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Optimization of nitrogen rate for three aromatic rice varieties in Patuakhali region

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ABSTRACT

An experiment was conducted at the Agronomy Field Laboratory of Patuakhali Science and Technology University, Dumki, Patuakhali under AEZ-13 during the period from June 2017–December 2017 to optimize the nitrogen rate for three aromatic rice varieties in *Aman* season. The experiment was laid out in a randomized complete block design with three replications. The experiment was consisted of three aromatic rice varieties viz., V_1= BRRI dhan34, V_2= BRRI dhan38 and V_3 = Sakkorkhora and four fertilizer treatments viz., N_0= 0 kg/ha nitrogen (Control), N_1= 30 kg/ha nitrogen, N_2= 45 kg/ ha nitrogen and N_3= 60 kg/ha nitrogen. The unit plot size was 4 m x 2.5 m. The result revealed that application of nitrogen significantly influenced the yield of aromatic rice varieties. The number of effective tillers hill^{-1} (12.00), 1000-grain weight (16.69 g), grain yield (3.44 t ha^{-1}), biological yield (8.05 t ha^{-1}), panicle length (29.44 cm) and harvest index (42.76%) were found highest with 45 kg N ha^{-1} but the highest plant height (152.43 cm) and straw yield (4.64 t ha^{-1}) were found from 60 kg N ha^{-1} and all the characters showed the lowest value in control. The variety BRRI dhan38 showed the best performance among the varieties. The longest plant height (157.08 cm) was found from Sakkorkhora but the longest panicle (28.89 cm), the maximum 1000-grain weight (16.71 g), the maximum grain yield of 3.38 t ha^{-1}, the maximum biological yield (7.87 t ha^{-1}) and harvest index (42.89%) were obtained from BRRI dhan38 and maximum filled grains per panicle (145.99) from BRRI dhan34. Interaction effect showed that BRRI dhan38 when fertilized with 45 kg N ha^{-1} produced maximum grain yield (3.72 t ha^{-1}) and the minimal grain yield (2.93 t ha^{-1}) was obtained from BRRI dhan34 fertilized without N.

INTRODUCTION

Rice is the stable food for more than half of the world population and it provides 21% and 15% per capita of dietary energy and protein, respectively (Maclean et al., 2002). Rice is grown in three seasons namely *Aus* (Mid- march to mid -August) *Aman* (Mid June to November) *Boro* (Mid December to mid- June). In Bangladesh, more than four thousand landraces of rice are adopted in different parts of this country. Some of these are unique for quality traits including fineness, aroma, taste and protein contents (Kaul et al., 1982). But most high quality cultivars are low yielding (Shakeel et al., 2005).

Aromatic rice is the most highly valued rice commodity in Bangladesh agricultural trade markets having small grain pleasant aroma with soft texture upon cooking (Dutta *et al*., 1998). The rice is used in many ways by the people like polao, khir, finny, jarda etc. Most of the aromatic rice varieties in Bangladesh are traditional type, photoperiod sensitive and are grown during transplanted *aman* season in the rainfed lowland ecosystem (Islam et al., 1996). The yield of aromatic rice is lower (Gangaiah & Prasad, 1999) but its higher price and low cost of cultivation generated higher profit margins than other varieties (Farook et al., 1999). Production of aromatic rice in Bangladesh is becoming popular due to its high prices and export potentiality (Dutta et al., 2002). Farmers' net income was increased by 23% with the adoption of modern varieties (Shrestha et al., 2002).

Nitrogen is one of the major nutrient elements for aromatic rice production that influence the growth

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and yield of the aromatic rice. For increasing yield in aromatic rice, appropriate management of N fertilizers are needed. Efficient fertilizer management gives higher yield of crop and reduces fertilizer cost. To minimize the losses of nitrogen, the slower release of nitrogenous fertilizer has been advocated with deep placement. Considering the above facts, the recent study was conducted to identify the suitable aromatic rice variety and to determine the optimum rate of nitrogen fertilizer for the three aromatic fine rice cultivation.

