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Performance of Aromatic Local Fine Rice Varieties under Different Rates of Fertilizers Application in *Haor* Area

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Abstract—*The experiment was conducted at the farmers' fields of two villages namely Bahadurpur and Noagaon at Sadar upazilla and Daskin Sunamganj, respectively under Dekar haor (wet land) of Sunamganj district, Bangladesh November, 2016 to May 2017 to find out the performance of local fine rice varieties under different rates of fertilizers application in haor area. Two varieties viz. Atobshail (V_1) and Tapi boro (V_2) and six fertilizers package treatments- F_1= Recommended Fertilizer Dose, RFD (N P K S and Zn @ 69- 22.4- 31.7- 6.7- 0.65 kg ha^{-1}), F_2= RFD - 10 kg N, F_3= RFD - 20 kg N, F_4= IPNS (2.5 t cowdung ha^{-1} as organic fertilizer + inorganic fertilizer), F_5=IPNS (2.5 t poultryliter ha^{-1} as organic fertilizer + inorganic fertilizer) and F_6= Farmers' practice, FP (N P and K @ 41.4- 4.2- 10.5 kg ha^{-1}) were included in the experiment. The experiment was laid out in a two factors Completely Randomized Block Design (RCBD) with three replications. Data were collected on growth, yield and yield contributing characters of rice. Plant height responded significantly due to different varieties except at 15 DAT. The higher plant height (140.4 cm) was found in Tapi boro at harvest. Plant height also showed significant variation due to application of different fertilizer doses at 60 DAT, 75 DAT and at harvest. The longest plant (140.8 cm) was produced for application of IPNS (2.5 t CD ha^{-1}) based fertilizer at harvest. The higher number of tillers hill^{-1} (21.4) was produced in Tapi boro at harvest. Number of tillers hill^{-1} at harvest showed significant response due to application of different fertilizer doses. The highest number of tillers hill^{-1} (33.9) was produced due to application of IPNS (2.5 t CD ha^{-1}) based fertilizer. The grain and straw yield varied significantly between the varieties. The higher grain yield of 2.06 t ha^{-1} and straw yield of 4.15 t ha^{-1} was produced by Tapi boro. The grain and straw yield varied significantly due to application of different fertilizer doses. The highest grain yield of 2.45 t ha^{-1} and straw yield of 4.65 t ha^{-1} was produced due to application of fertilizers as per IPNS (2.5 t CD ha^{-1}). It was concluded that Tapi boro with application of IPNS (2.5 t cowdung ha^{-1}) based fertilizers may be suggested for the farmers' in the haor area.*

Keywords*: Variety, Fertilizert, Local Fine rice, Haor.*

1. INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food of more than half of the world's population. Among the leading rice growing countries of the world, Bangladesh ranks fourth in both rice area and production [2]. Rice grain is categorized into coarse, medium and fine according to size and 1000 grains weight. In Bangladesh, a number of fine rice cultivars are grown by the farmers dominated in T. aman season. A few number of aromatic fine rice is cultivating by the farmers in boro season. Some of them have special appeal for their aroma. Such common cultivars are Atobshail, Tapiboro, Rataboro, Begunbichi, Chinisagar, Basmati, Badshabhog, Kalizira, Tulsimla, Dulabhog etc. Fine rice is mainly used by the people in the preparation of palatable dishes and sold at a higher price in the market due to its special appeal for aroma and acceptability. Bangladesh has already exported fine rice in different countries with small quantities. Bangladesh has bright prospect for export of these fine rice thereby earning foreign exchange. There are many *haors* (basin like structure) where water remains either stagnant or in flash flooding condition during the months of late May to Octoer and mainly Boro rice is grown in the Rabi season. Geographically, most of the *haors* are situated in seven districts of the North-East Bangladesh [7]. In terms of ecosystem, crop production practices, economic activities and over all livelihood of the farmers of *haor* areas are quite different from those of the other parts of the country. Early flood, hailstorm and drought are the main constraints to grow modern boro rice. The available statistics indicate that the total cultivated area in those *haor* districts is about 1.99 million hectares of which 0.85 million ha is under *haor*. Almost 80% of this area is covered by Boro rice [4]. So, there is a great possibility of growing fine rice as well as other rice with improved management to get higher yields.

