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Effect of nitrogen application on morphological characters and yield attributes of fine *aman* rice cv. kalizira

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Abstract: An experiment was conducted at the Bangladesh Agricultural University Farm, Mymensingh during the *aman* season of 2005-2006 to investigate the response of different doses of nitrogen application at different growth stages for maximizing yield and yield attributes of fine *aman* rice (cv. kalizira). The experiment consisted of 3 levels of N application namely, 50% of recommended N, 100% of recommended N (150 kg ha^{-1}) and 25% higher than recommended N and 3 different plant growth stages of N application namely transplanting, maximum tillering and panicle initiation stage. The application of single super phosphate, muriate of potash, gypsum and zinc sulphate were same in all the plots at the rate of 125, 67, 20 and 5 kg ha^{-1} respectively. The experiment was laid out in a split plot design (SPD) with three replications. All data were analyzed using the analysis of variance technique and the mean differences were adjusted by DMRT. The results revealed that excluding a few parameters, different doses of nitrogen and nitrogen application stages had significantly influenced yield components. The highest grain yield (3.09 t ha^{-1}) was found in N application at maximum tillering stage due to higher effective tiller $hill^{-1}$ (10.31), filled grains $panicle^{-1}$ (148.58). In case of N dose, 25% higher than recommended dose was superior to other two doses with respect to number of grains $panicle^{-1}$, 1000-grain weight and harvest index. Although the interaction effect of N application stages and levels of N application were statistically insignificant but numerically higher grain yield (3.07 t ha^{-1}) was found in N application at maximum tillering stage under 100% N of recommended dose.
Key words: Growth stages, nitrogen fertilizer, agronomic practice, yield attributes, Kalizira variety.

Introduction

In Bangladesh, rice dominates over all other crops and covers 75% of the total cropped area and 92% peasant grow rice (Rikabdar, 2004). More than 4000 varieties of rice are adopted in different parts of Bangladesh. Some of these have some quality i.e., fineness, aroma, taste and protein content (Kaul *et al.,* 1982). The productivity of fine or aromatic rice is very low (Chander and Jitendra, 1996). But it is the most highly valued rice commodity in Bangladesh Agricultural Trade Market having small grain, pleasant aroma with soft texture upon cooking (Dutta *et al.*, 1998). Inspite of photoperiodic sensitivity and capability to grow under late transplanted condition, Kalizira - a popular fine rice cultivar when transplanted late in September has a poor opportunity to produce enough tillers before reaching its reproductive phase. Among different improved agronomic practices, rate and time of nitrogen application may compensate the yield loss of transplant *aman* rice due to late transplanting. BRRI (1990) reported that nitrogen has a positive influence on the production of effective tillers. But excess amount of nitrogen fertilizer results in lodging of plant, prolonging growing period, delaying maturity and reducing yield (Uddin, 2003).Quite a large number of experiments have so far been carried out through out the world to find out the optimum level of nitrogen in rice. However, in the country sufficient research work have not yet been done on different level of nitrogenous fertilizer especially with late planted fine *aman* rice. The present piece of research work was, therefore, undertaken to find out the response of different doses of nitrogen application at different growth stages for maximizing yield and yield attributes of fine *aman* rice (cv. kalizira).

Materials and Methods

The experiment was conducted at the Bangladesh Agricultural University Farm, Mymensingh during the *aman* season of 2005-2006 to investigate the response of different doses of nitrogen application at different growth stages for maximizing yield and yield attributes of fine *aman* rice (cv. kalizira). The experiment consisted of 3 levels of N application (kg ha^{-1}) namely, 50% of recommended dose of N (N_1), 100% of recommended dose of N (N_2) and 25% higher than recommended dose of N (N_3) and 3 different plant growth stages of N application namely transplanting (T_1), maximum tillering (T_2) and panicle initiation stage (T_3). According to the soil test values and their interpretations, the fertilizers dose were recommended with the help of FRG (2005) namely urea, single super phosphate, muriate of potash, gypsum and zinc sulphate at the rate of 150, 125, 67, 20 and 5 kg ha^{-1} respectively and except urea entire fertilizers were applied as same in all the plots at the time of final land preparation. Urea was applied in three equal splits at transplanting, maximum tillering and panicle initiation stage of the crop. The experiment was laid out in a split plot design (SPD) with three replications. The unit plot size was 5 m x 2 m with an inter-plot and inter-block spacing of 0.5 m and 1.5 m respectively. Thirty days old two healthy seedlings were transplanted per hill in the experimental plots at a plant spacing of 20 cm x 15 cm on 16 September, 2005 and the crop was harvested at maturity on 7 January, 2006. All the intercultural practices such as gap filling, weeding, water and pest management were done in time as and when necessary. Five hills were randomly selected from each plot for data collection excluding border rows. Grain and straw yield were determined from the harvest of central 2.5 m x 2.0 m area in each plot. All the data recorded at harvest, were analyzed using the analysis of variance technique and the mean differences among the treatments were adjusted by DMRT (Gomez and Gomez, 1984).

