Original Research Article

Effect of nitrogen level on growth, yield attributes and yield of hybrid varieties of rice (*Oryza sativa* L.)

ABSTRACT

A field experiment was conducted during two consecutive seasons of kharif 2020 and 2021 at Agronomy Research Farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj Ayodhya (U.P.) to evaluate the effect of nitrogen level on growth, yield attributes and yield of different hybrid varieties of rice (*Oryza sativa* L.). The experiment was conducted in factorial randomized block design which comprised of 4 levels of nitrogen *viz.* 0 % RDN, 50 % RDN, 75 % RDN and 100 % RDN and 4 varieties *viz.* Arize-6444 Gold, Ankur-7576, 27P31 and Shahi-Dawat. Experiment was replicated three times. Results revealed that significantly higher growth parameters, yield attributes and 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 RDN and 50 % of RDN (75kg N ha^{-1}) were increased at all stages except days taken to 50% flowering. The growth parameters, yield attributes and yield were increased significantly with Ankur-7576 variety except length of panicle (cm) and test weight (g). Ankur-7576 gave good response in low level 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.

Key words: *Growth parameters, hybrid rice, nitrogen levels, yield attributes*

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 (Tahir *et al.*, 2007). It has been suggested that by 2025, global rice production must increase by more than 50% for mid-1990 levels to meet that demand (Peng and Yang, 2003 and Walker *et al.*, 2008). It is a grain plant belonging to the family Poaceae and genus Oryza with chromosome number = 24. Rice cultivation in India is predominantly practiced under transplanting method that involves raising, uprooting and transplanting of seedlings. This technique requires continuous ponding of water. The slogan “Rice is life” is most appropriate for India as this crop plays a vital role in our national food security and is a means of livelihood for millions of rural households. This has to be done against the backdrop of declining natural resource base such as land, water, labour and other inputs and without adversely affecting the quality of environment. There is an urgent need to adopt some innovative technologies to break the yield ceiling in rice.

Among the available technological options to enhance rice production and productivity, hybrid rice is the most practically feasible and readily adoptable technology. To realize the maximum possible benefits of heterosis and to obtain higher yield, it is essential to adopt recommended package of practices for successful cultivation of rice hybrids.

Nitrogen is major input for higher productivity of rice. Among the essential nutrients, nitrogen (N) is the major essential element which is required in large quantities for rice crop.

The most limiting nutrient in irrigated rice is nitrogen and N recovery efficiency is only about 25-40% of applied N in most farmers' fields. 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 (Bindra *et al.* 2000; Laroo and Shivay 2011). Nitrogen mostly lost by leaching, gaseous loss through volatilization and surface run off. Now a day's consumption of N fertilizer is in increasing trend, but its use efficiency is low in most of the production systems. Nitrogen is the most important and yield-limiting nutrient in rice production worldwide (Lin *et al.* 2006).

MATERIAL & METHOD

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}).

The experiment was conducted in factorial randomized block design (FRBD) with 16 treatment combinations and three replications. Four levels 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).

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}.

RESULTS & DISCUSSION

Growth indices

Plant height was recorded as affected significantly by different nitrogen levels in different hybrid varieties of rice (Table-1). At harvest significantly the plant height increased successively with increase in nitrogen level in different varieties. Application of 100% RDN (150 kg N ha^{-1}) recorded more height (111.3 cm) compared to 75% RDN (112 kg N ha^{-1}), While recorded less height (94.8 cm) at 0 % of RDN. The highest plant height (108.8) was recorded by Ankur-7576 variety followed by 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. More or less similar effect of hybrid rice varieties and nitrogen levels in accelerating the height of rice plant have also been

reported by Mishra *et al.* (2014) and Kant *et al.* (2018). No. of total tillers hill^{-1} recorded at maturity was significantly affected by different nitrogen levels in hybrid varieties of rice (Table-1). Application of 100% RDN (150 kg N ha^{-1}) have significantly more no. of total tiller plant^{-1} (10.3) compared to 75 % RDN (112 kg N ha^{-1}), while less no. of total tiller hill^{-1} recorded under 0 % of RDN. The higher no. of tillers hill^{-1} (9.8) was recorded by Ankur 7576 variety followed by Arize 6444 gold (9.6) at 100% of RDN. The lowest no. of tillers hill^{-1} (8.8) was recorded by 27P31 variety at 0 % of RDN. This result was also agreed with the findings of Kant *et al.* (2018).

Yield attributes and yield

No. of effective tillers hill^{-1} was recorded significantly as affected by different nitrogen levels in hybrid varieties of rice (Table-1). Application of 100% RDN (150 kg N ha^{-1}) have significantly more effective tiller hill^{-1} (8.6) compared to 75 % RDN (112 kg N ha^{-1}), while less effective tiller hill^{-1} 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 recorded significantly as affected by different nitrogen levels 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 levels on number of effective tillers per m-2 have also been reported by Banerjee and Pal. (2011) and Reddy *et al.* (2018).

Days to 50% flowering as affected by different levels of nitrogen in different hybrid varieties of rice have been presented in table-1. Application of 100% RDN (150 kg N ha^{-1}) have non-significantly more no. of days to 50% flowering (97.7) compared to 75 % RDN (112 kg N ha^{-1}), while less no. of days to 50% flowering (97.3) recorded under 0 % of RDN. Ankur-7576 was earlier (103.5 DAT) under 75% RDN compared to 100% RDN, which is evident from days to 50% flowering. Similar pattern was observed in other hybrids also. These results are in close conformity with the findings of Mishra *et al.* (2014) and Reddy *et al.* (2018).

Panicle length was affected by different nitrogen level 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 recorded 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.* (2018) and Reddy *et al.* (2018).

No. of filled grains panicle^{-1} as affected by different nitrogen levels and varieties. 100% of RDN produces significantly more no. of filled grain panicle^{-1} (122.15) with nitrogen levels except 75 % RDN which was at par with that. Among rice varieties Ankur-7576 produces significantly more 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 level for 27P31. Similar results were also reported earlier by Manzoor *et al.*, (2006) and Laroo and Shivay (2011).

Number of unfilled grains panicle^{-1} as affected by different nitrogen levels and varieties. Different nitrogen levels 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 levels. 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. (2006); Rahman et al. (2007); Hossain et al. (2008); Mannan et al. (2010).

Test weight of rice as affected by different nitrogen level and varieties (Table 3). Data reveal that application of 100% RDN (150 kg ha^{-1}) was recorded significant effect on 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 level. All hybrid rice varieties have non-significant effect on test weight. Grain yield as affected by different nitrogen level and varieties. Application of 100 % RDN recorded higher grain yield (48.5 q ha^{-1}) followed by (47.5 q ha^{-1}) under 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 level and varieties. Application of 100 % RDN recorded higher straw yield (90.2 q ha^{-1}) followed by (88.6 q ha^{-1}) under 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}) under 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 levels 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 level				
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 level and hybrid varieties. (Average two-year data)

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

CONCLUSION

Based on two-year experimental results, it is recommended that the performance of Ankur-7576 is superior for both growth, yield attributes and yield parameters over all the varieties tested. Trial data revealed that Ankur-7576 gave highest value of growth, yield

attributes and 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 & 50 % of RDN (75kg N ha^{-1}). It may be concluded that, Ankur-7576 is giving good response in low level of nitrogenous fertilizer and shows good efficiency in utilization of available and applied nitrogen to the crop.

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