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Effect of Nitrogen Levels on Growth, Yield Attributes and Yield of Hybrid Varieties of Rice (*Oryza sativa* L.)

Divya Singh [a], Atish Yadav [a*], Ankur Tripathi [a], Subhendu Singh [a] and Anil Kumar Singh [a]

[a] A.N.D. University of Agriculture and Technology, Kumarganj, Ayodhya, U.P., India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

A field experiment was conducted to evaluate the effect of different Nitrogen levels on the yield performance of four rice hybrid in two consecutive Monsoon Season of 2020 and 2021. The experiment was conducted at Agronomy Research Farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj Ayodhya (U.P.). The experiment was conducted in factorial randomized block design with three replication which comprised of 4 levels of nitrogen *viz.* 0% RDN, 50% RDN, 75% RDN and 100% RDN and 4 hybrid varieties *viz.* Arize-6444 Gold, Ankur-7576, 27P31 and Shahi-Dawat. Results revealed that significantly higher yield contributing characters and yield was obtained at 100% of RDN (150 kg N ha^{-1}) which is at par with 75 % RDN (112 kg N ha^{-1}) and significantly superior over 0% of RDN and 50% of RDN (75kg N ha^{-1}). The growth parameters, yield attributes and yield were recorded significantly higher with Ankur-7576 variety except length of panicle (cm) and test weight (g). Ankur-7576 gave good response in low doses of nitrogenous fertilizer and showed good efficiency in utilization of available and applied nitrogen to the crop and best suitable for obtaining higher yield of hybrid rice.

**Corresponding author: Email: atish9241yadav@gmail.com;*

Keywords: Growth parameters; hybrid rice; nitrogen doses; yield attributes.

1. INTRODUCTION

"Rice (*Oryza sativa* L.) is one of the most important cereal crops of the world and it is the staple food in South-East-Asia and at present more than half of the world population depends on this crop" [1]. "It has been suggested that by 2025, global rice production must increase by more than 50% for mid-1990" [2,3]. "Introduction of hybrid rice is an important step towards augmentation of rice yield. Hybrid rice yields about 15-20% more than the promising high-yielding commercial varieties. Earlier studies reveal that judicious and proper use of fertilizers can markedly increase the yield and improve the quality of rice" [4,5].

"Nitrogen is one of the most important plant nutrients and plays a vital role in plant photosynthesis and biomass production. Increasing panicle numbers in per unit area is the main factor of yield increment as a result of nitrogen application" [6,7]. "Nitrogen is the most important and yield-limiting nutrient in rice production worldwide" [8]. Thus it is necessary to find out the suitable rate of nitrogen fertilizers for efficient management and better growth and yield of hybrid rice.

"A suitable amalgamation of hybrid varieties and rate of Nitrogen is necessary for better yield of rice" (BRRI, 1990). Extensive research is necessary to find out the appropriate variety and optimum rate of nitrogen to obtain satisfactory yield of these rice varieties. The present study was conducted to identify the suitable hybrid rice variety and to determine the optimum rate of nitrogen fertilizer for the hybrid rice cultivation in Eastern Uttar Pradesh of India.

2. MATERIALS AND METHODS

A two-year field experiment was conducted during *kharif* season of 2020 and 2021 at Agronomy research farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) situated at a latitude of $26^0.47^{'}$ N and longitude of $82^0.12^{'}$ E, and at an altitude of 113 m above mean sea-level). "The climate of site is semi-arid type with hot summer and cold winter with overall rainfall received during the cropping period (June-September) was 853.8 mm. The soil of the experimental field was silty loam in texture having slightly alkaline in reaction (pH 8.11), low in organic carbon (0.35%) and available nitrogen (145.81 kg ha^{-1}), medium in available phosphorus (13.71 kg ha^{-1}) and available potassium (247.21 kg ha^{-1})" [9].

The experiment was conducted in factorial randomized block design (FRBD) with 16 treatment combinations and three replications. Four doses of nitrogen as N_1: 0% of RDN; N_2: 50% of RDN (75kg ha^{-1}); N_3: 75% of RDN (112 kg ha^{-1}) and N_4: 100% of RDN (150 kg ha^{-1}), while four varieties V_1: Arize -6444 gold; V_2: Ankur-7576; V_3: 27P31 and V_4: Shahi Dawat were taken. "After 25 days old seedlings were removed carefully from nursery bed for transplanting in the experimental plots. Two seedlings were transplanted in each hill with plant geometry of 25 cm and 10 cm. Recommended dose of N, P and K @ 150: 75: 75 kg ha^{-1} (full doses of P_2O_5 and K_2O were applied at the time of transplanting along with 50% of N and rest 25% of N at active tillering stage and 25% of at panicle initiation stage as top dressing)" [9].

