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Effect of Variety and Fertilizer on the Growth and Yield of Modern Fine Rice in Boro Season under *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 (wet land) of Sunamganj district, Bangladesh during the period from November, 2016 to May 2017 to find out the effect of variety and fertilizer on the growth and yield of modern fine rice in boro season under haor areas. Two varieties viz. BRRI dhan50, BRRI dhan63 and seven fertilizer package treatments- F_1= Recommended fertilizers dose (RFD) ((N P K S and Zn @ 138.2- 22.4- 63.5-13.5- 1.3 kg ha^{-1}, F_2= RFD + 20 kg N, F_3= RFD - 20 kg N, F_4= RFD - 40 kg N, F_5= Integrated Plant Nutrient System (IPNS) (5 t cowdung ha^{-1} as organic fertilizer + inorganic fertilizer), F_6= Integrated Plant Nutrient System (IPNS) (5 t poultry liter ha^{-1} as organic fertilizer + inorganic fertilizer) and F_7= Farmers' practice (N P and K @ 82.9- 8.4- 21 kg ha^{-1}) were included in the experiment. The experiment was laid out in a two factors Completely Randomized Block Design (RCBD) with three disperse replications. Data were collected on growth, yield and yield contributing characters of rice. Plant height of BRRI dhan50 was significantly higher than BRRI dhan63 at 15, 30, 45, 60, 75 DAT and at harvest. Plant height also showed significant response to different fertilizers application at 30, 45, 60, 75 DAT and at harvest. The number of tillers hill^{-1} of BRRI dhan63 was significantly higher than BRRI dhan50 at 45 (24.4), 60 (42.0), 75 DAT (34.5) and at harvest. Number of tillers hill^{-1} showed significant variation due to application of different fertilizer doses at 75 DAT and at harvest. The grain and straw yield showed significant response due to varieties. The higher grain yield of 3.71 t ha^{-1} and straw yield of 6.00 t ha^{-1} was produced by the BRRI dhan63. The grain and straw yields varied significantly due to the application of different fertilizer doses. The highest grain yield of 4.15 t ha^{-1} and straw yield of 6.27 t ha^{-1} was produced due to application of IPNS (5 t cowdung ha^{-1}). It was concluded that BRRI dhan63 with application of IPNS (5 t cowdung ha^{-1}) based fertilizers may be suggested in the haor areas.*

Keywords*: Variety, Fertilizert, Growth, Yield and Modern Fine rice.*

1. Introduction

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 in different parts. Some of them have special appeal for their aroma. Such common cultivars are Chinisagar, Basmati, Badshabhog, BRRI dhan34, Kalizira, Tulsimla, Dulabhog, BRRI dhan37, BRRI dhan38, BRRI dhan50, Binadhan 12 and Binadhan15. 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 quantity. Bangladesh has bright prospect for export of these fine rice thereby earning foreign exchange. Moreover, internal markets are also expanding due raising income of some peoples. The yield of fine rice is lower than that of coarse and medium rice. The reasons for low yield are mainly associated with lack of improved varieties and judicious fertilizers management especially of inorganic and organic fertilizer. Selection of a potential variety, planting in appropriate method and application of optimum amount of nutrient elements can play an important role to increase yield. However, fine rice is grown well under lower levels of inputs. In Bangladesh, nutrient deficiencies of soils are increasing day by day. Use of fertilizer is an essential component of modern farming today with about 50% of the world crop production [6]. Most of the fine rice varieties are grown in T. aman season of Bangladesh. We need the Boro rice varieties to be cultivated. Due to high organic matter in *haor* the quality of fine rice may be superior from other region. They can avoid flashflood due to their short growth duration. Among the management practices, application of nitrogen fertilizer and variety are the important ones.

Objectives:

i. To investigate the suitability of modern fine rice varieties in the *haor* areas.
ii. To find out the optimum fertilizer dose for modern boro fine rice varieties grown in *haor* areas.

2. Materials and Methods

The experiment was conducted at the farmers' fields of two villages namely Bahadurpur and Noagaon at Sadarupazilla and Daskin Sunamganj, respectively under Dekar *haor* of Sunamganj district during the period from November, 2016 to May 2017. Two varieties- V_1= BRRI dhan50 and V_2= BRRI dhan63 and seven fertilizer treatments- F_1= BARC recommendation guide'12 based fertilizers (N-P-K-S-Zn @ 138.2-22.5-63.5-13.4-1.3) (RFD), F_2= RFD + 20 kg N, F_3=RFD - 20 kg N, F_4= RFD - 40 kg N, F_5= Integrated Plant Nutrient System (IPNS) (5 t cowdung ha^{-1}), F_6= Integrated Plant Nutrient System (IPNS) (5 t poultry liter ha^{-1}) and F_7= Farmers' practice (N-P-K @ 82.9-8.4-21 kg ha^{-1}) (FP). Three disperse replications 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 [2, 3, 4, 5, 7]. Seeds were sown in seedbed on 28 November 2016. Seedlings were transplanted on 5 January 2017 at 25 cm × 15 cm spacing. TSP, MoP, Gypsum, Zinc sulphate, Cowdung and Poultryliter were applied during final land preparation. Urea was applied as top dressing in three equal splits at 15, 30 and 45 days after transplanting. Marshal 10ml/ 10L water was sprayed 2 times 10 days interval to control blast disease. 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 22 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 basis. The data were analyzed following randomized complete block design and mean separation was done by DMRT [2].