Objectives:

i. To investigate the suitability of local fine rice varieties in the *haor* areas.

ii. To find out the optimum fertilizers dose of local boro fine rice varieties in *haor* areas.

2. MATERIALS AND METHODS

The experiment was conducted at the farmers' fields of two villages namely Bahadurpur and Noagaon at Sadarupazila and Daskin Sunamganj, respectively under Dekar *haor* of Sunamganj district, Bangladesh during the period from November, 2016 to May 2017. Two varieties viz. Atobshail (V_1) and Tapi boro (V_2) and six fertilizers package treatments- $F_{1=}$ Recommended Fertilizer Dose, RFD (N P K S and Zn @ 69- 22.4- 31.7- 6.7- 0.65 kg ha^{-1}), F_2= RFD - 10 kg N, F_3= RFD - 20 kg N, F_4= IPNS (2.5 t CD ha^{-1} as organic fertilizer + inorganic fertilizer), F_5=IPNS (2.5 t Pl ha^{-1} as organic fertilizer + inorganic fertilizer) and F_6= Farmers' practice, FP (N P and K @ 41.4- 4.2- 10.5 kg ha^{-1}) were included in the experiment. The initial soil properties of the experimental sites were pH 5.27, total-N 0.089%, organic carbon 0.90 %, organic matter 1.55 %, exchangeable K 0.14 meq 100 g^{-1} soil, available P 6.5 µg g^{-1} soil, available S 17.67µg g^{-1} soil and available Zn 0.137 mg kg^{-1} soil. Soil texture, pH, organic matter, available P and S, Zn and exchangeable K, were determined following standard methods [1,6,9,10,12]. Seeds were sown in seedbed on 28 November 2016. Seedlings were transplanted on 6 January 2017 at 25 cm × 15 cm spacing. Cowdung and Poultry liter were applied 10 days before final land preparation. TSP, MoP, Gypsum and Zinc sulphate were applied during final land preparation. Urea was applied as top dressing in three equal splits at 20, 35 and 55 days after transplanting. Two hand weeding were done during crop growth. Five hills were tagged for measuring the plant heights and counting the tillers. Harvesting was done on 15 April 2017. Ten sample hills were collected from each plot to record the agronomic characters. The grain and straw yields were recorded from whole plot. The data were analyzed following randomized complete block design and mean separation was done by DMRT [3].

3. RESULTS AND DISCUSSION

Plant heights were responded significantly due to different varieties except at 15 DAT (Table 1). The higher plant height (140.4 cm) was found in Tapi boro at harvest. Plant height showed significant variation due to application of different fertilizer doses at 60 DAT, 75 DAT and at harvest (Table 1). The longest plant (140.8 cm) was produced for application of IPNS (2.5 t CD ha^{-1}) based fertilizer at harvest [11]. Plant height also varied significantly due to interaction of different varieties and application of different fertilizer doses except at 15 DAT, 30 DAT and 75 DAT (Table 1).

The higher number of tillers $hill^{-1}$ (21.4) was produced in Tapi boro at harvest (Table 2). Number of tillers $hill^{-1}$ at harvest showed significant response due to application of different fertilizer doses. The highest number of tillers $hill^{-1}$ (33.9) was produced due to application of IPNS (2.5 t CD ha^{-1}) based fertilizer [13] (Table 2). Number of tillers $hill^{-1}$ varied significantly due to interaction of different fertilizer doses and different varieties except at 60 DAT (Table 2).

The effective tillers $hill^{-1}$ significantly varied between the varieties (Table 3). The higher number of effective tillers $hill^{-1}$ (17.6) was produced in Tapi boro. The higher number of grains $panicle^{-1}$ (109.4) was produced by Tapi boro. Sterile spikelets $panicle^{-1}$ did not significantly vary between the varieties. The higher number of sterile spikelets $panicle^{-1}$ (33.0) was produced by Atobshail. Panicle length significantly differed between the varieties. The longer panicle (20.6 cm) was produced by Atobshail. Thousand grains weight significantly varied between the varieties. The higher 1000 grains weight (18.0 g) was found in Tapi boro. The grain and straw yield varied significantly between the varieties. The higher grain yield of 2.06 t ha^{-1} and straw yield of 4.15 t ha^{-1} was produced by Tapi boro.

