plots and seven varieties (IET 21288, Jaldidhan, Varalu, IET 21296, IET 21278, Aditaya and Dantensavari) to the subplots, were tested in split-plot design with three replications. A uniform dose of 60 kg P_2O_5 + 40 kg K_2O ha^{-1} was applied in all plots through SSP and MOP, respectively. Nitrogen was applied through urea in 3 split doses that is 50% at basal, 25% at tillering and 25% at panicle initiation. The 21st days old seedlings were transplanted on July 21, 2011 keeping 20 cm spacing between row and 15 cm between hills. The crop was raised as per recommended package of practices. The crop varieties were harvested from 14th to 29th October 2011. The results of yield trait analysis are narrated below:

(1). The Observations on plant height and total number of effective tillers were taken from hills of each plot randomly selected 5 plant and tagged were recorded at 30 days interval, starting from 30 days after transplanting upto at harvesting stage. The height was measured in centimeter from the ground level to the apex of the shoot. The mean height was computed by dividing the summation with five.
(2). Number of tiller m^{-2} were counted and then divided by plant population m^{-2} for obtaining number of tiller $hill^{-1}$.
(3). The length of panicle was taken from ten panicles selected randomly from harvested produce. It was measured from the neck node to the tip of the apical grain. After this, average length of panicle was determined.
(4). Grain samples were taken from the produce of each net plot. Out of the samples, 1000 grains were counted and the same were dried in an oven at 60^{o}C to constant weight. Thereafter, weight was recorded on an electronic balance.
(5). The grain yield was observed at 14 per cent moisture content and converted to q ha^{-1}.
(6). The straw yield calculated by deducting the grain yield from bundle weight and converted to q ha^{-1}.
(7). The harvest index was calculated following formula given by Synder and Carlson (1984):

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (Grain yield)}}{\text{Biological yield (Grain + straw yield)}} \times 100$$

The following calculation further has been made to analysing data for benefit income of different varieties during investigation:

Net Return (Rs. ha^{-1}) = Gross return (Rs. ha^{-1}) – Cost of cultivation (Rs. ha^{-1})

$$\text{Benefit cost ratio} = \frac{\text{Net return (Rs. ha}^{-1}\text{)}}{\text{Total cost of cultivation (Rs. ha}^{-1}\text{)}}$$

RESULTS AND DISCUSSION

The yield attributes of rice were found to be differed significantly due to applied nitrogen levels. Each increase in the N-level significantly increased plant height and number of effective tillers resulting higher yield attributes (Table 1). Thus, at 120 kg N ha^{-1}, the yield attributes recorded maximum number of effective tillers (238.50 kg m^{-2}), panicle length (25.04 cm), panicle weight (2.83 g), number of fertile grains (106.51seeds $panicle^{-1}$) and 1000-grains weight (25.89 g) than lower fertilities. While, 40 N kg ha^{-1} was remained closed to 80 N kg ha^{-1} in number of effective tiller and returned lower net value during investigation.

The improvement in yield attributing traits may be ascribed to the improved vegetative growth due to N fertilization, facilitating photosynthesis, thereby increasing translocation of organic food materials towards the reproductive organs; which enhanced the formation of panicles with fertile grains. The improvement in yield components due to increased N levels have also been reported by many workers Gunri et al. (2004), Parihar (2004), Singh et al. (2005), Mittoliya (2006), Lar et al. (2007), Pandey et al. (2007) and Singh et al. (2008).

The rice varieties had exhibited significant differences in yield attributes. All yield attributing characters were remained differed with different varieties. The var. IET 21288 recorded maximum length of panicle (cm) and weight of panicle (g) and remained at par in number of effective tillers of rice var. Dhanteshwari during the study. While, the tallest plant height noticed with rice var. IET 21278.

However, variety Dantensavari obtained highest number of effective tillers and filled grains/panicle over the rest of the varieties; exerted second promising yield attributing characters during investigation. The climatic

Table 1. Yield attributes, yield and economics of transplanted rice as influenced by different N levels and Varieties.