The hybrids namely Arize -6444 gold, Ankur-7576, 27P31 and Shahi Dawat were tested for various levels of Nitrogen. The recommended agronomical practices were adopted to raise healthy crop for conducting the experiment. The Phosphorous, Potash and Zn were applied as full doses. The nutrients N, P and K were supplied through the chemical fertilizer urea, single super phosphate and muriate of potash, respectively. In case of Nitrogen, Recommended dose of Nitrogen (RDN) was applied as 150 kg ha^{-1}. The five sample hills were collected from each individual plot for recording various yield attributing characters i.e Plant height (cm), No. of total tillers $hill^{-1}$, No. of effective tillers $hill^{-1}$, No. of effective tillers $m^{-2=}$, Days taken to 50% flowering, Panicle Length (cm) , No. of filled grains $panicle^{-1}$, No. of unfilled grains $panicle^{-1}$and Test wt. (g). For grain and straw yield 1 m^2 area was harvested from center of each plot. The collected data on different parameters were analyzed following analysis of variance (ANOVA) by using OP STAT program.

3. RESULTS AND DISCUSSION

3.1 Growth Indices

Plant height was affected significantly by different nitrogen doses and with different hybrid varieties of rice (Table 1). The plant height increased successively with increase in nitrogen

doses in different varieties. Application of 100% RDN (150 kg N ha^{-1}) recorded significantly higher height (111.3 cm) over other doses of Nitrogen except 75% RDN (112 kg N ha^{-1}).The lowest plant height was recorded with 0 % RDN. Similar result was found by Hossain et al. [10], who found "the tallest plant height from 120 kg N/ha and the shortest was obtained from control". Zhilin et al. [11] stated that "pant height is increased significantly due to nitrogen application". The significantly highest plant height (108.8) was recorded by Ankur-7576 variety compare to Arize 6444 gold (104.9 cm) at 100 % RDN and the lowest plant height (100.4 cm) was recorded by Shahi Dawat variety at 0 % RDN. "Variation of plant height might be due to the differences of their genetic make-up" Shamsuddin et al. [12].

"More or less similar effect of hybrid rice varieties and nitrogen doses in accelerating the height of rice plant" have also been reported by Mishra et al. [13] and Kant et al. [14]. No. of total tillers $hill^{-1}$ recorded at maturity was significantly affected by different nitrogen doses in hybrid varieties of rice (Table 1). Application of 100% RDN (150 kg N ha^{-1}) have significantly higher no. of total tiller $plant^{-1}$ (10.3) over 75 % RDN (112 kg N ha^{-1}), while lower no. of total tiller $hill^{-1}$ recorded under 0 % of RDN. The significantly highest no. of tillers $hill^{-1}$ (9.8) was recorded by Ankur-7576 variety compare to Arize 6444 gold (9.6) at 100 % RDN and the lowest no. of tillers $hill^{-1}$ (8.8) was recorded by 27P31 variety at 0 % of RDN. The difference in numbers of tillers/hill is due to the genetic makeup of the rice varieties. This result is supported by Hossain et al. [10] and Chowdhury et al. (1993) who stated that effective tillers/hill varied with their variety.

3.2 Yield Attributes and Yield

Number of effective tillers $hill^{-1}$ was recorded significantly affected by different nitrogen doses in hybrid varieties of rice (Table 1). Application of 100% RDN (150 kg N ha^{-1}) have significantly higher number effective tiller $hill^{-1}$ (8.6) compared to 75 % RDN (112 kg N ha^{-1}), while lowest number of effective tiller $hill^{-1}$ was recorded (6.3) under 0 % of RDN. The higher effective tillers $hill^{-1}$ (8.9) was recorded by Ankur 7576 variety followed by Arize 6444 gold (7.8) at 100% of RDN. The lowest effective tillers $hill^{-1}$ (6.7) was recorded by 27P31 variety at 0 % of RDN. It indicates that, the Ankur-7576 has capacity to maintain its unique feature of modified new plant type.

