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Effect of Spacing on Different Short Duration Rice Varieties in T. Aman and Boro Season

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ABSTRACT

The selection of appropriate plant spacing may contribute to the yield potential of a rice variety. This experiment was conducted at the West Byde of BRRI HQ farm, Gazipur during T. Aman'2017 and Boro' 2017-18 seasons to find out the optimum spacing of different short duration rice varieties. In T. Aman season, the treatments were three rice varieties (V_1 = BRRI dhan71, V_2 = BRRI dhan75 and V_3 = BINA dhan17) and five spacings (S_1 = 15 cm × 15 cm, S_2 = 20 cm × 15 cm, S_3 = 20 cm × 20 cm, S_4 = 25 cm × 20 cm and S_5 = 25 cm × 25 cm). In Boro season the treatments were four rice varieties (V_1 = BRRI dhan81, V_2 = BRRI dhan84, V_3 = BRRI dhan86 and V_4 = BRRI dhan28) and the spacings were same as T. Aman season. In each season, the treatments were arranged in a Split-plot design as variety in the main plots and spacing in the sub plots with three replications. In T. Aman season, irrespective of variety and spacing, the number of tillers per hill increased sharply and reached the maximum at 30 to 45 DAT then gradually decreased. BRRI dhan75 produced the highest grain yield, which was statistically identical with the yield of BRRI dhan71 and BINA dhan17. The spacing 20 cm × 15 cm produced the highest grain yield compared to other spacing. On the other hand, during Boro season the number of tillers per hill increased sharply and reached the maximum at 60 to 80 DAT then gradually decreased. The 20 cm × 20 cm spacing produced the highest grain yield and among the varieties BRRI dhan84 provided the highest grain yield.

Key words: Spacing, short duration, rice, growth and yield

INTRODUCTION

The yield of T. Aman and Boro rice may be increased through introduction of high yielding varieties and improved agronomic manipulations such as proper spacing. Short duration T. Aman rice can also create opportunity to facilitate Mustard, legume, pulses and green manuring crops before late Boro sowing which can contribute significantly to achieve the twin objectives of increasing productivity and improving the sustainability of the cropping system**.** Some short duration T. Aman rice varieties (viz. BRRI dhan71, BRRI dhan75 and BINA dhan17) are not only photo insensitive, but also drought resistant and short duration Boro varieties (viz. BRRI dhan81, BRRI dhan84 and BRRI dhan86) provide higher yield (BRRI, 2022 and BINA, 2020). Pandey *et al.* (2021) reported that the appropriate plant spacing may influence the yield potential of a rice cultivar through effective utilization of solar radiation, soil moisture and nutrient uptake from the soil. When the planting density exceeds an optimum level, these factors may be deficient and competition among plants becomes severe. Accordingly, the plant growth slows down and the grain yield decreases. Conversely, these factors may

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not be properly utilized at lower planting density. Properly spacing between rows and within rows can result in the maximum advantage from a rice field. Plant density had great influence on the tillering habit and production of grains panicle^{-1} which is responsible for the variation of yield in rice. Alam (2006) found that optimum spacing produced maximum number of total tillers m^{-2}, maximum number of fertile tillers m^{-2} and which was reliant on temperature, moisture and other soil factors. Inappropriate spacing reduces the yield up to 25–30 percent whereas the optimum plant density ensures the plant to grow in their both aerial and underground parts through efficient utilization of solar radiation and nutrients (Salma *et al.*, 2017). In contrast, beyond the optimum level, severe competitions (for light, nutrients, and water) slow down plant growth and decrease grain yield (Bozorgi *et al.,* 2011). Akhter *et al.* (2007) observed that the selection of optimum spacing for transplanting of high yielding cultivars is an important part of high production package. Row transplanting is one of the good agronomic practices being promoted for lowland rice production in Bangladesh. Moro *et al*. (2016) stated that spacing significantly affected tiller production, number of panicles m^{-2} total biomass and grain yield. Both the number of tillers plant^{-1} and number of panicles m^{-2} were significantly reduced under closer spacing than wider spacing. Therefore, the present study was undertaken to find out the effect of spacing on different short duration rice varieties in transplanted Aman and Boro season.

MATERIALS AND METHODS

Study Area

The experiment was performed at the BRRI HQ farm, Gazipur, Bangladesh during T. Aman' 2017 and Boro' 2017-18 seasons to find out the optimum spacing of different short duration rice varieties. The experimental field situated at 23° 59' 33" N latitude and 90° 24' 19" E longitude and at elevation of 8.4 m from the mean sea level (Satter, 1994) and it's characterized by sub-tropical climate. The location was under the agro-ecological zone at Madhupur tract (AEZ 28).

Climatic Condition of the Study Area

The area is situated under subtropical zone, which was characterized by high temperature and high humidity. During the T. Aman season there are sufficient rainfall for growing the crops. However, sometimes where the crops suffered due to lack of rainwater, irrigation was given. Day length, maximum-minimum temperature gradually decreased from early to late in T. Aman season. On the other hand, the temperature increased on the onset of the T. Aman season and it gradually decreased with the advance of Boro season. But the Boro season rainfall was limited and irrigation water was given as and when necessary. The bright sunshine hours were high in the Boro season compared to the T. Aman season.