The effective tillers $hill^{-1}$ significantly varied due to application of different fertilizer doses (Table 3). The highest number of effective tillers $hill^{-1}$ (31.5) was produced due to application of IPNS (2.5 t CD ha^{-1}) based fertilizer. Number of grains $panicle^{-1}$, sterile spikelets $panicle^{-1}$ and panicle length significantly varied due to application of different fertilizer doses. The highest number of grains $panicle^{-1}$(126.7), sterile spikelets $panicle^{-1}$ (36.1) and the longest panicle (22.9 cm) was produced for application of RFD. The variation of 1000 grains weight was not significant due to application of different fertilizer doses. The grain and straw yield varied significantly due to application of different fertilizer doses. The highest grain yield of 2.45 t ha^{-1} and straw yield of 4.65t ha^{-1} was produced due to application of fertilizers as per IPNS (2.5 t CD ha^{-1}) [5].

The effective tillers $hill^{-1}$, grains $panicle^{-1}$, sterile spikelets $panicle^{-1}$, and panicle length were significantly varied due to interaction of different varieties and application of different fertilizer doses (Table 3). The grain and straw yield varied significantly due to interaction of different fertilizer doses and different varieties (Table 3). The highest grain yield of 2.54 t ha^{-1} and straw yield of 4.21t ha^{-1} was produced due to interaction of Tapi boro and application of IPNS (2.5 t CD ha^{-1}) [8].

Table 1: Plant heights of local fine boro rice at different DAT as affected by variety, fertilizer and their interactions in the *haor* area

Treatments	Plant height (cm)					
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	Harvest
Variety						
Atobshail	34.8	46.85 b	64.96 b	89.52 b	107.85 b	132.72 b
Tapi boro	36.4	48.84 a	68.47 a	90.06 a	112.04 a	140.44 a
LS	NS	*	**	**	*	**
Fertilizer						
RFD	36.0	46.9	68.6	93.95 a	113.46 ab	138.25 abc
RFD-10 kg N	35.3	49.2	69.5	90.42 b	114.85 a	139.12 ab
RFD-20 kg N	36.6	49.8	67.3	89.15 c	112.44 abc	136.09 c
IPNS (2.5 t CD ha^{-1})	34.0	45.8	64.3	87.82 d	106.92 bc	140.84 a
IPNS (2.5 t Pl ha^{-1})	35.5	47.2	65.4	90.43 b	106.73 bc	137.92 bc
FP	36.2	48.0	64.9	87.06 e	105.24 c	127.54 d
S_x	-	-	-	2.710	2.429	0.877
LS	NS	NS	NS	**	*	**
Variety × Fertilizer						
V_1F_1	36.9	48.2	68.40 bc	97.60 a	117.4	133.15 f
V_1F_2	33.8	46.3	67.20 bcd	88.60cde	109.4	132.96 f
V_1F_3	35.6	49.6	65.87 d	86.93 de	109.8	130.24 g
V_1F_4	33.0	43.5	62.13 e	86.93 de	104.2	136.57 e
V_1F_5	35.1	46.9	63.40 e	89.53bcde	102.8	135.59 e
V_1F_6	34.6	46.4	62.80 e	87.80cde	103.3	128.22 h
V_2F_1	35.0	45.6	68.87 b	90.20bcd	109.4	143.41 b
V_2F_2	36.8	52.0	71.93 a	92.33 b	120.2	145.33 a
V_2F_3	37.6	50.0	68.87 b	91.33bc	115.0	141.85 c
V_2F_4	35.0	48.0	66.47 d	88.80bcde	109.6	145.16 a
V_2F_5	36.0	47.5	67.40 bcd	91.33bc	110.5	140.34 d
V_2F_6	37.8	49.6	67.07 cd	86.27 e	107.0	126.81 i
S_x	-	-	0.543	1.106	-	0.358
LS	NS	NS	**	**	NS	**

In a column, figure(s) having common letter(s) do not differ significantly but different letter(s) indicate significantly different.** = Significant at 1 % level of probability; * = Significant at 5 % level of probability, NS=Not significant, LS= Level of significance, FP= Farmers' practice (N P and K @ 41.4- 4.2- 10.5 kg ha^{-1}), RFD= Recommended Fertilizer Dose (N P K S and Zn @ 69- 22.4- 31.7- 6.7- 0.65 kg ha^{-1}), IPNS= Integrated plant nutrient system. V_1= Atobshail, V_2= Tapi boro, F_1= RFD, F_2= RFD- 10 kg N ha^{-1}, F_3= RFD- 20 kg N ha^{-1}, F_4=IPNS(2.5 t CD ha^{-1}), F_5= IPNS (2.5 t PL ha^{-1}) and F_6=FP.