No. of effective tillers m^{-1} was significantly affected by different nitrogen doses in hybrid varieties of rice. Application of 100% RDN (150 kg N ha^{-1}) have significantly more effective tiller m^{-1} (330.7) compared to 75 % RDN (112 kg N ha^{-1}), while less effective tiller m^{-1} recorded (250.7) under 0 % of RDN. The higher effective tillers m^{-1} (315.7) was recorded by Ankur 7576 variety followed by Arize 6444 gold (312.4) at 100% of RDN. The lowest effective tillers m^{-1} (264.0) was recorded by 27P31 variety at 0 % of RDN. "The more or less similar results of hybrid rice varieties and nitrogen doses on number of effective tillers per m-2" have also been reported by Banerjee and Pal. [15] and Reddy et al. [16].

Days to 50% flowering was not significantly affected by the different doses of nitrogen in different hybrid varieties of rice (Table 1). While Ankur-7576 taken significantly higher no of days to 50% flowering as compare all other hybrid rice cultivars. Similar pattern was observed in other hybrids also. These results are in close conformity with the findings of Mishra et al. [13] and Reddy et al. [16].

Panicle length was affected by different nitrogen doses and hybrid varieties have been presented in Table 2. The maximum panicle length was recorded in 100% RDN (30.8 cm) followed by 75% RDN (29.7 cm) and lowest panicle length was observed in 0% RDN (27.8 cm). The panicle length was non-significantly affected with hybrid varieties of rice. The results of present investigation in respect of these yield attributes are in close conformity with the findings of Tripathi and Jaiswal (2006), Kant et al. [14] and Reddy et al. [16].

Number of filled grains $panicle^{-1}$ as affected by different nitrogen doses and varieties has been presented in Table 2. 100% of RDN produces significantly higher no. of filled grain $panicle^{-1}$ (122.15) with nitrogen doses except 75 % RDN which was at par with that. Among rice varieties Ankur-7576 produces significantly higher no. of filled grains $panicle^{-1}$ (123.40) which was significantly over all the rest varieties under 100% of RDN and the lowest no. of filled grains $panicle^{-2}$ (90.52) was recorded under zero nitrogen doses for 27P31. The results were also supported by Singh and Gangwer [17] who stated that "varietal differences regarding the number of filled grains/panicle might be due to their differences in genetic constituents".

Number of unfilled grains $panicle^{-1}$ as affected by different nitrogen doses and varieties. Different

nitrogen doses had marked effect on the number of unfilled grains panicles^{-1}. Minimum unfilled grains panicle^{-1} (18.03) was found in 100% of RDN compared to rest of the nitrogen doses. Lower number of unfilled grains panicle^{-1} (18.29) was recorded in Ankur 7576 under 100% of RDN followed by under 75% of RDN of same hybrid. Similar findings were reported by Manzoor et al. [18]; Rahman et al. [19]; Hossain et al. [10]; Mannan et al. [20].

Test weight of rice as affected by different nitrogen doses and varieties (Table 3). Data reveal that application of 100% RDN (150 kg ha^{-1}) was recorded significant higher test weight (23.26 g) followed by (22.7 g) with 75% RDN. The lowest test weight (20.76 g) was recorded under Zero nitrogen doses. The thousand seed weight increased with the nitrogen rate. Bhuiya et al. [21] and Rafey et al. [22] also found that "application of nitrogen 0-60 kg N/ha increased the 1000-grains weight linearly". "However, the individual grain weight is usually a stable varietal character and the management practice has less effect on its variation" [23]. All hybrid rice varieties have non-significant effect on test weight. Grain yield was significantly affected by different nitrogen doses and varieties. Application of 100% RDN recorded significantly higher grain yield (48.5 q ha^{-1}) over all the nitrogen levels except the (47.5 q ha^{-1}) at 75% RDN. 0% RDN was recorded lowest grain yield (36.6 q ha^{-1}).

The hybrid Ankur-7576 has higher grain yield (50.9 q ha^{-1}) under 100% RDN and followed by 75% of RDN, it differs significantly. The lowest grain yield was recorded 27P31 (35.3 q ha^{-1}) under 0% of RDN. Straw yield was significantly as affected by different nitrogen doses and varieties. Application of 100% RDN recorded significantly higher straw yield (90.2 q ha^{-1}) over all the doses of nitrogen except (88.6 q ha^{-1}) at 75% RDN. 0% RDN was recorded lowest straw yield (69.6 q ha^{-1}). The hybrid Ankur-7576 has higher straw yield (91.3 q ha^{-1}) at 100% RDN and followed by 75% of RDN, it differs significantly. The lowest straw yield was recorded 27P31 (68.1 q ha^{-1}) under 0% of RDN. These findings were also confirmed by Bali et al. (1995) and Meena et al. (2003).

