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YIELD IMPROVEMENT OF LOCAL FINE BORO RICE VARIETIES THROUGH FERTILIZER MANAGEMENT IN THE *HAOR* AREAS

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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* of Sunamganj district, Bangladesh during November 2015 to May 2016 to find out the effect of variety and fertilizer on the growth, yield and yield contributing characters of local fine boro rice. Four varieties (Tapi boro, Begun bichi, Rata boro, Atobshail) and three fertilizer treatments (Farmers' practice, BARC recommendation guide based fertilizers and Soil test based fertilizers) were included in the experiment. The experiment was laid out in a two factors Randomized Complete Block Design (RCBD) with three disperse replications at farmers' field. The highest grain yield of 2.81 t ha^{-1} was recorded from the variety Atobshail. The highest straw yield of 4.90 t ha^{-1} was recorded at Begun bichi. The grain yield was significantly affected due to fertilizer application, the lowest yield was observed in the farmers' practice (2.22 t ha^{-1}) and the highest was in STB fertilizer application (2.85 t ha^{-1}). The highest grain yield of 2.91 t ha^{-1} was produced due to interaction of Tapiboro and application of soil test based fertilizer dose.

***Keywords*:** Productivity, fine rice, fertilizer management, *haor*.

Introduction

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 part of Bangladesh. The districts are: Sunamganj, Kishoreganj, Netrokona, Sylhet, Habiganj, Maulavibazar and B. Baria. There are as many as 373 small or large *haors* in Bangladesh. The Hakaloki *haor*, Sunir *haor*, Dekar *haor*, Tanguyar *haor*, Gungiajuri *haor*, Mukhar *haor*, Kaowadighir *haor* etc. are the prominent *haors* in Bangladesh. 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. Flash flood, hailstorm and drought are the main constraints to grow modern boro rice. The available statistics indicated 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, while only about 10% area is covered by T. Aman production (Huda, 2004). In the *haor* areas, hybrid rice is also grown (Das, 2004). Hybrid rice cultivation is gradually increasing in different locations of *haor* districts (Husain *et al*., 2001). So, there is a great possibility of growing fine rice as well as other rice and non-rice crops in the *haor* areas. Since the cropped land area is being continuously shrinking over time leading to serious challenge towards increasing productivity and thus to the mission of attaining self-sufficiency in food production for the land scarce economy of Bangladesh. It is indeed become imperative to exploit the crop production potentiality of the large *haor* areas, as because those areas usually remain under-utilized with quite low cropping intensity (Jabber and Alam, 1996). The present study was therefore, undertaken to investigate the suitability of local fine rice varieties in the *haor* areas and to find out the optimum fertilizer dose for local boro fine rice varieties in *haor* areas.

Materials and Methods

The experiment was conducted in different farmers' fields of Sadar upazilla and Daskin Sunamganj, respectively under Dekar *haor* of Sunamganj district during November 2015 to May 2016. Four varieties- V_1= Tapiboro, V_2= Begun bichi, V_3= Rata boro, V_4=Atobshail and three fertilizer treatments- $F_{1=}$ Farmers' practice (90-21-21 kg ha^{-1} of

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urea-TSP-MoP), F_2= BARC recommendation guide'12 based fertilizers (150-56-63.5-37.5-5.5 kg ha^{-1} of urea-TSP-MoP-$CaS0_4$- $ZnS0_4$) and F_3= Soil testbased fertilizers (132.5-87.5-67-17.5-2 kg ha^{-1} of urea-TSP-MoP-$CaS0_4$-$ZnS0_4$) were included in the experiment. The initial soil properties of the experimental site are presented in Table 1. Soil texture, pH, organic matter, available P and S, Zn and exchangeable K were determined following standard methods (Black, 1965; Jackson, 1962; Walkley and Black, 1935; Olsen, Cole, Watanable and Dean, 1954 and Page, Miller and Keeney, 1982). Seeds were sown in seedbed on 28 November 2015. Seedlings were transplanted on 4 - 5 January 2016 at 25 cm × 15 cm spacing. Urea was applied as top dressing in three equal splits at 15, 30 and 45 days after transplanting. Having no measures was taken to control insect and pest. Two hand weeding were done for each plot; first weeding was done at 25 days after transplanting followed by second weeding after first weeding at 45 days. Standing water was maintained 2 - 3 cm in the field throughout the growing period. Five hills were tagged for counting the tillers and measuring the plant heights. Harvesting was done on 21 - 22 April 2016. Ten sample hills were collected from each plot to record the agronomic characters. The grain and straw yields were recorded from one square meter area. The data were analyzed following MSTAT-C and mean separation was done by DMRT (Gomez and Gomez, 1984).

