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Effect of Fertilizer and Agronomic Practices on the Growth of Boro Rice (*cv.* BRRI dhan58) in *Haor* Area

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Authors' contributions

This work was carried out in collaboration between all authors. Authors MK 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 MK and SA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was carried out at Sunamganj district during November 2014 to April 2015 to observe the fertilizer management and agronomic practices on the growth of boro rice (*cv.* BRRI dhan58) in *haor* area of Bangladesh. The experimental site was located under Sylhet basin (AEZ-21) having moderately acidic and medium with very low drainage facility and the soil was Loamy clays type. The experiment comprised two level of fertilizers *viz.* farmers' practice based fertilizer (F_1) and BARC recommended fertilizer dose (F_2) and three agronomic practices *viz.* farmers' agronomic practice (P_1), proper seedling age and proper spacing (P_2), proper seedling age and proper spacing + Integrated Pest Management (IPM), (P_3). The experiments were laid out in a 2x3 factorial fitted into a randomized complete block design (RCBD) with five farmers' replications. Fertilizer significantly affected the growth parameter of boro rice (*cv.* BRRI dhan58). BARC recommended fertilizer treatment gave taller plant height (90.38 cm) at harvest than farmers' practice based fertilizer treatment. The number of tillers (17.64) hill^{-1} at 90 DAT was significantly affected due to BARC recommended fertilizer than farmers' practice based fertilizer. The growth parameter was not significantly affected due to agronomic practices. The non-significant effect of

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their interaction was recorded the highest plant height (90.50 cm) obtained from (F_2P_3) and number of tillers hill^{-1} increased up to 90 days after transplanting (DAT). From the results of the study it can be concluded that BARC recommended fertilizer dozes (F_2) with proper seedling age and proper spacing + IPM (F_2P_3) gave the best growth performance of boro rice (*cv.* BRRI dhan58) in *haor* area.

Keywords: Agronomic practices; BRRI dhan58; fertilizer; Haor; growth.

1. INTRODUCTION

Fertilizers are indispensable for the crop production systems of modern agriculture. Among the factors that affect crop production, fertilizer is the single most important factor that plays a crucial role in yield increase, provided other factors are not too limiting. That is N, P, K, S and Zn fertilizer today hold the key to the success of the crop production systems of Bangladesh agriculture, being responsible for about 50% of the reduction [1]. Plant spacing has an important role on the growth of rice. Optimum plant density ensures the plant to grow properly with their aerial and underground parts by utilizing more solar radiation and soil nutrients [2]. Closer spacing hampers intercultural operations. Also in a densely populated crop, the inter-plant competition is very high for nutrients, air and light, which usually results in mutual shading, lodging and thus favours more straw yield than grain yield. On the other hand, under wider plant spacing desired hill unit^{-1} area cannot be obtained, which ultimately reduces yield unit^{-1} area. The maximum benefit can be derived from a rice field, if the crop is properly spaced between rows and within rows. Shrirame et al. [3] reported that a total number of tillers hill^{-1} was higher at the wider spacing. They also observed that two seedlings hill^{-1} gave the significantly higher number of tillers hill^{-1} than three seedlings hill^{-1}. The age of seedling is an important factor because it has a tremendous influence on the growth and development, tiller production, grain formation and other yield contributing characters of rice [4]. The use of over aged seedling ultimately affects the general performance of crop and the yield of the crop reduces drastically. So, it is very important to find out the optimum age of seedlings of a variety for a particular season. Therefore the present study was undertaken to observe the fertilizer management and agronomic practices on the growth of boro rice *(cv.* BRRI dhan58) in haor area.