Results and Discussion

Plant height: Plant height was significantly affected by both the nitrogen application at different growth stage and the amount of nitrogen applied. The tallest plant height was found (148.65 cm) when N was applied at panicle initiation stage. Nahar *et al.* (1996) observed that 100 kg ha^{-1} N application increased the plant height at maximum tillering stage (Table1). On the other hand, the longest plant height was found (150.00 cm) in 25% higher N level

than recommended dose and which was (135.54 cm) statistically similar to 100% N recommended level. In general, it was observed that the results clearly showed that plant height markedly increased by increasing level of N application. These results are in agreement with Li-zhilin *et al.* (1997) that in fine rice by applying nitrogen plant height increased significantly in Basmoti-370 compared with other cultivars (cv. Ratna, HKR-228). Interaction effect of N application stages and N levels did not show any significant difference.

Number of effective tillers hill^{-1}: Number of effective tillers hill^{-1} was significantly affected by both the nitrogen application at different growth stage and the amount of nitrogen applied. When N was applied at maximum tillering stage showed the highest effective tillers hill^{-1}(9.75) which was followed by panicle initiation stage. Shoo *et al.* (1989) stated that number of effective tillers hill^{-1} was the highest with nitrogen applied in 2-3 split dressing at tillering, panicle emergence and flowering stages. The highest number of effective tillers hill^{-1}(10.31) was found from100% of recommended N application. In general, it was observed that the results clearly showed that effective tillers hill^{-1}markedly increased at 100% of recommended dose of N and than declined at 25% higher than recommended dose of N application(Table1).The result is similar to the findings of BINA (1996) that productive tillers hill^{-1} was significantly affected by the level of nitrogen application. Interaction effect of N application stages and N levels was not significantly affected by number of effective tillers hill^{-1}.

Number of non-effective tillers hill^{-1}: Number of non-effective tillers hill^{-1} was significantly affected by the amount of nitrogen applied but not by the nitrogen application at different growth stage. The highest number of non-effective tillers hill^{-1}(2.95) was observed when N applied at transplanting stage and in the study it was higher than panicle initiation stage. The highest non-effective tillers hill^{-1}(3.94) was found from 50% recommended of N application. Interaction effect between N application stage and level of N was not significantly affected by non-effective tillers hill^{-1}.

Panicle length: Panicle length was significantly affected by both the nitrogen application at different growth stage and the amount of nitrogen applied. The longest panicle (21.24 cm) was found when N was applied at tillering stage and there was no significant difference between N application at transplanting and panicle initiation stage. Rao *et al.* (1977) found the longest panicle when nitrogen was applied at tillering and booting stage. The longest panicle (20.92 cm) was found from 100% recommended N level and it was the lowest in 50% N application which was statistically similar to 25% higher than recommended dose of N application (Table1). Azad *et al.* (1995) observed that panicle length increased significantly with increased level of nitrogen from 0 to 75 kg ha^{-1}. Effect of interaction between N application stages and levels of N was not significantly affected by panicle length.

Filled grain panicle^{-1}: Filled grain panicle^{-1} was significantly affected by both the nitrogen application at different growth stage and the amount of nitrogen applied. The highest number of filled grain panicle^{-1} (140.28) was found with N application at tillering stage. The highest filled grain panicle^{-1} (148.58) was observed from 100% of recommended N. Naseem *et al.* (1995) indicated the similar comments that grains panicle^{-1} increased when N fertilizer supplied at optimum level. Effect of interaction between N application stages and levels of N was not significant for the character filled grain panicle^{-1}.