Results and Discussion

Effect of variety: Plant height was significantly different due to varieties except at 75 DAT (Table 2). The highest plant height (146.82 cm) was found in Tapiboro at harvest. The highest number of tillers $hill^{-1}$ (15.46) was produced by Begun bichi at harvest (Table 3). The effective tillers $hill^{-1}$ significantly varied among different varieties. The highest number of effective tillers $hill^{-1}$ (14.64) was produced by Begun bichi. The highest number of grains $panicle^{-1}$ (114.03) was produced by Atobshail. Sterile spikelets $panicle^{-1}$ significantly varied among different varieties. The highest number of sterile spikelets $panicle^{-1}$ (13.16) was produced by Tapiboro. Panicle length significantly varied among different varieties. The longest panicle (23.69 cm) was produced by Tapiboro. Thousand grains weight significantly varied among different varieties. The highest 1000 grains weight (20.66 g) was found in Rata boro. The highest grain yield of 2.81 t ha^{-1} was produced by Atobshail. Straw yield varied significantly among different varieties. The highest straw yield of 4.90 t ha^{-1} was produced by Begun bichi which was statistically identical with Tapiboro rice variety.

Table 1. Chemical characteristics of the initial soil of the experimental site

Constituents	Characteristics
Soil pH	4.9
Organic matter (%)	1.7
Total Nitrogen (%)	0.11
Exchangeable K (milimol 100 g^{-1} soil)	0.15
Available P (µg g^{-1} soil)	6.00
Available S (µg g^{-1} soil)	22
Available Zn (µg g^{-1} soil)	0.3

Table 2. Effect of variety on the plant height of local Boro fine rice at different DAT in *haor* area

Variety	Plant height (cm)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	Harvest
Tapiboro	36.20 c	49.64 b	84.42 b	114.73 b	141.63	160.13 c	146.82 a
Begun bichi	37.86 c	52.70 b	88.91 a	120.10 a	154.54	171.04 a	145.69 a
Rata boro	42.68 a	56.63 a	87.23 a	110.40 c	147.93	163.96 bc	132.33 b
Atobshail	40.76 b	57.40 a	88.50 a	120.73 a	154.40	167.53 ab	146.30 a
S_x	0.575	0.767	0.575	0.575	-	1.383	1.695
LS	**	**	*	**	NS	**	**

In a column, figure(s) having common letter(s) do not differ significantly but having 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

Effect of fertilizer: Plant height was significantly affected due to application of different fertilizer doses at 60, 75 and 90 DAT (Table 4). The longest plant (168.40 cm) was produced for application of soil test based fertilizer at 90 DAT. Number of tillers $hill^{-1}$ at harvest varied significantly due to application of different fertilizer doses. The highest number of tillers $hill^{-1}$ (15.58) was produced due to application of soil test based fertilizer (Table 5). The effective tillers $hill^{-1}$

significantly varied due to application of different fertilizer doses (Table 5). The highest number of effective tillers hill^{-1} (14.26) was produced due to application of soil test based fertilizer. The variation of grains panicle^{-1}, panicle length and 1000 grains weight was not significant due to the application of different fertilizer doses. Grain yield significantly varied due to application of different fertilizer doses. The highest grain yield of 2.85 t ha^{-1} was produced due to the application of fertilizers based on STB. Straw yield significantly varied due to application of different fertilizer doses. The highest straw yield of 4.85 t ha^{-1} was produced due to application of soil test based fertilizer dose.

Table 3. Effect of variety on the yield and yield contributing characters of local Boro fine rice in *haor* area

Variety	Tillers hill^{-1} at harvest (no.)	Effective tillers hill^{-1} (no.)	Grains panicle^{-1} (no.)	Unfilled grains panicle^{-1} (no.)	Panicle length (cm)	1000 grains weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Tapiboro	15.10 a	13.80 ab	112.50 a	13.16 a	23.69 a	15.18 b	2.64 b	4.78 a
Begun bichi	15.46 a	14.64 a	101.16 b	10.25 b	21.66 b	19.30 a	2.40 d	4.90 a
Rata boro	15.37 a	13.53 ab	100.43 b	11.83 ab	21.98 b	20.66 a	2.53 c	4.50 b
Atobshail	13.56 b	12.67 b	114.03 a	10.60 ab	22.18 ab	20.17 a	2.81 a	4.49 b
S_x	0.311	0.263	3.337	0.616	0.352	0.603	0.106	0.112
LS	**	**	*	*	**	**	**	*