3. Results and Discussion

Plant height of BRRI dhan50 was significantly higher than BRRI dhan63 at 15, 30, 45, 60, 75 DAT and at harvest (Table 2). Plant height did not vary significantly due to different fertilizer application at 15 DAT (Table 2). Plant height showed significant response to different fertilizers application at 30, 45, 60, 75 DAT and at harvest. The longest plants were produced for application of RFD at 15 DAT (32.5 cm), 30 DAT (41.1 cm), 60 DAT (68.5 cm) and 75 DAT (78.6 cm) and for application of RFD + 20 kg N at 45 DAT (53.7 cm) and at harvest (87.3 cm). Plant height was affected due to the interaction effect of variety and different fertilizer application at 15, 30 DAT and at harvest (Table 2).

The number of tillers $hill^{-1}$ of BRRI dhan63 was significantly higher than BRRI dhan50 at 45 DAT (24.4), 60 DAT (42.0), 75 DAT (34.5) and at harvest (34.2) (Table 3). Number of tillers $hill^{-1}$ showed significant variation due to application of different fertilizer doses at 75 DAT and at harvest. The highest number tillers $hill^{-1}$ (36.5) at 75 DAT and at harvest (33.1) was produced due to application of RFD (Table 3). Number of tillers $hill^{-1}$ significantly varied due to effect of interaction of variety and fertilizers at 60, 75 DAT and at harvest (Table 3).

The number of effective tillers $hill^{-1}$ responded significantly due different varieties. Number of grains $panicle^{-1}$ of BRRI dhan63 was significantly higher over BRRI dhan50. Number of sterile spikelets $panicle^{-1}$ of BRRI dhan50 was significantly higher than BRRI dhan63 (Table 4). Panicle length varied significantly due to variety. The 1000 grains weight of BRRI dhan63 was significantly higher in comparison to BRRI dhan50. The grain and straw yield showed significant response due to varieties. The higher grain yield (3.71 t ha^{-1}) and straw yield (6.00 t ha^{-1}) was produced by the BRRI dhan63.

Number effective tillers $hill^{-1}$and grains $panicle^{-1}$showed significant response due to different fertilizers application. The highest number of effective tillers $hill^{-1}$ (31.5) and grains $panicle^{-1}$ (146.0) was produced due to application of IPNS (5 t CD ha^{-1}). Variation in number of sterile spikelets $panicle^{-1}$ was significant due to application of different fertilizer doses (Table 4). Panicle length and1000 grains weight varied significantly due to different fertilizers application. The longest panicle (21.4 cm) was produced due to application of RFD and the highest 1000 grains weight was produced due to application of IPNS. The grain and straw yields varied significantly due to the application of different fertilizer doses. The highest grain yield (4.15 t ha^{-1}) and straw yield (6.27 t ha^{-1}) was produced due to application of IPNS.

Number of effective tillers $hill^{-1}$, number of grains $panicle^{-1}$ and number of sterile spikeletspanicle^{-1} was showed statistically significant variations among the varieties and different fertilizer doses interactions (Table 4). Insignificant variation was observed in panicle length and 1000 grains weight due to the interaction of different varieties and fertilizer doses. The grain and straw yield varied significantly due to the interaction of varieties and different fertilizer doses.

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

Constituents	Characteristics
Soil pH	5.34
Total Nitrogen (%)	0.10
Organic matter (%)	1.75
Available P (µg g^{-1} soil)	8.32
Exchangeable K (meq 100^{-1} g soil)	0.11
Available S (µg g^{-1} soil)	22.42
Available Zn (µg g^{-1} soil)	0.3

