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Performance of variety and spacing on the yield and yield contributing characters of transplanted *Aman* rice

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Abstract: The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during July to December 2011 to evaluate the effect of spacing on the performance of four rice cultivars in *aman* season. The experiment consisted of four spacing viz. 25cm×15cm, 25cm×20cm, 20cm×20cm, 20cm×10cm and four rice varieties viz. BRRI dhan41, BRRI dhan46, BRRI dhan51 and BRRI dhan52. The experiment was laid out in randomized complete block design with three replications. The highest plant height (118.79cm), number of total tillers hill^{-1} (16.04), number of effective tillers hill^{-1} (13.19), number of grains panicle^{-1} (144.48), grain yield (5.04 t ha^{-1}), straw yield (6.29 t ha^{-1}) and biological yield (11.33 t ha^{-1}) were recorded from BRRI dhan52; while the lowest number of total tillers hill^{-1} (13.08), number of effective tillers hill^{-1}(9.29), number of grains panicle^{-1} (127.46), grain yield (4.22 t ha^{-1}), straw yield (5.65 t ha^{-1}) and biological yield (9.88 t ha^{-1}) were recorded from BRRI dhan41. The highest grain yield (5.21 t ha^{-1}), number of total tillers hill^{-1} (17.17), number of effective tillers hill^{-1} (13.46) and grains panicle^{-1} (153.54) were obtained from the spacing 25cm×15cm. The highest grain yields of all tested varieties were recorded in all combination with spacing 25cm×15cm. BRRI dhan52 could be transplanted with 25cm×15cm spacing as promising for optimization yield in *aman* season.
Key words: variety, spacing, yield, transplant, *aman*, rice

Introduction

Bangladesh, being an agriculture country earns about 23.50 percent of its gross domestic product (GDP) from agriculture (BBS, 2006). Rice is the staple food crop of the people of Bangladesh where it is extensively grown in all seasons of the year. The total area and production of rice in Bangladesh are about 11.27 million hectares and 32.36 million metric tons, respectively (BBS, 2010).Variety itself is the genetical factor which contributes a lot for producing yield and yield components of a particular crop. Yield components are directly related to the variety and the neighboring environments in which it grows. The Bangladesh Rice Research Institute has released 58 modern varieties of rice suitable for cultivation in one or more rice growing seasons of Bangladesh (BRRI, 2011). The present study considered four moderns cultivars (BRRI dhan41, BRRI dhan46, BRRI dhan51 and BRRI dhan52) of transplant *aman* rice. Spacing has an important role on the growth, yield and yield components of transplant *aman* rice. Optimum plant spacing ensures the plants to grow properly with their aerial and underground parts utilizing more solar radiation and nutrients (Miah *et al*., 1990). When the plant spacing exceeds an optimum level, competition among plants for light becomes severe. Consequently the plant growth slows down and the grain yield decreases. The tillering habit and production of grains panicle^{-1} depends to a great extent on the spacing of transplanting which is responsible for the variation of yield in rice. The plant spacing influences the availability of sunlight, leaf area, nutrient to the plant, photosynthesis and respiration. The plant to pant and row to row distances determine the plant population per unit area which has a direct effect on the yield of rice. In transplant rice hill density both row to row and with row density constitute the plant population. Although very few and sporadic research have been done on the spacing of these rice varieties, the effect of spacing changes depending on the edaphic and climatic conditions (BRRI, 1999). It is mentioned that depending on fertility of soil and climatic conditions spacing of these varieties ranges from 10-30cm from row to row and 10-30cm spacing. The present study was therefore, undertaken to search the appropriate spacing of these varieties for attaining yield maximization.

Materials and Methods

The experiment was conducted at the Agronomy Field laboratory, Bangladesh Agricultural University, Mymensingh during July to December 2011. The experimental site belongs to the Sonatola Soil Series of Old Brahmaputa Floodplain (AEZ 9) having non calcarious dark grey floodplain soil. The land was medium high with sandy loam texture having pH 5.9-6.5. Two experimental factors were included in the study namely variety and spacing. Factor A consisted of four spacing viz. 25cm×15cm, 25cm×20cm, 20cm×20cm, 20cm×10cm and factor B consisted four rice varieties viz. BRRI dhan41, BRRI dhan46, BRRI dhan51 and BRRI dhan52. There were 16 treatment combinations. The experiment was laid out in a randomized complete block design with three replications. The size of the plot was 4m×2.5m. A spacing of 1m and 0.75m was maintained in between the replications and unit plot, respectively. Seedlings were raised in well-prepared seedbed and transplanted on 18 August 2011. The experimental plots were fertilized with Urea, Triple Super Phosphate (TSP), Muriate of Potash (MOP), Gypsum and Zinc Sulphate at the rate of 180 kg, 100kg, 60kg, 60kg and 10kg, respectively as per recommendation. One-third of urea and other fertilizers were broadcast and 'incorporated with the soil at the time of final land preparation. After 30 days of transplanting one-third of urea was applied at the time of active tillering stage and remaining quantity was applied before panicle initiation stage. Weeding, supplemented irrigation, drainage and other intercultural operation has been done as per requirements. Five hills were randomly selected excluding boarder rows from each plot to record the data on plant characters and yield components. Harvesting was done on 9 December 2011. The harvested crop was then threshed, cleaned and sun dried to record the grain yield plot^{-1}, which was finally converted to t ha^{-1} at 14% moisture basis. The collected data were compiled and tabulated in proper form and analyzed statistically. Analysis of variance was done following RCBD with the help of computer package MSTAT and the mean differences among the treatments were adjudged by Duncan's Multiple Range Test as laid out by Gomez and Gomez (1984).