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Interaction effect: Plant height also varied significantly due to interaction between varieties and application of different fertilizer doses except at 60 and 75 DAT (Table 6). The highest plant height (151.40 cm) was found in Tapiboro and soil test based fertilizer interaction at harvest. Number of tillers hill^{-1} varied significantly due to interaction of different fertilizer doses and different varieties at harvest (Table 7). The highest number of tillers hill^{-1} (17.23) was found in Rata boro and soil test based fertilizer interaction at harvest. The effective tillers hill^{-1}, grains panicle^{-1}, panicle length and 1000 grains weight were significantly varied due to interaction of different varieties and application of different fertilizer doses (Table 7). The highest number of grains panicle^{-1} (124.50) was found in Tapiboro and soil test based fertilizer interaction at harvest. Grain yield did not vary significantly among the interaction effects of different varieties and application of different fertilizer doses. The highest grain yield of 2.91 t ha^{-1} was produced due to interaction of Tapiboro and application of soil test based fertilizer dose (Table 7). Straw yield was significantly differed due to interaction of different varieties and application of different fertilizer doses. The highest straw yield of 5.16 t ha^{-1} was produced due to the interaction of Begun bichi and application of soil test based fertilizer dose.

Table 4. Effect of fertilizers on the plant height of local Boro fine rice at different DAT in *haor* area

Fertilizer	Plant height (cm)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	Harvest
FP	39.67	53.70	85.67	114.12 b	142.17 c	161.45 c	141.42
FRG	39.04	54.05	87.60	116.32 ab	149.05 b	167.15 b	143.81
STB	39.42	54.53	88.52	119.02 a	157.65 a	168.40 a	143.11
S_x	-	-	-	1.274	3.113	1.197	-
LS	NS	NS	NS	*	**	**	NS

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** = Significant at 1% level of probability; * = Significant at 5% level ofprobability
NS= Not significant, LS= Level of significance
FP= Farmers' practice (90-21-21 kg ha^{-1} of urea-TSP-MoP),
FRG= Fertilizer recommendation guide '12 based fertilizers (150-56-63.5-37.5-5.5 kg ha^{-1} of urea-TSP-MoP-$CaS0_4$-$ZnS0_4$),
STB= Soil test based fertilizers (132.5-87.5-67-17.5-2 kg ha^{-1} of urea-TSP-MoP-$CaS0_4$-$ZnS0_4$).

Table 5. Effect of fertilizers on the yield and yield contributing characters of local Boro fine rice in *haor* area

Fertilizer	Tillers hill^{-1} at harvest (no.)	Effective tillers hill^{-1} (no.)	Grains panicle^{-1} (no.)	Unfilled grains panicle^{-1} (no.)	Panicle length (cm)	1000 grains weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
FP	14.57 b	13.22 b	102.97	11.25	22.71	18.06	2.22 c	4.70 a
FRG	14.47 b	13.50 b	107.10	11.45	22.32	18.62	2.52 b	4.45 b
STB	15.58 a	14.26 a	111.02	11.69	22.11	19.80	2.85 a	4.85 a
S_x	0.269	0.228	-	-	-	-	0.086	0.097
LS	*	*	NS	NS	NS	NS	*	*

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* = Significant at 5 % level of probability
NS= Not significant, LS=Level of significance
FP= Farmers' practice, FRG= Fertilizer recommendation guide '12 based fertilizers,
STB= Soil test based fertilizers.

Table 6. Effect of interaction of variety and fertilizers on the plant height of local Boro fine rice at different DAT in *haor* area