2. MATERIALS AND METHODS

The experiment was conducted at Bahadurpur village under the Sadar upazila of Sunamganj district during November 2014 to May 2015. The experimental site Bahadurpur lies between 24º34'' and 25º12'' north latitudes and between 90º56'' and 91º49'' east longitudes. The climate of the district is warmer in the summer and cooler in the winter. The annual temperature in 2014-15 was maximum 33.5ºC and minimum 14.8ºC and the mean monthly relative humidity was 73.35%. Heavy rainfall occurs during the monsoon and annual rainfall of 3250 mm was also recorded during the years of 2014-15. The initial soil samples were collected from 0-15 cm soil depth from study area before planting. The soil analysis was done at the laboratory of the Soil Resources Development Institute (SRDI), Sylhet. The experiment comprised of two fertilizer packages viz. F1= Farmers' practice-based fertilizers (180-42-42 kg ha-1 of Urea-TSP-MOP) and F2= BARC recommended fertilizers (300-112-127-75-11 kg ha-1 of Urea-TSP-MOP-CaS04-ZnS04) and three levels of agronomic practices viz. P_1= Farmers' agronomic practice (45 days-old seedlings, and spacing: 15 cm×15 cm), P_2= Proper seedling age with proper spacing (35 days-old seedlings, and spacing: 20 cm×20 cm) and P_3= P_2 + IPM (Integrated pest management) (Hand picking of harmful insects after 10 days intervals, perching, removal diseased infected plants by hands when necessary). The test crop was BRRI dhan58. The experiment was laid out in a 2x3 factorial fitted into a randomized complete block design (RCBD) with five farmers' replications. Total numbers of plots were 30, the unit plot size was 5 m × 4 m. BRRI recommended seeds were sown on the seedbed on 29 November 2014 for raising nursery seedlings and Farmers' seeds were sown on the seedbed on 19 November, 2014. The experiment field was ploughed on 14 December, 2014 with the help of a power tiller, later on, 30 December, 2014. Fertilization was taken according to treatments mentioned above. 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). The seedlings were transplanted on 3 January 2015. Two seedlings were planted hill^{-1}. Two hand weedings were done for each plot at 25 and 50 DAT and other intercultural operations were done

as and when necessary. Crop (BRRI dhan58) was harvested on 30 April 2015 and 3 May 2015. The recorded data were compiled and tabulated for statistical analysis. Analysis of variance was done with the help of computer package, MSTAT-C [5].

3. RESULTS AND DISCUSSION

The morphological characteristics and chemical properties of 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 4.03 ppm and S was 27 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 [1].

Plant height at 15, 30, 45, 60, 75, 90 DAT and at harvest showed significant variations among different levels of fertilizer dose (Table 2). BARC recommended fertilizer dose was given taller

Table 1. Morphological characteristics and chemical properties of soils in the experimental field at the depth of 0-15 cm (Initial soil analysis)

Soil series	Land type	Soil type and soil color	Agro-ecological zone	pH	Total-N %	OM %	Available P (ppm)	Exchangeable K (meq/100 g)	Available S (ppm)
Balagonj-goainghat	Medium low land	Loamy clays and Grey	Sylhet basin (AEZ-21)	4.90	0.11	2.90	4.00	0.15	27

Table 2. Effect of fertilizers and agronomic practices on the plant height (cm) of boro rice in *haor* area at different days after transplanting

Treatments	Plant height (cm)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	At harvest
Fertilizers							
F_1	32.50	41.12	52.89	76.56	84.98	88.32	88.46
F_2	34.30	42.93	54.28	76.43	86.81	90.34	90.38
LS	**	**	**	**	**	**	**
Agronomic practices							
P_1	33.24	41.88	53.46	75.84	85.90	89.26	89.35
P_2	33.82	42.10	53.44	75.80	85.92	89.34	89.44
P_3	33.16	42.10	53.86	77.84	85.86	89.40	89.46
LS	NS	NS	NS	NS	NS	NS	NS
LSD value	-	-	-	-	-	-	-
Fertilizers and agronomic practices							
F_1P_1	32.08	41.04	52.88	75.00	85.00	88.24	88.38
F_1P_2	33.40	41.32	52.40	75.12	84.92	88.40	88.56
F_1P_3	32.04	41.00	53.40	79.56	85.00	88.32	88.42
F_2P_1	34.40	42.72	54.04	76.68	86.80	90.28	90.32
F_2P_2	34.24	42.88	54.48	76.48	86.92	90.28	90.32
F_2P_3	34.28	43.20	54.32	76.12	86.72	90.48	90.50
LS	NS	NS	NS	NS	NS	NS	NS
LSD value	-	-	-	-	-	-	-

*** = Significant at 1% level of provability; LS= Level of significance; NS= Non-Significant; CV=Coefficient of variance; F_1= Farmers' practice based fertilizer [180-42-42 kg ha^{-1} of Urea-TSP-MoP]; F_2= BARC recommended fertilizer dozes [300-112-127-75-11 kg ha^{-1} of Urea- TSP-MoP-CaS0$_4$-ZnS0$_4$]; P_1 = Farmers' agronomic practice; P_2 = Proper seedling age and proper spacing; P_3 = Proper seedling age and proper spacing + Integrated Pest Management (IPM)*