Results and Discussion

Effect of variety: Plant height, number of total tillers hill-1, number of effective tillers hill-1, grains panicle^{-1}, un-filled grains panicle^{-1}, grain yield, straw yield, biological yield and harvest index were significantly affected by variety (Table 1). The highest plant height (118.79) was recorded in BRRI dhan52 which was as good as BRRI dhan41 (117.75) followed by BRRI dhan46 (110.81). The lowest plant height was obtained in BRRI dhan51 (89.32c). Maximum number of total tillers hill^{-1} (16.02) and effective tillers hill^{-1} (13.19) were obtained from BRRI dhan52 followed by BRRI dhan51 while BRRI dhan41 produced the minimum number of total tillers hill^{-1} (13.08) and effective tillers hill^{-1} (9.29). This confirms the report of Sawant *et al.* (1986), who reported that variable effect of variety on the number of effective tillers hill^{-1}. BRRI dhan46 produced the highest number of non effective tillers hill^{-1} (4.36) and BRRI dhan52 produced the minimum number of non effective tillers hill^{-1} (2.85). BRRI dhan52 gave the highest number of grains panicle^{-1} (144.48) while BRRI dhan4l produced the lowest number of grains panicle^{-1} (127.46). BRRI dhan5l produced the second highest number of grains panicle^{-1} (140.70) which was as good as BRRI dhan46 (139.66b). BRRI dhan4l produced the highest number of unfilled grains panicle^{-1} (28.71) followed by BRRI dhan51 (24.88) and BRRI dhan46 (19.50). The lowest number of unfilled grains panicle^{-1} produced by BRRI dhan52 (14.17). BRRI dhan52 produced the highest grain yield (5.04 t ha^{-1}) which was contributed from higher number of effective tillers hill^{-1}, higher number of grams panicle^{-1} and more weight of 1000-grain. The lowest grain yield was obtained from BRRI dhan41 (4.22 t ha^{-1}). BRRI dhan46 produced the second highest grain yield (4.69 t ha^{-1}) followed by BRRI dhan51 (4.54). Similar results were reported elsewhere (IRRI 1978; Alam, 1988 and Karim *et al.* 1992). The highest straw yield was produced in BRRI dhan46 (6.43 t ha^{-1}) which was identical to BRRI dhan52 (6.29 t ha^{-1}) and BRRI dhan51 (6.24 t ha^{-1}). The lowest one was obtained from BRRI dhan41 (4.22 t ha^{-1}). The highest biological yield was obtained from BRRI dhan52 (13.33 t ha^{-1}) which was identical to BRRI dhan46 (11.12 t ha^{-1}) and followed by BRRI dhan51 (10.78 t ha^{-1}) and the lowest one was recorded from BRRI dhan41 (9.88 t ha^{-1}). The highest harvest index was obtained from BRRI dhan52 (44.52) followed by BRRI dhan41 (42.58) which was as good as BRRI dhan46 (42.23) and BRRI dhan52 (42.14) (Table 2). Increased grain yield was the main reason for the increase harvest index in BRRI dhan52. The lowest harvest index was obtained from BRRI dhan51 (42.14%). Shah *et al.* (1991) reported that variety had great influenced to harvest index.

Table 1. Effect of variety on the yield contributing characters of transplant aman rice

Variety	Plant height (cm)	No. of Total tillers hill^{-1}	No. of Effective tillers hill^{-1}	No. of Non-effective tillers hill^{-1}	Panicle length (cm)	No. of grains panicle^{-1}	No. of Unfilled grains panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V_1	117.75ab	13.08c	9.29c	3.79b	24.87	127.46c	28.71a	23.39	4.22d	5.65b	9.88c	42.58b
V_2	110.81b	15.08b	10.73b	4.36a	25.27	139.66b	24.88b	23.13	4.69b	6.43a	11.12a	42.23b
V_3	89.32c	14.92b	11.03b	3.89b	25.13	140.70b	19.50c	23.01	4.54c	6.24a	10.78b	42.14b
V_4	118.79a	16.04a	13.19a	2.85c	25.32	144.48a	14.17d	23.35	5.04a	6.29a	11.33a	44.52a
CV (%)	3.65	5.44	6.54	20.29	5.82	2.88	6.74	2.47	2.33	4.20	2.58	2.55
$S\overline{X}$	0.67	1.55	1.76	9.57	0.32	0.74	0.74	0.59	0.25	0.58	0.22	0.34
Level of Sig.	**	**	**	**	NS	**	**	NS	**	**	**	**