Table 2: Plant height of modern Boro fine 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						
BRRIdhan50	32.46 a	41.25 a	52.54 a	69.46 a	77.60 a	83.88 a
BRRIdhan63	29.92 b	37.84 b	49.92 b	65.04 b	72.92 b	82.92 b
LS	**	**	*	**	**	*
Fertilizer						
RFD	32.5	41.15 a	51.72 a	68.52 a	78.62 a	86.42 ab
FRD + 20 kg N	31.7	40.64 a	53.74 a	68.22 a	78.30 a	87.35 a
FRD - 20 kg N	31.5	39.52 a	52.90 a	67.53 b	75.92 ab	84.33 c
FRD – 40 kg N	30.5	38.24 a	52.05 a	66.54 c	76.92 a	81.82 d
IPNS (5 t CD ha^{-1})	29.9	38.56 ab	51.06 ab	66.35 c	72.75 bc	85.62 bc
IPNS (5 t PL ha^{-1})	31.0	38.63 ab	50.14 ab	66.06 c	72.82 bc	80.43 d
FP	29.3	37.05 b	47.12 b	66.74 c	71.61 c	77.54 e
Sx	-	0.864	1.321	1.406	1.213	0.540
LS	NS	*	*	**	**	**
Variety × Fertilizer						
V_1F_1	32.07 bc	41.20 bc	51.4	73.7	80.0	86.37 c
V_1F_2	33.33 ab	42.80 a	55.6	71.2	80.8	85.37 d
V_1F_3	33.33 ab	42.87 a	54.6	70.1	80.2	83.20 e
V_1F_4	33.67 a	41.73 b	52.4	66.2	77.4	81.43 g
V_1F_5	31.00 cde	39.80 de	50.4	68.6	74.7	83.70 e
V_1F_6	33.00 ab	41.20 bc	53.8	67.3	74.4	81.60 g
V_1F_7	30.67 de	39.13 ef	49.2	69.0	75.6	78.77 h
V_2F_1	32.13 bc	40.40 cd	52.0	63.2	77.2	86.57 c
V_2F_2	30.20 def	38.53 f	51.7	65.2	75.8	89.30 a
V_2F_3	29.73 ef	39.33 ef	51.3	67.0	71.6	85.43 d
V_2F_4	31.33 cd	38.73 f	51.6	66.8	76.4	82.30 f
V_2F_5	28.93 fg	37.20 g	51.6	63.9	70.8	87.50 b
V_2F_6	29.07 fg	36.00 h	46.0	64.7	71.2	79.30 h
V_2F_7	27.93 g	35.00 i	45.0	64.4	67.6	76.30 i
Sx	0.426	0.326	-	-	-	0.204
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, RFD= BARC Fertilizer recommendation guide '12 based fertilizers (N-P-K-S-Zn @ 138.2-22.5-63.5-13.4-1.3 kg ha^{-1}), IPNS= Integrated plant nutrient system, FP= Farmers' practice (N-P-K @ 82.9-8.4-21 kg ha^{-1}), V_1 = BRRI dhan50, V_2 = BRRI dhan63, F_1= RFD, F_2= FRD + 20 kg N, F_3= FRD - 20 kg N, F_4=FRD - 40 kg N, F_5=IPNS (5 t CD ha^{-1}), F_6=IPNS (5 t PL ha^{-1}) and F_7=Farmers' practice.

Table 3: Tiller production of modern Boro fine 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						
BRRIdhan50	4.8	11.0	21.12 a	33.35 b	29.12 b	27.62 b
BRRIdhan63	5.1	11.8	24.45 b	42.06 a	34.54 a	34.25 a
LS	NS	NS	*	**	**	**
Fertilizer						
RFD	4.8	12.1	23.4	38.7	36.56 a	33.18 a
FRD + 20 kg N	4.9	11.6	24.0	38.9	35.52 b	32.74 b
FRD - 20 kg N	5.5	11.6	24.5	41.5	33.31 c	27.35 c
FRD – 40 kg N	5.5	12.5	24.7	40.2	29.25 e	26.96 e
IPNS (5 t CD ha^{-1})	4.9	11.6	22.0	32.3	28.62 f	27.52 c
IPNS (5 t PL ha^{-1})	4.3	9.5	19.1	34.2	27.45 g	27.06 d
FP	4.6	11.0	21.3	37.9	32.03 d	26.05 f
Sx	-	-	-	-	0.512	0.505
LS	NS	NS	NS	NS	**	**
Variety × Fertilizer						
V_1F_1	4.9	11.7	23.2	34.84 g	31.76 g	30.48 d
V_1F_2	5.6	12.7	25.5	35.65 f	33.05 f	30.55 d
V_1F_3	5.4	10.9	21.3	33.15 i	28.39 i	27.92 f
V_1F_4	4.8	10.8	21.0	33.08 i	27.37 k	25.37 i
V_1F_5	5.1	11.6	20.8	30.81 k	29.55 h	25.84 h
V_1F_6	3.8	8.8	18.0	31.86 j	27.54 k	23.25 j
V_1F_7	4.0	11.0	17.7	33.96 h	27.92 j	26.36 g
V_2F_1	4.7	12.4	23.6	42.64 b	41.33 a	35.82 a
V_2F_2	4.2	10.5	22.5	42.25 b	40.65 b	32.31 b
V_2F_3	5.7	12.4	27.8	41.02 d	38.86 c	26.33 g
V_2F_4	6.2	14.2	28.5	47.45 a	33.11 f	26.55 g
V_2F_5	4.8	11.6	23.2	47.46	40.48	31.44 c

				a	b	
V_2F_6	4.9	10.3	20.2	36.66 e	35.67 e	32.16 b
V_2F_7	5.1	11.0	24.8	41.90 c	36.16 d	29.37 e
Sx	-	-	-	1.031	1.006	0.190
LS	NS	NS	NS	**	**	**

