



## **Growth Characters of Boro Rice as Affected by Different Fertilizer Doses in *Haor* Area of Bangladesh**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Authors AA and SA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MAK and MAA managed the analyses of the study. Authors AA, SA and TKS managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The experiment was conducted at Bahadurpur village under the Laksmanshri union of Sadar upazila of Sunamganj district during November 2014 to May 2015 to evaluate the response of different varieties with the application of different fertilizers for obtaining optimum growth of boro rice in *haor* area of Bangladesh. Two varieties were selected from Bangladesh Rice Research Institute (BRRI) viz. V<sub>1</sub>= BRRI dhan 29; V<sub>2</sub>= BRRI dhan 58 and three fertilizer treatments viz. F<sub>1</sub>= Farmers' practice-based fertilizer; F<sub>2</sub>= BARC recommendation guide based fertilizer; F<sub>3</sub>= Soil test based fertilizer were included in the experiment. The experiment was laid out in a randomized complete block design (RCBD) with five farmer field replications. BRRI dhan58 (92.17 cm) was significantly taller than BRRI dhan29 (89.60 cm). Plant height also significantly influenced due to application of fertilizer. The tallest plant (93.84 cm) was produced due to application of BARC recommendation guide based fertilizer. Number of tillers hill<sup>-1</sup> was significantly affected in two rice varieties at 15, 30 Days after transplanting (DAT) and at harvest. Different fertilizer application significantly affected the number of

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tillers hill<sup>-1</sup> of all Days after transplanting (DAT) and at harvest. At 75 Days after transplanting (DAT), the highest number of tillers hill<sup>-1</sup> (18.72) was produced due to application of BARC recommendation guide based fertilizer. BARC recommendation guide based fertilizer treatment show best growth performance of boro rice in *haor* area.

*Keywords: Fertilizer; variety; growth; Haor; rice.*

## 1. INTRODUCTION

Rice (*Oryza sativa* L.) belongs to the family Gramineae and is dominant over all other crops in respect of economic and social significance in Bangladesh. The acreage and production of boro rice in Bangladesh are about 11.79 million hectares and 18.93 million metric tons, respectively with an average yield of only 4.36 t ha<sup>-1</sup> [1]. Among the rice producing countries, Bangladesh ranks fourth to China, India and Indonesia both in acreage and production [2]. It is the most extensively cultivated crop and the staple food of the country. Rice yield can be increased in many ways such as developing new high yielding varieties or adopting proper agronomic management to the existing varieties. Proper fertilization is an important management practice to increase rice yield. Proper fertilization can markedly increase the yield and improve the quality of rice. Imbalanced use of fertilizer is a serious problem for the management of soil fertility in the country as a whole. The nutrients that play a direct role in the growth and yield of rice are Nitrogen (N), Phosphorus (P), Potassium (K), Sulfur (S) and Zinc (Zn). It is very important to apply these nutrients in an efficient way to minimize loss and to improve the nutrient use efficiency. But our farmers (180-42-42 kg ha<sup>-1</sup> of Urea-TSP-MoP) use of imbalanced fertilizer to maintain yield levels. It directly affects the crop growth resulting poor yield. Rice yield (3.47 t ha<sup>-1</sup>) is low in Sylhet areas of Bangladesh [1] primarily due to low fertility status of soils and unbalanced use of fertilizers like urea is mostly used than other fertilizers like Phosphorus (P), Potassium (K), Sulfur (S) and Zinc (Zn) [3]. Generally in our country, farmers have no access to use the soil test based fertilizer management practice which has been proved to increase the grain yield of boro rice [4]. Biswas et al. [5] reported that farmers are using more nitrogen fertilizers than others for boro rice, because of its visible influence on crop growth. Inadequate and improper applications of balanced fertilizer are now considered one of the major reasons for low yield of boro rice in Bangladesh [6]. The optimum dose of balanced fertilizer plays vital role for the growth

and development of rice plant. So, it is essential to find out the optimum rate of balanced fertilizer application for efficient utilization of these elements by the plants for better plant growth. This study was undertaken to evaluate the response of different varieties with the application of different fertilizers for obtaining optimum growth of boro rice.