Table 1. Growth and yield attributes of transplanted rice as affected by nitrogen doses and hybrid varieties. (Average two-year data)

Treatments	Plant ht. (cm) at harvest	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of effective tillers m^{-2}
Nitrogen doses				
0% RDN	94.8	8.6	6.3	250.7
50% RDN	100.9	9.0	7.2	287.4
75% RDN	108.6	9.7	8.0	310.6
100% RDN	111.3	10.3	8.6	330.7
SEm ±	1.11	0.12	0.43	9.25
CD at 5%	3.22	0.35	1.25	26.82
Hybrid Varieties				
Arize 6444 Gold	104.9	9.6	7.8	312.4
Ankur 7576	108.8	9.8	8.9	315.7
27 P 31	103.6	8.8	6.7	264.0
Shahi Dawat	100.4	9.2	7.3	287.4
SEm ±	1.11	0.12	0.43	9.25
CD at 5%	3.22	0.35	1.25	26.82

Table 2. Yield attributes of transplanted rice as affected by nitrogen doses and hybrid varieties. (Average two-year data)

Treatments	Days taken to 50% flowering	Panicle length (cm)	No. of filled grains panicle^{-1}
Nitrogen doses			
0% RDN	97.3	27.8	93.34
50% RDN	97.5	28.8	109.61
75% RDN	97.6	29.7	118.09

Treatments	Days taken to 50% flowering	Panicle length (cm)	No. of filled grains panicle^{-1}
100% RDN	97.7	30.8	122.15
SEm ±	1.30	0.32	1.96
CD at 5%	NS	0.93	5.68
Hybrid Varieties			
Arize 6444 Gold	96.4	29.5	120.23
Ankur 7576	103.5	29.9	123.40
27 P 31	94.4	29.3	90.52
Shahi Dawat	95.7	28.5	95.76
SEm ±	1.30	0.32	1.96
CD at 5%	3.77	NS	5.68

Table 3. Yield attributes and yield of transplanted rice as affected by nitrogen doses and hybrid varieties. (Average two-year data)

Treatments	No. of unfilled grains panicle^{-1}	Test wt. (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
Nitrogen doses				
0% RDN	23.34	20.76	36.6	69.6
50% RDN	20.98	22.05	42.4	82.9
75% RDN	18.42	22.70	47.5	88.6
100% RDN	18.03	23.26	48.5	90.2
SEm ±	0.73	0.31	1.32	1.46
CD at 5%	2.11	0.87	3.83	4.23
Hybrid Varieties				
Arize 6444 Gold	19.46	22.33	50.3	89.8
Ankur 7576	18.29	22.63	50.9	91.3
27 P 31	25.52	22.26	35.3	68.1
Shahi Dawat	22.67	22.15	38.4	80.8
SEm ±	0.73	0.31	1.32	1.46
CD at 5%	2.11	NS	3.83	4.23

4. CONCLUSION

Based on two-year experimental results, it is recommended that the performance of Ankur-7576 is superior for growth, and yield parameters over all the varieties tested. Trial data revealed that Ankur-7576 gave highest yield at 100% of RDN (150 kg N ha^{-1}) which is at par with 75 % RDN (112 kg N ha^{-1}) and significantly superior over 0 % of Nitrogen and 50 % of RDN (75kg N ha^{-1}). It may be concluded that, Ankur-7576 is giving good response in low doses of nitrogenous fertilizer and shows good efficiency in utilization of available and applied nitrogen to the crop.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Tahir HA, Safdar ME, Mirza MA, Yaqub M. Economic effect of different plant establishment techniques on rice, (*Oryza sativa*) production. Journal Agricultural Research. 2007;45(1):521-529.
2. Peng S, Yang J. Current status of the research on high-yielding and high efficiency in resources use and improving grain quality in rice. Chin. J. Rice Sci. 2003;17:275-280.
3. Walker TW, Bond JA, Ottis BV. Hybrid rice response to nitrogen fertilization for Mid southern United States rice production. Agron. J. 2008;100:381-386.
4. Place GA, Sims JL, Hall UL. Effects of nitrogen and phosphorous on the growth yield and cooking, characteristics of rice. Agron. J. 1970;62:39–41.