Unfilled grain panicle^{-1}: Unfilled grain panicle^{-1} was significantly affected by both the nitrogen application at different growth stage and the amount of nitrogen applied. The highest unfilled grain panicle^{-1} (26.92) was found with N application at transplanting stage and the lowest (22.81) from N application at tillering stage which was statistically identical to N application at panicle initiation stage (Table 1). Channabasavanna and Setty (1994) observed that sterile spikelets were higher with application of N at transplanting stage than at the maximum tillering stage. On the other hand the highest unfilled grain panicle^{-1} (26.39) was observed from 50% of recommended of N level. At the interaction effect, numerically the highest unfilled grain panicle^{-1} was found when N was applied at transplanting stage with 50% of recommended of N level and the lowest from N application at tillering stage under 50% of recommended N level.

1000-grain weight: 1000-grain weight was not significantly affected by both the nitrogen application at different growth stage and the amount of nitrogen applied and their interaction also show the same results. Numerically almost similar1000-grain weight (gm) was found in all the nitrogen application stages.

Grain yield: Grain yield was significantly affected by both the nitrogen application at different growth stage and the amount of nitrogen applied. The highest grain yield (3.09 t ha^{-1}) was found in N application at maximum tillering stage and it was the lowest (2.52 t ha^{-1}) in transplanting stage which statistically identical to N application at panicle initiation stage. The highest grain yield (3.07 t ha^{-1}) was observed in 100% of recommended N level which was identical to 25% higher than of recommended N level and the lowest (2.38 t ha^{-1}) in 50% of recommended of N level(Table 2). Islam *et al.* (1990) described that grain yield was increased significantly with nitrogen application up to 80 kg ha^{-1} and thereafter the yield response was not found up to 120 kg ha^{-1}. Although the interaction effect of N application stage and level of N was statistically insignificant but numerically higher grain yield (t ha^{-1}) was found in N application at maximum tillering stage under 100% and 50% N level of recommended dose. The rest treatments showed grain yield almost similar.

Straw yield: Straw yield was significantly affected by nitrogen application at different growth stage but the amount of nitrogen application and the interaction effect between N application stages and levels of N was not significant for the character. The highest straw yield (4.44 t ha^{-1}) was found in N application at maximum tillering stage and the lowest (3.80 t ha^{-1}) was found in N application at transplanting stage which statistically identical to N application at panicle initiation stage (Table 2). Salam *et al.* (1988) reported that straw yield was the

highest with split applications of nitrogen also at tillering. Numerically higher straw yield (t ha^{-1}) was found in 100% N level of recommended dose and 25% higher than of recommended N level (Table 2). The results clearly showed that straw yield was markedly increased by increasing level of N. These results on straw yield are in conformity with the findings of Thakur (1993) who obtained increased straw yield of rice with increasing nitrogen level.

Table1. Effect and interaction of N application stage and N levels on plant height and yield attributes at harvest of fine T. *aman* rice (var. Kalizira)

Treatment	Plant height (cm)	Effective tillers $hill^{-1}$	Non-effective tillers $hill^{-1}$	Panicle length (cm)	Filled grain $panicle^{-1}$	Unfilled grain $panicle^{-1}$
T_1	137.90b	7.90b	2.95	20.47	129.28b	26.92a
T_2	141.63ab	9.75a	22.40	20.87	140.28a	22.81b
T_3	148.65a	8.30ab	2.52	21.24	132.44b	23.81b
Level of sig.	*	*	NS	**	**	**
CV(%)	3.48	11.23	16.35.	2.11	3.04	4.27
N_1	135.54b	7.20b	3.94a	20.92	121.33c	26.39a
N_2	142.63ab	10.31a	1.45c	20.77	148.58a	22.93b
N_3	150.00a	8.45ab	2.49b	20.89	132.08b	24.22b
Level of sig.	**	**	NS	**	**	**
CV(%)	3.48	11.23	16.35	2.11	3.04	4.27
T_1 N_1	129.17	6.22	2.30	20.43	117.13	28.82
T_1 N_2	138.97	9.67	1.52	20.47	144.44	25.25
T_1 N_3	145.55	7.82	3.75	20.52	126.27	26.69
T_2 N_1	137.10	8.00	2.27	21.16	124.55	24.27
T_2 N_2	139.77	11.40	1.12	20.59	157.93	21.54
T_2 N_3	148.02	9.87	3.82	20.85	138.36	22.62
T_3 N_1	140.35	7.37	2.90	21.16	122.31	26.08
T_3 N_2	149.15	9.87	1.70	21.26	143.39	22.00
T_3 N_3	156.45	7.67	4.25	21.31	131.61	23.37
Level of sig.	NS	NS	NS	NS	NS	NS
CV(%)	3.48	11.23	16.35	2.11	3.04	4.27