Table 2. Effect of spacing on the yield contributing characters of transplant *aman* rice

Spacing	Plant height (cm)	No. of Total tillers hill^{-1}	No. of Effective tillers hill^{-1}	No. of Non-effective tillers hill^{-1}	Panicle length (cm)	No. of grains panicle^{-1}	No. of Unfilled grains panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
S_1	112.57a	17.17a	13.46a	3.71ab	24.47	153.54a	16.60d	23.00	5.21a	6.93a	12.13a	42.91b
S_2	111.71ab	15.30b	11.90b	3.40b	25.78	135.43b	19.32c	23.48	4.69b	6.05b	10.74b	43.71a
S_3	107.12b	14.24c	10.20c	4.03a	25.31	134.98b	23.57b	23.30	4.52c	6.07b	10.59b	42.68b
S_4	105.27c	12.42d	8.67d	3.75ab	25.02	128.36c	27.78a	23.08	4.08d	5.55c	9.64c	42.18b
CV(%)	3.65	5.44	6.54	20.29	5.82	2.88	6.74	2.47	2.33	4.20	2.58	2.55
$S\overline{X}$	0.67	1.55	1.76	9.57	0.32	0.74	0.74	0.74	0.74	0.59	0.25	0.58
Level of Sig.	**	**	**	*	NS	**	**	NS	**	**	**	**

Effect of spacing: Plant height, number of effective tillers hill^{-1}, non-effective tillers hill^{-1}, grains panicle^{-1}, unfilled grains panicle^{-1}, grain yield, straw yield, biological yield and harvest index were significantly influenced by spacing (Table 2). The highest plant height (112.57cm) was recorded in 25cm×15cm which was identical to 25cm x 20cm (117.75cm) followed by 20cm×20cm (110.81cm) while the lowest plant height (105.27 cm) was obtained in 20cm×10cm. Spacing 25cm ×15cm produced the highest number of effective tillers hill^{-1} (13.46) followed by 25cm x 20cm (15.30). Spacing 20cm×10cm produced the lowest number of effective tillers hill^{-1} (8.67). Similar results were also reported by Quddus and Huda (1975). The highest number of grains panicle^{-1} (153.54) in 25cm×15cm. The lowest number of grains panicle^{-1} (128.36) produced in the closest spacing 20cm×10cm. This finding was in agreement with that of Quddus and Huda (1975) and Rao *et al.* (1990) who stated that wider spacing produced higher number of grains panicle^{-1}. Since fertility of grains and development of grains depend on environmental factors such as nutrition, moisture and light, wider spacing

possibly facilitated to supply of more food materials, moisture and light for the plant and ultimately for development of grain comparing to closer spacing. Spacing 20cm×10cm produced the highest number of unfilled grains panicle^{-1} (27.78). The lowest number of unfilled grains panicle^{-1} (16.60) was produced by the spacing 25cm×15cm which was followed by spacing 20cm×20cm. The highest grain yield (5.21 t ha^{-1}) was produced in pacing 25cm×15cm while the lowest grain yield (4.08 t ha^{-1}) was produced in spacing 20cm ×10 cm. Similar results were reported elsewhere (Souza *et al.* 1994), Shah *et al.* 1991 and Ghosh *et al.* 1988). Competition among plants for various growth factors in the densely transplanted crop as resulted in slow growth of plant, reduction in the production of effective tillers hill^{-1}, increased non-bearing tillers hill^{-1}, less number of grains panicle-1 and maximum sterile spikelets panicle^{-1}. Yield parameters were adversely affected due to competition among the plants for space, light, air, water and nutrients resulted to lower yield.