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Table 4: Yield and yield contributing characters of modern Boro fine rice varieties as affected by variety, fertilizer and their interactions in the *haor* area

Treatments	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							
BRRIdhan50	24.05 b	120.32 b	44.35 a	20.56 a	18.78 b	3.44 b	5.65 b
BRRIdhan63	26.96 a	121.56 a	41.42 b	19.64 b	19.65 a	3.71 a	6.00 a
LS	**	**	**	*	*	**	**
Fertilizer							
RFD	28.27 b	116.72 c	38.72 c	21.42 a	19.72 a	3.65 b	5.90 b
FRD + 20 kg N	25.45 cd	117.04 c	39.14 c	20.41 abc	18.41 c	3.76 b	6.01 b
FRD - 20 kg N	24.26 d	121.05 b	42.15 b	19.82 bc	19.05 b	3.56 b	5.67 c
FRD – 40 kg N	22.34 e	118.07 bc	45.36 bc	19.51 bc	18.82 c	3.11 c	5.31 d
IPNS (5 t CD ha^{-1})	31.52 a	146.05 a	45.97 a	20.63 ab	19.75 a	4.15 a	6.27 a
IPNS (5 t PL ha^{-1})	26.23 c	118.06 bc	42.74 b	19.85 bc	19.62 a	3.71 b	6.03 b
FP	20.24 f	106.60 d	46.06 a	19.16 c	18.94 b	3.10 c	5.57 c
Sx	0.542	1.024	0.907	0.447	0.521	0.075	0.069
LS	**	**	**	*	**	**	**
Variety × Fertilizer							
V_1F_1	26.25 e	113.15 gh	37.45 i	22.3	19.5	3.51 f	5.60
V_1F_2	24.46 g	120.34 d	40.86 h	21.3	17.2	3.62 e	5.72
V_1F_3	23.24 h	117.51 e	36.71 i	19.3	18.2	3.41 g	5.52
V_1F_4	22.13 i	116.26 f	42.32 g	19.3	18.3	3.21 h	5.61
V_1F_5	28.61 d	147.44 a	44.83 e	21.1	19.0	3.91bc	6.06
V_1F_6	23.23 h	117.32 e	42.05 g	20.3	18.8	3.42 g	5.83
V_1F_7	20.24 j	112.57 h	45.68 de	20.2	19.8	3.01 i	5.20
V_2F_1	30.25 b	120.36 d	40.06 h	20.4	19.9	3.79 d	6.20
V_2F_2	26.46 e	113.72 g	37.55 i	19.5	19.5	3.91 c	6.31
V_2F_3	25.30 f	124.55 c	47.56 ab	20.3	19.8	3.72 d	5.83
V_2F_4	22.42 i	119.81 d	48.34 a	19.7	19.3	3.02 i	5.01
V_2F_5	34.57 a	144.62 b	47.12 bc	20.2	20.5	4.40a	6.49
V_2F_6	29.22 c	120.13 d	43.33 f	19.2	20.3	3.99 b	6.23
V_2F_7	20.25 j	100.72 i	46.35 cd	18.0	18.1	3.18 h	5.94
Sx	0.205	0.387	0.342	-	-	0.028	0.026
LS	**	**	**	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, RFD= BARC Fertilizer recommendation guide '12 based fertilizers (N-P-K-S-Zn @ 138.2-22.5-63.5-13.4-1.3 kg ha^{-1}), IPNS= Integrated plant nutrient system, FP= Farmers' practice (N-P-K @ 82.9-8.4-21 kg ha^{-1}), V_1 = BRRI dhan50, V_2 = BRRI dhan63, F_1= RFD, F_2= FRD + 20 kg N, F_3= FRD - 20 kg N, F_4=FRD - 40 kg N, F_5=IPNS (5 t CD ha^{-1}), F_6=IPNS (5 t PL ha^{-1}) and F_7=Farmers' practice.

4. Conclusion

The result of the experiment revealed that the higher grain yield of 3.71 t ha^{-1} was produced by BRRI dhan63. IPNS with cowdung produced the highest grain of yield. It may be concluded that BRRI dhan63 with application of IPNS (5 t cowdung ha^{-1}) based fertilizers is suggested for the farmers in the *haor* area.

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