In a column figurers with same letter or with out letters do not differ significantly at the level of 5% as per DMRT. NS = Not significant, ** = 1% level of significant, * = 5% level of significant, T_1= Transplanting stage, T_2 =Maximum tillering stage, T_3 = Panicle initiation stage, N_1= 50% of recommended dose of N, N_2 =100% of recommended dose of N, N_3 = 25% higher than recommended dose of N.

Table 2. Effect and interaction of N application stage and N levels on yield and yield attributes at harvest of fine T. *aman* rice (var. Kalizira)

Treatment	1000-grain Weight (gm)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological Yield (t ha^{-1})	Harvest index (%)
T_1	10.66	2.52b	3.84b	6.44b	39.52b
T_2	10.83	3.09a	4.44a	7.53a	40.93b
T_3	10.81	2.68b	3.80b	6.49b	41.32a
Level of significance	NS	**	**	**	**
CV(%)	6.94	5.44	6.61	5.56	3.74
N_1	10.81	2.38b	3.87	6.34b	37.98b
N_2	10.81	3.07a	4.12	7.20a	42.72a
N_3	10.69	2.85a	4.08	6.93ab	41.07a
Level of significance	**	**	**	**	**
CV(%)	6.94	5.44	6.61	5.56	3.74
T_1 N_1	10.56	2.155	3.79	6.20	36.24
T_1 N_2	10.95	2.89	3.87	6.77	42.75
T_1 N_3	10.48	2.52	3.85	6.37	39.57
T_2 N_1	10.92	2.66	4.08	3.74	39.40
T_2 N_2	10.80	3.42	4.73	8.15	41.89
T_2 N_3	10.78	3.20	4.51	7.71	41.51
T_3 N_1	10.95	2.33	3.75	6.08	38.31
T_3 N_2	10.68	2.91	3.77	6.68	43.52
T_3 N_3	10.82	2.82	3.89	6.71	42.12
Level of significance	NS	NS	NS	NS	NS
CV(%)	6.94	5.44	6.61	5.56	3.74

In a column figurers with same letter or with out letters do not differ significantly at the level of 5% as per DMRT. NS = Not significant, ** = 1% level of significant, * = 5% level of significant, T_1= Transplanting stage, T_2 =Maximum tillering stage, T_3 = Panicle initiation stage, N_1= 50% of recommended dose of N, N_2 =100% of recommended dose of N, N_3 = 25% higher than recommended dose of N

Biological yield: Biological yield was significantly affected by both the nitrogen application at different growth stage and the nitrogen levels of recommended dose. But interaction effect between N application stages and levels of N did not show significant difference in biological yield. The highest biological yield (7.53 t ha^{-1}) was observed in N application at maximum tillering stage and N application at transplanting and panicle initiation stage showed statistically similar that. The highest biological yield (7.20 t ha^{-1}) was observed in 100% of recommended N level and the lowest (6.34 t ha^{-1}) from 50% N application of recommended dose which was identical to 25% higher than of recommended N level (Table 2). Park (1987) observed that high N rate tended to increase biological yield.

Harvest index: Harvest index was significantly affected by both the nitrogen application at different growth stage and the nitrogen levels of recommended dose. But interaction effect between N application stages and levels of N did not show significant difference in harvest index. From Table 2, according to N application, the highest harvest index (41.32%) was observed at panicle initiation stage and it was the lowest (39.52%) at transplanting stage which statistically identical to N application at maximum tillering stage. Park (1987) observed that high N rate tended to increase biological yield and decrease harvest index. Higher and statistically similar harvest index was found in 100% of recommended N level and 25% higher than of recommended N level and it was the lowest in 50% of recommended N level (Table 2).

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