MATERIALS AND METHODS

The experiment was carried out at the Agronomy Field Laboratory of Patuakhali Science and Technology University, Dumki, Patuakhali, Bangladesh during the period from June 2017 – December 2017 to optimize the nitrogen rate for three aromatic rice varieties in *Aman* season under AEZ-13 tidal ecosystem. The experimental field was located at 22° 27′ 57.96″ N latitude and 90° 22′ 56.64″ E longitude having an altitude of 1.5 m above the mean sea level. The experiment was laid out in randomized complete block design with three replications. The experiment was consisted of three aromatic rice varieties viz., BRRI dhan34, BRRI dhan38 and Sakkorkhora and four fertilizer treatments viz., N_0= 0 kg/ha nitrogen (Control), N_1= 30 kg/ha nitrogen, N_2= 45 kg/ha nitrogen and N_3= 60 kg/ha nitrogen. The unit plot size was 4 m x 2.5 m. All cultural practices were done uniformly as per recommendation. Whole plots were harvested to obtain grain yield. Data recorded for different parameters were compiled and tabulated in proper form for statistical analysis. The collected data were statistically analyzed using "Analysis of variance technique" with the help of computer package MSTAT. The mean differences among the treatments were tested with Duncan's Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Plant height

The nitrogen @ 60 kg ha^{-1} produced significantly the longest plant (152.43 cm) (Table 1). The shortest plant (137.91 cm) was produced by rice grown without nitrogen (0 kg N ha^{-1}). The result was in line with findings of Mannan et al. (2010) who reported that, increasing the different levels of N in soil significantly influenced growth in rice crop. Table 2 shows that Sakkorkhora produced the longest plant (157.08 cm) followed by BRRI dhan34 (149.87 cm); while the shortest plant (132.28 cm) was obtained from BRRI dhan38. Hasan (2007) and BRRI (2000) found that plant height differed significantly among the varieties.

Table 1
Effect of nitrogen levels on plant height, number of effective tillers $hill^{-1}$ and panicle length of aromatic rice varieties.

Nitrogen levels	Plant height (cm)	Number of effective tillers $hill^{-1}$	panicle length
0 kg (Control)	137.91 d	10.03 d	27.06 c
30 kg	144.85 c	11.19 c	27.23 c
45 kg	150.44 b	12.00 a	29.44 a
60 kg	152.43 a	11.44 b	28.28 b
Level of significance	**	**	**
CV (%)	3.24	8.30	3.20

Figures in a column followed by different letters differ significantly, but with common letter (s) do not differ significantly at 5% level of probability by DMRT. ** = Significant at 1%.

Table 2
Effect of variety on plant height, number of effective tillers hill^{-1} and panicle length of aromatic rice varieties.

Variety	Plant height (cm)	Number of effective tillers hill^{-1}	panicle length
BRRI dhan34	149.87 b	11.08 b	28.09 b
BRRI dhan38	132.28 c	11.72 a	28.89 a
Sakkorkhora	157.08 a	10.71 c	27.03 c
Level of significance	**	*	**
CV (%)	3.24	8.30	3.20

Figures in a column followed by different letters differ significantly, but with common letter (s) do not differ significantly at 5% level of probability by DMRT. * and ** = Significant at 5 and 1%, respectively.

Table 3
Interaction effect of different nitrogen levels and variety on plant height, number of effective tiller hill^{-1} and panicle length of aromatic rice varieties.

Nitrogen levels × Variety		Plant height (cm)	Number of effective tillers hill^{-1}	panicle length
0 kg N ha^{-1}	BRRI dhan34	140.74 c	10.10 f	27.59
	BRRI dhan38	129.65 e	10.63 ef	28.48
	Sakkorkhora	143.33 bc	9.37 g	25.10
30 kg N ha^{-1}	BRRI dhan34	141.13 c	10.90 de	27.08
	BRRI dhan38	132.71 cd	11.87 b	27.68
	Sakkorkhora	160.70 ab	10.80 e	26.93
45 kg N ha^{-1}	BRRI dhan34	157.71 b	11.77 b	29.21
	BRRI dhan38	132.01 d	12.80 a	30.33
	Sakkorkhora	161.60 ab	11.43 cd	28.77
60 kg N ha^{-1}	BRRI dhan34	159.90 b	11.53 c	28.47
	BRRI dhan38	134.73 d	11.57 c	29.07
	Sakkorkhora	162.67 a	11.23 d	27.30
Level of significance		**	**	NS
CV (%)		3.24	8.30	3.20

Figures in a column followed by different letters differ significantly, but with common letter (s) do not differ significantly at 5% level of probability by DMRT. ** = Significant at 1%. NS= Not significant.