## 2. MATERIALS AND METHODS

The experiment was conducted at Bahadurpur village under the Laksmanshri union of Sadar upazila of Sunamganj district during November 2014 to May 2015. The experiment included two rice varieties viz V<sub>1</sub>= BRRI dhan29 and V<sub>2</sub>= BRRI dhan 58; and three fertilizer treatments viz. F<sub>1</sub>= Farmers' practice, F<sub>2</sub>= Bangladesh Agricultural Research Council (BARC) recommendation guide based fertilizer and F<sub>3</sub>= Soil test based fertilizer. The experiment was laid out in a randomized complete block design (RCBD) with five farmers field replications. The size of plot was 5 m × 6 m. Thirty-five days old seedlings were transplanted in the experimental field with spacing 20 cm × 20 cm. The experimental field was ploughed on 01 January, 2015 with the help of a power tiller, later on 03 January, 2015. The field was prepared by three successive ploughings and cross ploughings with a power tiller and subsequently levelled by laddering and fertilizers were applied with Farmers' practice (180-42-42 kg ha<sup>-1</sup> of Urea-TSP-MoP); Bangladesh Agricultural Research Council (BARC) recommendation guide based fertilizer (300-112-127-75-11 kg ha<sup>-1</sup> of Urea-TSP-MoP-Gypsum-ZnSO<sub>4</sub>); Soil test based (265-175-134-35-4 kg ha<sup>-1</sup> of Urea-TSP-MoP- Gypsum-ZnSO<sub>4</sub>), respectively. All the fertilizers were applied at the time of final land preparation but urea was applied at three equal splits at 15, 35 and 60 Days after transplanting (DAT). Seedlings were transplanted on 5 January 2015. Two hand weeding were done for each plot at 25 and 45 Days after transplanting (DAT). BRRI dhan58 was harvested on 30 April 2015 and BRRI dhan29 was harvested on 5 May 2015. The initial soil samples were collected before land preparation from 0-15 cm soil depth. The

samples were collected by an auger from different location covering the whole experimental plot and mixed thoroughly to make a composite sample. Then the samples were air dried, sieved and stored in a clean plastic container for analysis. The soil analysis was done at the laboratory of the Soil Resources Development Institute (SRDI), Sylhet. The recorded data were compiled and tabulated for statistical analysis. Analysis of variance was done with the help of computer package, MSTAT-C [7].

### 3. RESULTS AND DISCUSSION

The morphological characteristics and chemical properties of initial soils in the rice field of *haor* area of Sunamganj District have been presented in the Table 1. The area is under Sylhet basin (AEZ-21). The soil series are Balagonj-goainghat. Soil was collected from medium low land. Soil type was loamy clays and color was grey. The pH value was 4.90, total N was 0.11%, soil organic matter was 2.90%, exchangeable K was 0.15, available P was 4.00 ppm and S was 27.00 ppm of initial soil nutrient status low in the *haor* area. The study region occupies the lower, western side of the Surma-Kushiyara Floodplain. The area is mainly smooth, broad basins with narrow rims of higher land along rivers. Soils of the area are grey, silty clay loams and clay loam in the higher parts that dry out seasonally and grey clays in the wet basins. Non-calcareous Grey Floodplain soils and Acid Basin Clays are the major components of the General Soil Types. This study area soil reaction is mainly slightly acidic [8].

**Table 1. Morphological characteristics and chemical properties of initial soils in the experimental field**

Parameters	Soil properties
Soil Series	Balagonj-goainghat
Land type	Medium low land
Soil type and soil color	Loamy clays and Grey
Agro-ecological zone	Sylhet basin (AEZ-21)
pH	4.90
Total-N %	0.11
OM %	2.90
Available P (ppm)	4.00
Exchangeable K (meq/100 g)	0.15
Available S (ppm)	27.00