Variety × Fertilizer	Plant height (cm)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	Harvest
V_1F_1	35.80 fg	48.30 f	81.50 f	112.30	131.50	149.90 g	147.80 c
V_1F_2	36.60 ef	50.00 e	87.16 c	114.40	147.90	168.00 cd	141.26 ef
V_1F_3	36.20 ef	50.63 de	84.60 e	117.50	145.50	162.50 f	151.40 a
V_2F_1	36.80 e	51.40 d	89.80 b	119.30	144.92	172.00 b	145.11 d
V_2F_2	35.20 g	50.40 de	84.13 e	119.20	142.80	166.73 de	143.80 de
V_2F_3	41.60 c	56.31 b	92.80 a	121.80	175.90	174.40 a	148.16 bc
V_3F_1	44.20 a	56.00 b	84.10 e	107.10	141.60	161.50 f	127.60 g
V_3F_2	41.66 c	57.00 b	86.50 cd	107.80	149.00	164.90 e	139.60 f
V_3F_3	42.20 bc	56.90 b	91.10 b	116.30	153.20	165.50 e	129.80 g
V_4F_1	41.90 bc	59.10 a	87.30 c	117.80	150.66	162.40 f	145.20 d
V_4F_2	42.70 b	58.80 a	92.60 a	123.90	156.53	169.00 c	150.60 ab
V_4F_3	37.70 d	54.30 c	85.60 de	120.50	156.00	171.20 b	143.10 de
S_x	0.287	0.383	0.504	-	-	0.691	0.847
LS	**	*	**	NS	NS	**	*

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NS= Not significant, LS= Level of significance
V_1= Tapiboro, V_2= Begun bichi, V_3= Rata boro, V_4= Atobshail,
F_1= Farmers' practice, F_2= Fertilizer recommendation guide '12 based fertilizers,
F_3= Soil test based fertilizers.

Table 7. Effect of interaction of variety and fertilizers on the yield and yield contributing characters of local Boro fine rice in *haor* area

Variety × Fertilizer	Tillers hill^{-1} at Harvest (no.)	Effective tillers hill^{-1} (no.)	Grains panicle^{-1} (no.)	Unfilled grain panicle^{-1} (no.)	Panicle length (cm)	1000 grains weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
V_1F_1	16.00 b	15.00 ab	95.20 e	12.30	24.10 a	13.93 g	2.90	4.61 e
V_1F_2	14.60 c	13.00 f	117.80 b	14.40	23.45 b	13.70 g	2.72	4.80 d
V_1F_3	14.70 c	13.40 def	124.50 a	12.80	23.53 b	17.93 ef	2.91	4.93 bcd
V_2F_1	15.80 b	14.60 b	100.40 d	9.60	21.30 e	17.20 f	2.43	5.05 abc
V_2F_2	14.80 c	14.10 c	101.10 d	10.60	20.60 f	19.40 cd	2.79	4.50 ef
V_2F_3	15.80 b	15.23 a	102.00 d	10.56	23.10 bc	21.30 a	2.90	5.16 a
V_3F_1	14.10 d	12.30 g	94.40 e	13.60	22.63 cd	20.70 ab	2.68	4.27 gh
V_3F_2	14.80 c	13.60 de	98.80 de	10.70	22.33 d	20.00 bc	2.48	4.15 h
V_3F_3	17.23 a	14.70 b	108.10 c	11.20	21.00 ef	21.30 a	2.43	5.10 ab
V_4F_1	12.40 e	11.00 h	121.90 ab	9.5	22.83 cd	20.43 ab	2.39	4.90 cd
V_4F_2	13.70 d	13.30 ef	110.70 c	10.10	22.90 c	21.40 a	2.50	4.35 fg
V_4F_3	14.60 c	13.73 cd	109.50 c	12.20	20.83 ef	18.70 de	2.55	4.23 gh
S_x	0.155	0.132	1.688	-	0.176	0.301	-	0.056
LS	**	**	*	NS	*	*	NS	*

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** = Significant at 1% level of probability; * = Significant at 5% level of probability

NS= Not significant, LS=Level of significance

V_1= Tapiboro, V_2= Begun bichi, V_3= Rata boro, V_4= Atobshail

F_1= Farmers' practice, F_2= Fertilizer recommendation guide'12 based fertilizers,

F_3= Soil test based fertilizers.

Conclusion

The result of the experiment revealed that the highest grain yield of 2.81 t ha^{-1} was produced by Atobshail. The highest straw yield of 4.90 t ha^{-1} was recorded at begun bichi. The grain yield was statistically varied significantly. The lowest yield was observed in the farmers' practice and the highest was in STB fertilizer application. The highest grain yield of 2.91 t ha^{-1} was produced due to interaction of Tapiboro and application of soil test based fertilizer dose. The highest straw yield of 5.16 t ha^{-1} was produced due to the interaction of Begun bichi and application of soil test based fertilizer dose. Considering the results it may be suggested that the local fine rice variety Atobshail may be cultivated in the *haor* areas with the application of STB fertilizer application.

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