Treatment	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
N-levels kg/ha											
40	88.47	160.88	21.93	2.22	80.40	24.55	37.69	71.27	34.48	20256	1.81
80	96.13	182.37	23.34	2.55	92.73	25.19	42.68	80.36	34.61	25501	2.0
120	103.91	238.50	25.04	2.83	106.51	25.89	49.88	93.10	34.84	33356	2.27
C.D. (P= 0.05)	0.85	38.90	0.71	0.08	4.08	0.46	0.60	0.75	0.22	-	-
Varieties											
IET 21288	106.58	195.95	26.82	2.96	95.89	27.67	46.91	86.35	35.22	30448	2.19
Jaldidhan	72.33	157.15	21.32	1.71	55.98	27.91	33.76	67.27	33.36	15031	1.59
Varalu	100.98	252.13	23.63	2.43	121.02	19.93	45.19	84.05	34.94	28438	2.11
IET 21296	107.74	151.09	23.23	2.59	95.61	25.00	39.41	75.56	34.21	21658	1.85
IET 21278	109.24	195.65	23.78	2.66	93.17	25.98	47.17	87.46	34.95	30789	2.20
Aditaya	93.9	191.20	22.33	2.59	87.19	25.62	41.13	78.01	34.51	23675	1.93
Dantensavari	82.41	214.23	22.92	2.82	103.64	24.34	50.37	92.35	35.30	34557	2.35
C.D. (P= 0.05)	1.27	32.59	1.12	0.26	4.97	0.48	2.23	3.61	0.28	-	-
Remarks:	I-Plant height (cm), II- No. of effective tiller, III- Length of panicle (cm), IV- Wt. of panicle (g), V- Filled grains/panicle (No.), VI- 1000 grain Weight (g), VII- Grain yield (q/ha), VIII- Straw yield (q/ha), IX- HI (%), X-Net return (Rs./ha) and XI- B:C ratio.										

condition and genetic makeup of variety had better interaction under which could be enhanced growth and development of panicles. The photoperiodic responses and genetic potentiality on variation of yield attributes of improved varieties have also been reported by Lar et al. (2007) and Singh and Tripathi (2008).

Productivity of rice

The productivity of rice was found to be differed with different level of N and significantly affected the yield of rice. The application of 120 kg N ha^{-1} produced highest grain yield (49.88 q ha^{-1}) and straw yield (93.10 q ha^{-1}) over lower N-levels. This might be due to overall better growth in plant height and appreciable improvement in yield attributing characters. Similar result have also evinced by Luikhan et al. (2004), Sabir et al. (2007), Pandey et al. (2007) and Singh et al. (2008). But the value of harvest index under 80 kg N ha^{-1} remained at par to 40 kg N ha^{-1} and closed to 100 kg N ha^{-1} in present study. The significant rise in HI might be because of the increased grain production as compared to that of straw. Moreover, the improvement in the HI might have also been due to being increased in grain yield through greater partitioning of assimilates from shoot to grain.

The rice variety had also found to be significant differences in yield of rice and var. Dhanteshwari produced significantly higher grain and stove yield that is 50.37 and 92.35 q ha^{-1}, respectively over IET 21278. While, vars. IET 21288 and Varalu were remained at par to each other and found closed to IET 21278 during investigation.

Furthermore, the value of var. Aditaya and IET 21296 found to be non- significant differences among themselves and found to be higher than variety Jaladidhan in study. The increased in grain yield by the varieties due to overall respective performance in growth and appreciable improvement in the yield- attributing characters. Significant variations in the grain yield of rice varieties have also been reported by many workers (Ajeet et al., 2005; Mittoliyam 2006; Lar et al., 2007; Singh and Tripathi, 2008). The increase in the straw yield of var. Dhanteshwari might be due to the superiority of growth parameters. The harvest index also had significantly higher

(35.30%) as compared to rest of the varieties. Jaldidhan recorded the lowest harvest index (33.36%). So much difference in HI among the varieties from different origins reveals that there was greater variations in the partitioning of assimilate from shoot to grain.