Table 2: Tiller production of local fine boro rice at different DAT as affected by variety, fertilizer and their interactions in the *haor* area

Treatments	Tillers $hill^{-1}$ (no.)					
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	Harvest
Variety						
Atobshail	3.23 b	9.52 b	19.1	25.86 a	29.12 a	20.34 b
Tapi boro	4.75 a	13.13 a	19.1	24.92 b	25.84 b	21.42 a
LS	**	**	NS	**	**	**
Fertilizer						
RFD	3.96 a	11.05 b	19.34 ab	27.8	23.12 a	28.42 b
RFD-10 kg N	3.70 b	11.54 b	19.95 a	24.7	20.73 b	24.83 c
RFD-20 kg N	3.36 c	12.32 a	20.16 a	24.6	20.94 b	24.91 c
IPNS (2.5 t CD ha^{-1})	3.96 a	11.23 b	18.67 c	26.4	19.92 c	33.90 a
IPNS (2.5 t Pl ha^{-1})	4.00 a	11.42 b	18.42 c	25.4	21.23 b	30.32 b
FP	3.86 b	10.64 bc	18.31 c	23.3	19.35 d	22.54 c
S_x	0.467	0.956	1.065	-	1.313	0.997
LS	**	**	**	NS	**	**
Variety × Fertilizer						
V_1F_1	3.46 de	10.13 cd	22.00 a	28.6	23.27 a	34.20 b
V_1F_2	3.60 de	10.80 c	20.07 bc	23.0	19.20 efg	24.27 f
V_1F_3	3.13 ef	9.53 de	19.20 c	23.7	20.07 def	26.20 e
V_1F_4	3.40 de	9.53 de	16.93 d	26.4	18.53 fg	35.63 a
V_1F_5	2.80 f	8.66 e	20.07 bc	27.6	23.07 ab	32.47 c
V_1F_6	3.06 ef	8.60 e	16.40 d	25.8	18.10 g	22.23 h
V_2F_1	4.46 c	12.00 b	16.73 d	27.0	23.03 ab	22.67 gh
V_2F_2	3.80 d	12.33 b	19.80 bc	26.5	22.20 abc	25.50 e
V_2F_3	5.60 a	15.07 a	21.00 ab	25.5	21.70 abcd	23.67 fg
V_2F_4	4.53 c	13.00 b	20.27 bc	26.4	21.41 bcd	32.17 c
V_2F_5	5.20 ab	14.13 a	16.87 d	23.2	19.40 efg	28.13 d
V_2F_6	4.66 bc	12.60 b	20.27 bc	20.8	20.62 cde	22.87 gh
S_x	0.190	0.390	0.434	-	0.536	0.407
LS	**	**	**	NS	**	**

In a column, figure(s) having common letter(s) do not differ significantly but different letter(s) indicate significantly different.** = Significant at 1 % level of probability; * = Significant at 5 % level of probability, NS=Not significant, LS= Level of significance, FP= Farmers' practice (N P and K @ 41.4- 4.2- 10.5 kg ha^{-1}), RFD= Recommended Fertilizer Dose (N P K S and Zn @ 69- 22.4- 31.7- 6.7- 0.65 kg ha^{-1}), IPNS= Integrated plant nutrient system. V_1=

Atobshail, V_2= Tapi boro, F_1= RFD, F_2= RFD- 10 kg N ha^{-1}, F_3= RFD- 20 kg N ha^{-1}, F_4=IPNS(2.5 t CD ha^{-1}), F_5= IPNS (2.5 t PL ha^{-1}) and F_6=FP.