Table 3. Effect of fertilizers and agronomic practices on number of tillers hill^{-1} of boro rice in *haor* area at different days after transplanting

Treatments	Number of tillers hill^{-1}						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	At harvest
Fertilizers							
F_1	7.16	13.85	16.20	16.63	16.63	16.65	16.58
F_2	7.64	14.54	16.89	17.64	17.59	17.64	17.62
LS	**	**	**	**	**	**	**
Agronomic practices							
P_1	7.44	13.93	16.50	17.14	17.15	17.14	17.16
P_2	7.30	14.06	16.60	17.14	17.14	17.18	17.10
P_3	7.46	14.20	16.54	17.12	17.04	17.12	17.05
LS	NS	NS	NS	NS	NS	NS	NS
LSD value	-	-	-	-	-	-	-
Fertilizers and agronomic practices							
F_1P_1	7.20	13.52	16.16	16.52	16.52	16.52	16.42
F_1P_2	7.20	13.38	16.20	16.64	16.64	16.64	16.68
F_1P_3	7.08	13.84	16.24	16.72	16.72	16.80	16.64
F_2P_1	7.68	14.48	16.80	17.64	17.66	17.64	17.64
F_2P_2	7.52	14.28	16.96	17.56	17.56	17.56	17.65
F_2P_3	7.72	14.88	16.92	17.72	17.56	17.72	17.68
LS	NS	NS	NS	NS	NS	NS	NS
LSD value	-	-	-	-	-	-	-

*** = Significant at 1% level of provability; LS= Level of significance; NS= Non-Significant; CV=Coefficient of variance; F_1= Farmers' practice based fertilizer [180-42-42 kg ha^{-1} of Urea-TSP-MoP]; F_2= BARC recommended fertilizer dozes [300-112-127-75-11 kg ha^{-1} of Urea- TSP-MoP-$CaSO_4$-$ZnSO_4$]; P_1 = Farmers' agronomic practice; P_2 = Proper seedling age and proper spacing; P_3 = Proper seedling age and proper spacing + Integrated Pest Management (IPM)*

plant height (90.38 cm) at harvest than farmers' practice based fertilizer application. The height of plant up till maturity varied due to different agronomic practices (Table 2). Interaction between fertilizer and agronomic practices were non-significant on plant height at 15, 30, 45, 60 and 75 DAT and at harvest (Table 2). Among the interaction was the tallest plant height (90.50 cm) obtained due to BARC recommended fertilizer dose with proper seedling age and proper spacing + Integrated Pest Management (IPM) and the shortest plant (88.38 cm) was obtained due to interaction effect of farmers' practice based fertilizer with farmers' agronomic practice at harvest. These results are supported by Herve et al. [6] study was conducted the fertilizer N-P-K (23-10-05) gave a better growth with appropriate doses compared to N-P-K (20-10-10) in NERICA3, NERICA7 (up land rice), NERICA36 and NERICA42 (low land rice) rice varieties.

Fertilizer was a significantly effect on the number of tillers hill^{-1} at 15, 30, 45, 60, 75, 90 DAT and at harvest (Table 3). BARC recommended fertilizer was given highest number of tillers (17.64) hill^{-1} at 90 DAT than farmers' practice based fertilizer. The number of tillers hill^{-1} was non-significantly influenced due to the agronomic practices, and the interaction of fertilizer and agronomic practices (Table 3). Interaction effect at 90 DAT, numerically the highest number of tillers hill^{-1} (17.72) was observed due to BARC recommended fertilizer dose with proper seedling age and proper spacing + IPM. The results showed at all growth stages statistically non-significance. But as per the treatment combinations it should have shown significance because the crop spacing has a due influence on the tillering habit as well. Miah [7] noticed the highest number of total tillers hill^{-1} (15.51) in the widest spacing (20 cm × 25 cm) and the lowest number of total tillers hill^{-1} (1.61) in the closest spacing (16 cm × 20.8 cm) at 90 DAT.

4. CONCLUSION

Results of the experiment revealed that the fertilizers were significantly effect on growth parameters. Generally, the plant height and number of tillers hill^{-1} observed gradually increased due to combined applications of BARC recommended fertilizer dose with proper seedling age and proper spacing + Integrated Pest Management (IPM).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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