Number of effective tillers hill^{-1}

The rice plant produced the maximum (12.00) number of effective tillers hill^{-1} fertilized with 45 kg N ha^{-1} and the lowest number (10.03) of effective tillers hill^{-1} was obtained from control treatment of nitrogen (Table 1). The maximum number of effective tillers hill^{-1} was produced by BRRI dhan38 (11.72). The minimum number of effective tillers hill^{-1} (10.71) was obtained from Sakkorkhora (Table 2).

Panicle length

From the table 1, it was noticed that the panicle length was the longest (29.44 cm) at 45 kg N ha-1 and the shortest (27.06 cm) panicle was found at control treatment. The result of Table 2 showed that BRRI dhan38 produced the longest panicle (28.89 cm) while the shortest panicle (27.03 cm) was obtained from Sakkorkhora.

Grain Yield

Application of nitrogen significantly influenced grain yield per hectare. The rice plant produced the maximum grain yield (3.44 t ha^{-1}) when fertilized with 45 kg N ha^{-1}. The lowest (2.99 t ha^{-1}) grain

yield was obtained from rice grown without N (0 kg N ha^{-1}). Miah et al. (2006) stated that USG increased an average of 20% rice yield in tidal flooded condition. Varieties of rice exerted significant variation in respect of production of grain yield. The maximum grain yield of 3.38 t ha^{-1} was obtained from BRRI dhan38 (Figure 2). The lowest (3.09t ha^{-1}) grain yield. Hossain et al. (2003) observed that the grain yield varied among varieties of *aman* rice.

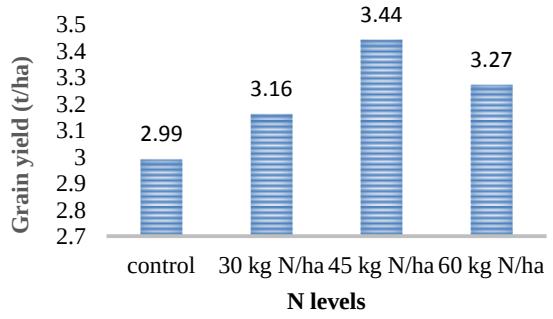

Figure 1
Effect of different nitrogen levels on grain yield of aromatic rice varieties.

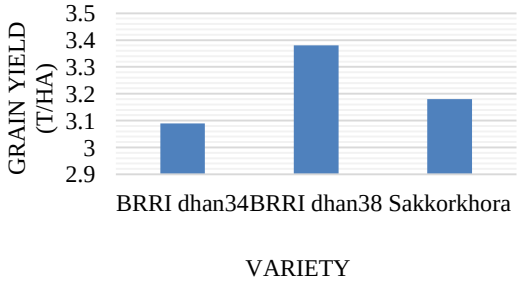

Figure. 2

Effect of variety on grain yield of aromatic rice varieties.

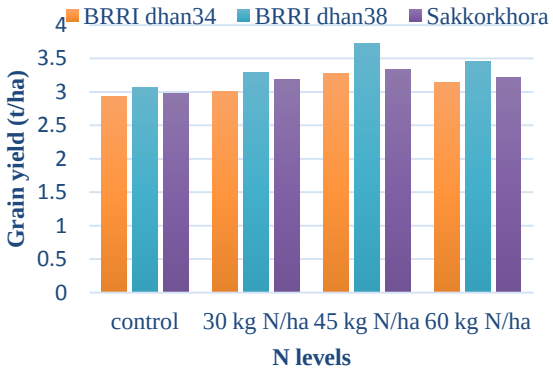

Figure 3
Interaction effect of different nitrogen levels and variety on grain yield of aromatic rice varieties.

Number of filled grains $panicle^{-1}$

The fertilization of 45 kg N ha^{-1} produced the highest number of grains $panicle^{-1}$ (139.61) and the lowest (112.61) was obtained from the nitrogen level 0 kg ha^{-1} (Table 4). Similar result was stated by Kumar et al. (2003) who stated that number of grains $panicle^{-1}$ increased significantly with the application of N. BRRI dhan34 treated with 45 kg N ha^{-1} produced the maximum number of grains $panicle^{-1}$ (169.10). The lowest number of grains $panicle^{-1}$ (105.27) was obtained from Sakkorkhora grown without N (Table 6).