Table 3: Yield and yield contributing characters of local fine boro rice as affected by variety, fertilizer and their interactions in the *haor* area

Treatments	Yield and yield contributing characters						
	Effective tillers $hill^{-1}$ (no.)	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	Panicle length (cm)	1000 grains weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Variety							
Atobshail	16.32	105.62	33.05	20.68 a	17.85 b	1.86 b	3.52 b
Tapi boro	17.66	109.44	31.52	20.22 b	18.06 a	2.06 a	4.15 a
LS	NS	NS	NS	**	**	**	*
Fertilizer							
RFD	28.40 b	126.72 a	36.12 a	22.90 a	18.2	1.87 c	4.16 b
RFD-10 kg N	24.02 c	100.83 c	29.03 b	19.75 bc	17.7	1.87 c	3.67 de
RFD-20 kg N	25.05 c	96.10 c	31.14 b	19.82 bc	17.5	1.75 cd	3.51 e
IPNS (2.5 t CD ha^{-1})	31.52 a	115.75 b	30.05 b	20.91 b	19.0	2.45 a	4.65 a
IPNS (2.5 t Pl ha^{-1})	29.03 ab	110.24 b	31.66 b	20.03 bc	17.9	2.21 b	3.93 c
FP	23.87 c	95.83 c	35.80 a	19.15 c	17.3	1.62 d	3.71 d
S_x	0.977	3.103	1.018	0.486	-	0.057	0.056
LS	**	**	**	**	NS	**	**
Variety × Fertilizer							
V_1F_1	32.27 a	136.45 a	32.94 e	23.45 a	18.0	1.81 d	4.01 d
V_1F_2	23.30 e	92.26 e	27.63 h	19.42 e	17.0	1.73 e	3.52 g
V_1F_3	25.17 d	96.17 e	38.35 cd	20.05 de	17.0	1.69ef	3.30 i
V_1F_4	32.90 a	118.84 c	37.64 d	21.43 c	19.3	2.36 b	5.11 a
V_1F_5	28.90 c	94.86 e	23.55 ij	19.61 e	17.5	1.99 c	4.01 d
V_1F_6	23.30 e	95.72 e	29.36 g	19.74 e	18.4	1.61 g	3.42 h
V_2F_1	24.53 de	116.93 c	39.27 bc	22.32 b	18.5	1.95 c	4.11 c
V_2F_2	24.73 d	109.54 d	30.54 f	20.03 de	18.4	2.01 c	3.82 e
V_2F_3	24.93 d	96.06 e	23.93 i	19.54 e	18.0	1.82 d	3.72 f
V_2F_4	30.13 b	112.77 d	22.47 j	20.52 d	18.7	2.54 a	4.21 b
V_2F_5	29.17 bc	125.51 b	39.86 b	20.55 d	18.3	2.43 b	3.85 e
V_2F_6	24.43 de	95.96 e	42.32 a	18.53 f	16.2	1.64fg	4.01 d
S_x	0.399	1.267	0.415	0.198	-	0.023	0.021
LS	*	**	**	**	NS	*	**

In a column, figure(s) having common letter(s) do not differ significantly but different letter(s) indicate significantly different.** = Significant at 1 % level of probability; * = Significant at 5 % level of probability, NS=Not significant, LS= Level of significance, FP= Farmers' practice (N P and K @ 41.4- 4.2- 10.5 kg ha^{-1}), RFD= Recommended Fertilizer Dose (N P K S and Zn @ 69- 22.4- 31.7- 6.7- 0.65 kg ha^{-1}), IPNS= Integrated plant nutrient system. V_1= Atobshail, V_2= Tapi boro, F_1= RFD, F_2= RFD- 10 kg N ha^{-1}, F_3= RFD- 20 kg N ha^{-1}, F_4=IPNS(2.5 t CD ha^{-1}), F_5= IPNS (2.5 t PL ha^{-1}) and F_6=FP.

4. CONCLUTION

The result of the experiment revealed that the higher grain yield of 2.06 t ha^{-1} was produced by Tapi boro. IPNS with cowdung produced the highest grain of yield. It may be concluded that Tapi boro with application of IPNS (2.5 t cowdung ha^{-1}) based fertilizers is suggested for the farmers in the *haor* area.

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