Table 3. Effect of interaction of variety and spacing on the yield contributing characters of transplant *aman* rice

Interaction (V×S)	Plant height (cm)	No. of Effective tillers hill^{-1}	No. of Non-effective tillers hill^{-1}	No. of Total tillers hill^{-1}	Panicle length (cm)	No. of grains panicle^{-1}	No. of Unfilled grains panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V_1S_1	122.06	11.15de	4.73ab	15.88bc	24.37	135.33cde	21.85e	23.14	4.87cd	11.44b	42.61b-f
V_1S_2	116.80	10.69ef	3.80cde	14.49de	25.80	129.09efg	25.22cd	23.51	4.57e	10.24def	44.67ab
V_1S_3	118.10	9.34gh	3.29def	12.62f	24.73	125.60gh	30.60b	23.36	4.30g	9.80f	43.90a-d
V_1S_4	114.05	5.98j	3.35def	9.33g	24.57	119.83h	37.17a	23.53	3.14i	8.02g	39.14g
V_2S_1	112.55	13.80ab	3.03ef	16.83ab	23.80	157.17a	19.40ef	22.76	5.13b	12.24a	41.91def
V_2S_2	113.32	11.12de	4.31abc	15.42cd	25.93	135.13cde	20.68e	23.43	4.83cd	11.16b	43.27a-e
V_2S_3	109.61	9.90fg	5.17a	15.07cd	26.00	138.50bcd	27.66c	23.56	4.48ef	10.96bc	40.93f
V_2S_4	107.75	8.08i	4.92ab	13.00f	25.33	127.83fg	31.77b	22.77	4.33fg	10.11def	42.81b-f
V_3S_1	92.40	14.53a	3.41c-f	17.94a	24.37	160.65a	14.03h	22.80	5.22b	12.27a	42.51v-f
V_3S_2	93.04	12.24cd	2.93ef	15.17cd	25.27	137.28bcd	19.61ef	23.32	4.43efg	10.43de	42.60b-f
V_3S_3	85.71	8.57hi	5.10a	13.67ef	24.77	132.26def	19.32ef	22.90	4.39fg	10.47cd	41.89def
V_3S_4	86.13	8.78ghi	4.11bcd	12.89f	26.10	132.61def	25.03d	23.00	4.12h	9.92ef	41.56ef
V_4S_1	123.28	14.35a	3.66cde	18.02a	25.33	160.99a	11.13i	23.31	5.61a	12.58a	44.60ab
V_4S_2	123.68	13.56ab	2.54f	16.10bc	26.13	140.20bc	11.75hi	23.67	4.93c	11.14b	44.30abc
V_4S_3	115.06	13.02bc	2.58f	15.60bcd	25.73	143.57b	16.68g	23.38	4.89cd	11.13b	43.98abc
V_4S_4	113.13	11.83cde	2.61f	14.44de	24.07	133.17def	17.12fg	23.02	4.74d	10.49cd	45.20a
CV(%)	3.65	6.54	20.29	5.44	5.82	2.88	6.74	2.47	2.33	2.58	2.55
$S\overline{X}$	0.67	1.76	9.57	1.55	0.32	0.74	0.74	0.59	0.25	0.22	0.34
Level of Sig.	NS	**	**	**	NS	**	**	NS	**	**	**

*= Significant at 5% level of probability, **= Significant at 1% level of probability, NS= Non-significant, V_1= BRRI dhan41, V_2= BRRI dhan46, V_3= BRRI dhan51, V_4= BRRI dhan52, S_1= 25cm×15cm, S_2=25cm×20cm, S_3=20cm×20cm, S_4=20cm×10cm

Interaction of variety and spacing: Number of total tillers hill^{-1}, number of effective tillers hill^{-1}, grains panicle^{-1}, un-filled grains panicle^{-1}, grain yield, straw yield, biological yield and harvest index were significantly affected by variety (Table 3). It was observed that the highest number of effective tillers hill^{-1} (14.53) was produced in the combination of BRRI dhan51 with spacing 25cm×15cm and the lowest number of effective tillers hill^{-1} (5.98) was produced in the combination of BRRI dhan41 and spacing 20cm × 10cm. The highest number of non-effective tillers hill^{-1} (5.17) was produced in the combination of BRRI dhan46 and spacing 20cm×20cm. and the lowest number of non-effective tillers hill^{-1} (2.54) was produced in the combination of BRRI dhan52 with spacing 25cm×20cm. The highest number of grains panicle^{-1} (160.99) was produced in the combination of BRRI dhan52 with spacing 25cm×15cm and the lowest number of grains panicle^{-1} (119.83) was produced in the combination of BRRI dhan41 with spacing 20cm×10cm. The highest number of unfilled grains panicle^{-1} (37.17) was produced in the combination of BRRI dhan41 with spacing 20cm×10cm and the lowest number of unfilled grains panicle^{-1} (11.13) was produced in the combination of BRRI dhan52 with spacing 25cm×15cm. The highest grain yield (5.61t ha^{-1}) was produced in the combination of BRRI dhan52 with spacing 25cm×15cm while the lowest (3.14 t ha^{-1}) grain yield was produced in the combination of BRRI dhan41 with spacing 20cm×10cm. It can be concluded that among tested four varieties BRRI dhan52 showed best performance and BRRI dhan52 with the spacing of 25cm×15cm was found to be the best possible combination for achieving higher grain yield.

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