Economic gain

Among different levels of N, the application of 120 N kg ha^{-1} resulted in maximum net income (Rs.33356 ha^{-1}) and B: C ratio (2.27) followed 80 N kg ha^{-1} and 40 kg N ha^{-1}. The higher net income is due to higher grain the straw yield at the highest of N level. The different rice varieties also gave promising yield and net returned in var. Dantensavari (Rs. 34557 ha^{-1}) was found maximum with B: C ratio 2.35 than rest of varieties. While, the var. IET 21278 and 21288, the economical gain up to the same extent was obtained Rs. 30789 and 30448 ha^{-1} with 2.20 and 2.19 B: C ratio during the study. The remaining series of varieties for net return and B: C ratio were i.e. Aditaya> Varalu> IET 21296> Jaldidhan, respectively. Such differences in the net income from rice varieties were differences grain and straw yields.

Conflict of Interest

The authors declare that they have no conflict of interest.

REFERENCES

Ajeet Singh R, Namdeo KN (2005). Performance of conventional and hybrid rice varieties under different fertility levels. Ann. Plant Soil Res. 7(1):91-92.

Anonymous (2012). Rice in Madhya Pradesh paddy in Madhya Pradesh. http://seorohitgupta.blogspot.com/2012/02/rice-in-madhya-prades-paddy-in-madhya.html

Gunri SK, Pal SK, Choudhary A (2004). Effect of nitrogen application and spacing on yield of rice in foot- hill soil of West Bengal. Indian J. Agron. 49(4):248-250.

Huang ZA, Jiang DA, Yang Y, Sun JW, Jin SH (2004). Effects of nitrogen deficiency on gas exchange, chlorophyll fluorescence, and antioxidant enzymes in leaves of rice plants. Photosynthetica, 42:357-364. http://dx.doi.org/10.1023/B:PHOT.0000046153.08935.4c

Kato MC, Hikosaka K, Hirotsu N, Makin A, Hirose T (2003). The excess light energy that is neither utilized in photosynthesis nor dissipated by photoprotective mechanisms determines the rate of photoinactivation in photosystem II. Plant Cell Physiol. 44:318-325.

Lampayan RM, Bouman BAM, Dios JLD, Espirity AJ, Soriano JB, Lactaoen AT, Faronilo JE, Thant KM (2010). Yield of aerobic rice in rainfed lowlands of the Philippines as affected by nitrogen management and row spacing. Field Crops Res. 116:165-174. http://dx.doi.org/10.1016/j.fcr.2009.12.007

Lar OO, Shivay YS, Kumar D, (2007). Effect of nitrogen and sulphur fertilization on yield attributes, productivity and nutrient uptake of aromatic rice (*Oryza sativa*). Indian J. Agric. Sci. 77(11):772-775.

Luikhan E, Krishnarajan J, Premsekhar M (2004). Irrigation and nitrogen application schedules for hybrid 'Adtrh 1' rice (*Oryza sativa* L.) in Tamil Nadu. Indian J. Agron. 49(1):37-39.

Mae T (1997). Physiological nitrogen efficiency in rice: Nitrogen utilization, photosynthesis, and yield potential. Plant Soil 196(2):201-210.

Mittoliya VK (2006). Response of rice varieties to different nitrogen levels under transplanted conditions. M.Sc. Thesis, JNKVV, College of Agriculture, Rewa (M.P.).

Pandey N, Verma AK, Anurag Tripathi RS (2007). Integrated nutrient management in transplanted hybrid rice (*Oryza sativa*). Indian J. Agron. 52(1):40-42.

Parihar SS (2004). Influence of nitrogen and irrigation schedule on yield, water use and economics of rice in summer season. Ann. Plant Soil Res. 6(1):29-31.

Saleque MA, Naher UA, Islan A, Pathan ABMU, Hossain ATMS, Meisner CA (2004). Inorganic and organic phosphorus fertilizer effects on the phosphorus fractionation in wetland rice soils. Soil Sci. Soc. Am. J. 68:1635-1644.

Singh AP, Meshram RK, Sarwagi SK (2005). Blending of urea to enhance nitrogen use efficiency in transplanted low land rice. Ann. Plant Soil Res. 7(1):57-59.

Singh A, Pandey G, Sing RP (2008). Effect of green manuring and nitrogen on productivity of rice – wheat cropping system. Ann. Plant Soil Res. 10(2):191-192

Singh UN, Tripathi BN (2008). Response of rice cultivars to zinc sodic soil. Ann. Plant Soil Res. 10(1):75-77.

Synder FW, Carlson GE (1984). Selecting for partitioning of photosynthesis products in crops. Advan. Agron. 37:47-72.