Table 4
Effect of different nitrogen levels on number of filled grains $panicle^{-1}$, Straw yield and 1000 grain weight of aromatic rice varieties.

Nitrogen levels	number of filled grains $panicle^{-1}$	Straw yield	1000 grain weight (g)
0 kg (Control)	112.61 d	4.41 d	15.16
30 kg	124.68 c	4.42 c	15.47
45 kg	139.61 a	4.61 b	15.69
60 kg	129.73 b	4.64 a	15.56
Level of significance	**	**	NS
CV (%)	3.05	3.88	0.62

Figures in a column followed by different letters differ significantly, but with common letter (s) do not differ significantly at 5% level of probability by DMRT. ** = Significant at 1%. NS= Not significant.

Table 5
Effect of variety on number of filled grains panicle^{-1}, Straw yield and 1000 grain weight of aromatic rice varieties.

Variety	number of filled grains panicle^{-1}	Straw yield	1000 grain weight (g)
BRRI dhan34	145.99 a	4.57 a	13.76 c
BRRI dhan38	120.13 b	4.49 b	16.71 a
Sakkorkhora	113.86 c	4.51 b	15.95 b
Level of significance	**	**	**
CV (%)	3.05	3.88	0.62

Figures in a column followed by different letters differ significantly, but with common letter (s) do not differ significantly at 5% level of probability by DMRT. ** = Significant at 1%.

Table 6
Interaction effect of different nitrogen levels and variety on number of filled grains panicle^{-1}, Straw yield and 1000 grain weight of aromatic rice varieties.

Nitrogen levels × Variety		Number of filled grains panicle^{-1}	Straw yield	1000 grain weight (g)
0 kg N ha^{-1}	BRRI dhan34	119.83 e	4.38 d	13.38 h
	BRRI dhan38	112.73 f	4.37 d	16.37 bc
	Sakkorkhora	105.27 g	4.49 c	15.73 e
30 kg N ha^{-1}	BRRI dhan34	141.87 c	4.36 d	13.80 g
	BRRI dhan38	118.03 e	4.48 c	16.71 b
	Sakkorkhora	114.13 ef	4.43 e	15.91 d
45 kg N ha^{-1}	BRRI dhan34	169.10 a	4.86 a	13.98 f
	BRRI dhan38	128.53 d	4.59 b	16.95 a
	Sakkorkhora	121.20 de	4.38 d	16.15 c
60 kg N ha^{-1}	BRRI dhan34	153.17 b	4.66 b	13.87 fg
	BRRI dhan38	121.20 de	4.52 bc	16.81 ab
	Sakkorkhora	114.83 ef	4.74 a	16.01 cd
Level of significance		**	*	**
CV (%)		3.05	3.88	0.62

Figures in a column followed by different letters differ significantly, but with common letter (s) do not differ significantly at 5% level of probability by DMRT. * and ** = Significant at 5 and 1%, respectively.

Straw yield

Table shows that the highest straw yield (4.64 t ha^{-1}) was recorded from 60 kg N ha^{-1}, while the lowest (4.41 t ha^{-1}) was recorded from the 0 kg N ha^{-1}. Fertilizer management differences regarding straw yield were also reported by Shah et al. (2013) and Das (2011). Data of Table 4.8 showed that the maximum (4.57 t ha^{-1}) straw yield was obtained from BRRI dhan34, while minimal of that was produced by BRRI dhan38 (4.49 t ha^{-1}) that was statistically similar to that of Sakkorkhora (4.51). Hasan (2007) stated that straw yield differed significantly among the varieties.

1000 grain weight

The maximum (15.69 g) thousand grain weight was obtained from 45 kg N ha-1 while the minimum (15.16 g) was recorded from the 0 kg N ha-1 (Table 4). BRRI dhan38 produced heavier seeds than others varieties (Table 5). Rahman et al. (2002) reported that the weight of thousand grains varied among varieties. The maximum 1000 grain weight of 16.95 g was obtained from BRRI dhan38 fertilized with 45 kg N ha-1 and the lowest (13.38 g) in BRRI dhan34 having no N (Table 6).

CONCLUSION

It may be concluded from the present study that application of N @ 45 kg ha^{-1} showed the best performance in respect of yield and yield attributes of aromatic rice varieties. BRRI dhan38 gave the highest yield among the aromatic rice varieties and coupled with N @ 45 kg ha^{-1} gave the best performance in respect of growth and yield.

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