5. Manzoor Z, Awan T, Safdar M, Ali R, Mira A, Ahmad M. Effect of nitrogen doses on yield and yield components of basmati 2000. J. Agric. Res. 2006;44(2): 115-121.
6. Bindra AD, Kalia BD, Kumar S. Effect of nitrogen doses and dates of transplanting on growth, yield and yield attributes of scented rice. Advance Agriculture Research. 2000;10:45-48.
7. Laroo N, Shivay YS. Effect of nitrogen and sulphur doses on growth and productivity of scented rice. Current Advan. In Agri. Sci. 2011;3(1):45-48.
8. Lin X, Zhou W, Zhu D, Chen H, Zhang Y. Nitrogen accumulation, remobilization and partitioning in rice (*Oryza sativa* L.) under an improved irrigation practice. Field Crops Research. 2006;96 (2-3):448-454.
9. Pal RP, Singh RP, Maurya S, Mishra H. Response of nitrogen levels under different varieties of hybrid rice on growth, yield and yield attributes (*Oryza sativa* L.) in eastern Uttar Pradesh. The Pharma Innovation Journal. 2021;10(10):2352-2355.
10. Hossain MB, Islam MO, Hasanuzzaman M. Influence of different nitrogen doses on the performance of four aromatic rice varieties. Int. J. Agri. Biol. 2008;10(6):693–696.
11. Zhilin L, Sarker RS, Nayak SK, Ravi I, Li JL. Physiological effect of nitrogen application on aromatic rice. Journal South China Agricultural University. 1997;18: 13-17.
12. Shamsuddin AM, Islam MA, Hossain A. Comparative study on the yield and agronomic characters of nine cultivars of Aus rice. Bangladesh Journal of Agricultural Sciences. 1988;15(1):121-124.
13. Mishra D, Sharma JD, Pandey AK, Mishra RK, Shukla UN, Kumar J. Growth, phenology and yield attributes of hybrid rice (*Oryza sativa* L.) as influenced by different doses of nitrogen. Biochemical and Cellular Archives, Connect Journals. 2014;14(2):0972-5075.
14. Kant K, Bora PK, Telkar SG, Gogoi M. Performance of various rice cultivars under variable nitrogen doses. Journal of Pharmacognosy and Phytochemistry. 2018;7(5):1378-1382.
15. Banerjee H, Pal S. Effect of planting geometry and different doses of nitrogen on hybrid rice. Oryza. 2011;48(3):274-275.
16. Reddy S, Singh V, Mithare P. Evaluation of rice (*Oryza sativa* L.) hybrids on growth and yield under agroclimatic conditions of Allahabad Uttar Pradesh in Kharif season. Journal of Pharmacognosy and Phyto-Chemistry. 2018;7(3):805-810.
17. Singh S, Gangwer B. Comparative studies on production potentials in transitional tall and improved rice cultivars. Journal of Andaman Science Association. 1989; 5(1):81-82.
18. Manzoor Z, Awan HI, Zahid MA and Farz FA. Response of rice crop (Super Basmati) to different nitrogen doses. J. Ani. Plant Sci. 2006;16(1-2): 52-55.
19. Rahman MH, Khatun MM, Mamun MAA, Islam MZ, Islam MR. Effect of number of seedling hill-1 and nitrogen doses on growth and yield of BRRI DHAN32. J. Soil. Nature. 2007;1(2):01-07.
20. Mannan MA, Bhuiya MSU, Hossain HMA, Akhand MIM. Optimization of nitrogen rate for aromatic basmati rice (*Oryza sativa* L.). Bangladesh J. Agril. Res. 2010;35(1):157-165.
21. Bhuiya MSU, Hossain SMA, Kabir SKG. Nitrogen fertilization in rice cv. BR10 after green manuring. Bangladesh Journal of Agricultural Sciences. 1998;16(1):87-92.
22. Rafey A, Khan PA, Srivastava VC. Effect of N on growth, yield and nutrient uptake of upland rice. Indian Journal of Agronomy. 1989;34(2):133-135.
23. Yoshida S. Fundamentals of rice crop science. International Rice Research Institute, Manila, Philippines; 1981.

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