BRR1 dhan58 produced significantly taller plant than BRR1 dhan29 at 30, 45, 60, 75 Days after transplanting (DAT) and at harvest (Table 2). Plant height was also varied significantly due to application of fertilizers at all growth stages and at harvest. The taller plant was observed in Bangladesh Agricultural Research Council (BARC) recommendation guide based fertilizer (300-112-127-75-11 kg ha<sup>-1</sup> of Urea-TSP-MoP-Gypsum-ZnSO<sub>4</sub>) treatment at 45 (53.88 cm), 75 (80.20 cm), 90 Days after transplanting (DAT) (89.04 cm) and at harvest (93.84 cm) while smaller plant from farmers' practice based fertilizers (180-42-42 kg ha<sup>-1</sup> of Urea-TSP-MoP) applied. Roy et al. [9] found that plant height varied significantly at different Days after transplanting (DAT) among 12 indigenous boro rice varieties. Similar result was also observed by Singaravel et al. [10] who also found that the effects of recommended N-P-K rates (120-38-38 kg ha<sup>-1</sup>) significantly increased plant height.

The number of tillers hill<sup>-1</sup> of BRR1 dhan58 was significantly higher than BRR1 dhan29 at 15, 30 Days after transplanting (DAT) and at harvest (Table 3). Number of tillers hill<sup>-1</sup> was significantly varied due to application of fertilizers at all growth stages and at harvest. The highest number of tillers hill<sup>-1</sup> (18.72) was produced due to application of BARC recommendation guide based fertilizer treatment. The highest tillers number hill<sup>-1</sup> was recorded for Bangladesh Agricultural Research Council (BARC) recommended dose of fertilizer (300-112-127-75-11 kg ha<sup>-1</sup> of Urea-TSP-MoP-Gypsum-ZnSO<sub>4</sub>), and farmers' practice treatment (180-42-42 kg ha<sup>-1</sup> of Urea-TSP-MoP) had the lowest number. Number of total tillers hill<sup>-1</sup> gradually decreases at 90 Days after transplanting (DAT) and at harvest due to unproductive tillers were died at harvesting period. Number of total tillers hill<sup>-1</sup> gradually decreases at 90 DAT and at harvest due to over maturity. Interaction of effect of variety and fertilizer did not vary significantly on number of tillers hill<sup>-1</sup>. Sarker [11] observed that number of total tillers hill<sup>-1</sup> ranged from 13.16 to 17.25 and the highest number of total tillers hill<sup>-1</sup> was obtained from BRR1 dhan52. Sarfaraz et al. [12] observed that the number of tillers m<sup>-2</sup> significantly increased with the application of N-P-K-S rates (110-90-70-20 kg ha<sup>-1</sup>) over control. The present finding is agreed with his statement.

**Table 2. Effect of variety and fertilizer on the plant height (cm) of boro rice in *haor* area at different DAT**

Treatment	Plant height (cm)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	At Harvest
<b>Variety</b>							
V <sub>1</sub>	30.91	36.07	48.68	64.12	73.99	83.27	89.60
V <sub>2</sub>	29.65	40.47	56.12	73.03	77.92	86.67	92.17
LS	NS	**	**	**	**	NS	**
<b>Fertilizer</b>							
FP	28.92	37.74	49.94	65.07	69.52	80.58	85.54
FRG	30.98	38.60	53.88	70.10	80.20	89.04	93.84
STB	30.94	38.46	53.38	70.56	78.14	85.28	93.28
LS	*	*	**	*	**	**	**
LSD value	0.75	0.96	2.78	4.06	2.20	5.92	1.80
<b>Variety and Fertilizer</b>							
V <sub>1</sub> F <sub>1</sub>	29.72	35.64	45.32	60.52	66.36	80.72	84.68
V <sub>1</sub> F <sub>2</sub>	31.48	36.24	50.16	66.12	76.68	81.40	91.60
V <sub>1</sub> F <sub>3</sub>	31.52	36.32	50.56	65.72	78.92	87.68	92.52
V <sub>2</sub> F <sub>1</sub>	28.12	39.84	54.56	69.52	72.68	80.44	86.40
V <sub>2</sub> F <sub>2</sub>	30.44	40.88	57.20	74.48	81.48	90.40	95.16
V <sub>2</sub> F <sub>3</sub>	30.40	40.68	56.60	75.00	79.60	89.16	94.96
LS	NS	NS	NS	NS	NS	NS	NS
LSD value	-	-	-	-	-	-	-

LS= Level of significance; NS = Not-significant; \*\* = Significant at 1% level of provability, \* = Significant at 5% level of provability; V<sub>1</sub> = BRRI dhan29, V<sub>2</sub> = BRRI dhan58; F<sub>1</sub> = Farmers' practice based fertilizers (180-42-42 kg ha<sup>-1</sup> of Urea-TSP-MoP), F<sub>2</sub> = BARC recommendation guide based fertilizers (300-112-127-75-11 kg ha<sup>-1</sup> of Urea-TSP-MoP-Gypsum-ZnSO<sub>4</sub>), F<sub>3</sub> = Soil test based fertilizers (265-175-134-35-4 kg ha<sup>-1</sup> of Urea-TSP-MoP-Gypsum-ZnSO<sub>4</sub>)

**Table 3. Effect of variety and fertilizer on the number of tillers hill<sup>-1</sup> of boro rice in *haor* area at different DAT**

Treatment	Tillers hill <sup>-1</sup> (no.)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	At Harvest
<b>Variety</b>							
V <sub>1</sub>	8.12	12.67	15.28	16.37	17.00	16.69	15.91
V <sub>2</sub>	7.46	13.31	16.02	16.67	17.52	17.08	16.46
LS	*	*	NS	NS	NS	NS	*
<b>Fertilizer</b>							
FP	7.02	12.62	14.38	15.65	15.30	14.76	13.88
FRG	8.04	13.48	16.57	16.92	18.72	18.26	17.77
STB	8.31	12.86	16.00	17.00	17.76	17.64	16.90
LS	**	*	**	**	**	**	**
LSD value	1.03	0.66	1.32	0.88	0.91	0.86	0.94
<b>Variety and Fertilizer</b>							
V <sub>1</sub> F <sub>1</sub>	7.04	12.16	13.76	15.64	15.00	14.40	13.48
V <sub>1</sub> F <sub>2</sub>	8.80	12.80	15.40	16.68	17.40	17.48	16.68
V <sub>1</sub> F <sub>3</sub>	8.52	13.04	16.68	16.80	18.60	18.20	17.56
V <sub>2</sub> F <sub>1</sub>	7.00	13.08	15.00	15.66	15.60	15.12	14.28
V <sub>2</sub> F <sub>2</sub>	7.56	13.92	16.46	17.04	18.84	18.32	17.98
V <sub>2</sub> F <sub>3</sub>	7.82	12.92	16.00	17.32	18.12	17.80	17.12
LS	NS	NS	NS	NS	NS	NS	NS
LSD value	-	-	-	-	-	-	-

LS= Level of significance; NS = Not-significant; \*\* = Significant at 1% level of provability, \* = Significant at 5% level of provability; V<sub>1</sub> = BRRI dhan29, V<sub>2</sub> = BRRI dhan58; F<sub>1</sub> = Farmers' practice based fertilizers (180-42-42 kg ha<sup>-1</sup> of Urea-TSP-MoP), F<sub>2</sub> = BARC recommendation guide based fertilizers (300-112-127-75-11 kg ha<sup>-1</sup> of Urea-TSP-MoP-Gypsum-ZnSO<sub>4</sub>), F<sub>3</sub> = Soil test based fertilizers (265-175-134-35-4 kg ha<sup>-1</sup> of Urea-TSP-MoP-Gypsum-ZnSO<sub>4</sub>)

#### 4. CONCLUSION

It is concluded from the result that the performance of growth parameters of BRRI dhan58 was significantly better than BRRI dhan29. The plant height and tillers number were differed considerably among fertilizer levels. The highest plant height and tiller number were found for applying recommended dose of all fertilizers ( $F_2$ ) in soil and the lowest plant height and tiller number noticed where farmers' practice-based fertilizers applied. Among the treatment, Bangladesh Agricultural Research Council (BARC) recommendation guide based fertilizer treatment show best growth performance of boro rice in *haor* area. Farmers have access to use the Bangladesh Agricultural Research Council (BARC) recommendation guide based fertilizer (300-112-127-75-11 kg ha<sup>-1</sup> of Urea-TSP-MoP-Gypsum-ZnSO<sub>4</sub>) management practice which has been proved to increase the growth of boro rice under the similar agro-climatic condition in similar soil.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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