Treatments and Experimental Design

In T. Aman season the treatments were three rice varieties (V_1 = BRRI dhan71, V_2 = BRRI dhan75 and V_3 = BINA dhan17) and five spacings (S_1 = 15 cm × 15 cm, S_2 = 20 cm × 15 cm, S_3 = 20 cm × 20 cm, S_4 = 25 cm × 20 cm and S_5 = 25 cm × 25 cm). In Boro season the treatments were four rice varieties (V_1 = BRRI dhan81, V_2 = BRRI dhan84, V_3 = BRRI dhan86 and V_4 = BRRI dhan28) and the spacing's were same as T. Aman season. In each season, the treatments were arranged in a Split Plot design as variety in the main plots and spacing in the sub plots with three replications. The unit plot size was 4 m × 4 m. Twenty five and forty day old seedling @

one seedling per hill were transplanted in T. Aman and Boro seasons respectively. Fertilizers were used in BRRI recommended dose. Tiller number per hill from transplanting to maturity with 15 and 20 days interval was recorded in T. Aman and Boro season respectively. All other cultural operations were conducted for proper crop management as and when appropriate. Yield and yield components data were taken.

Statistical Analysis

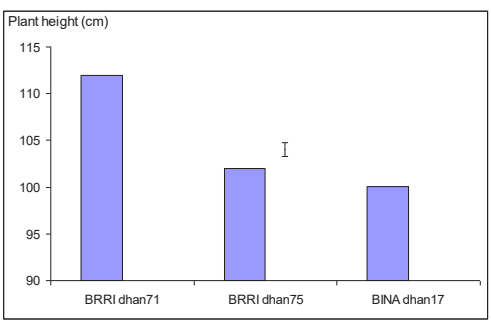
Using the Crop Stat Analysis package, the collected data were analyzed.

RESULTS AND DISCUSSION

Growth Parameter at Different Growth Stages

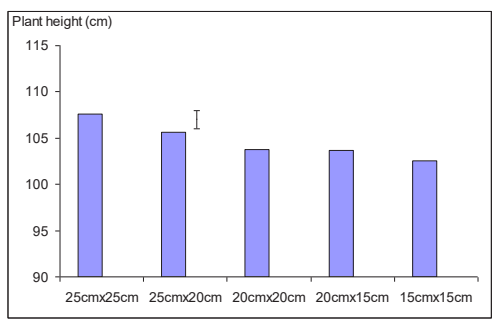
Growth parameters like plant height and number of tiller hill^{-1} were significantly influenced by different plant spacing at different growth stages (Figs. 2, 4 and 5).

Plant height: Plant height is a genetic character and it differed significantly by the variety. In T. Aman season, comparing short duration varieties, the tallest plant height was recorded in BRRI dhan71 followed by BRRI dhan75 and the lowest in BINA dhan17 but there was no significant difference between BRRI dhan75 and BINA dhan17 (Fig.1) and in Boro season, comparing short duration varieties, the tallest plant height was recorded in BRRI dhan84 followed by BRRI dhan28, BRRI dhan81 and the lowest in BRRI dhan86 but there was no significant difference among BRRI dhan81, BRRI dhan28 and BRRI dhan86 (Fig. 3). Salam *et al.* (2019) and Tyeb *et al.* (2013) observed such variation in plant height due to varietal differences. Comparing different spacings, it was observed that widest spacing (25 cm × 25 cm) produced the tallest plant and it was decreased with decreasing spacing in both seasons (Figs. 2 and 4). Salam *et al.* (2019), Haque *et al.* (2015) and Moro *et al.* (2016) reported reciprocal result that plant height was significantly influenced by spacing.



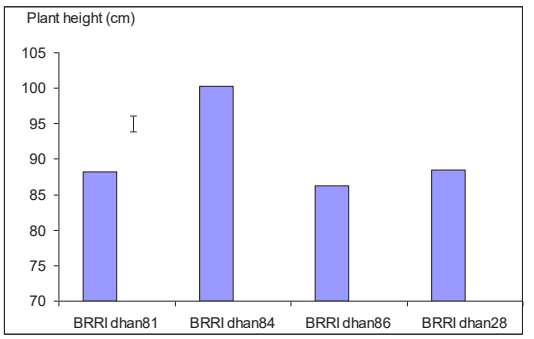
Variety

Fig. 1. Plant height at maturity as affected by T. Aman rice varieties (Vertical bar represents the Lsd (0.05) value).



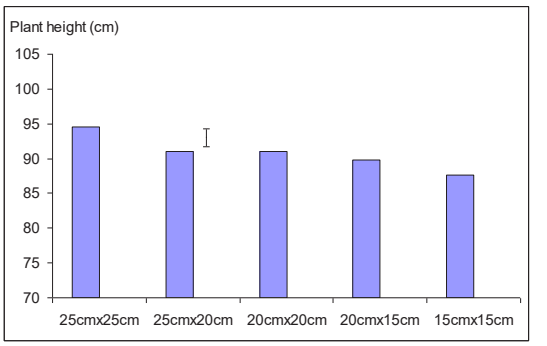
Spacing

Fig. 2. Plant height at maturity of T. Aman rice varieties as affected by spacing (Vertical bar represents the Lsd (0.05) value).



Variety

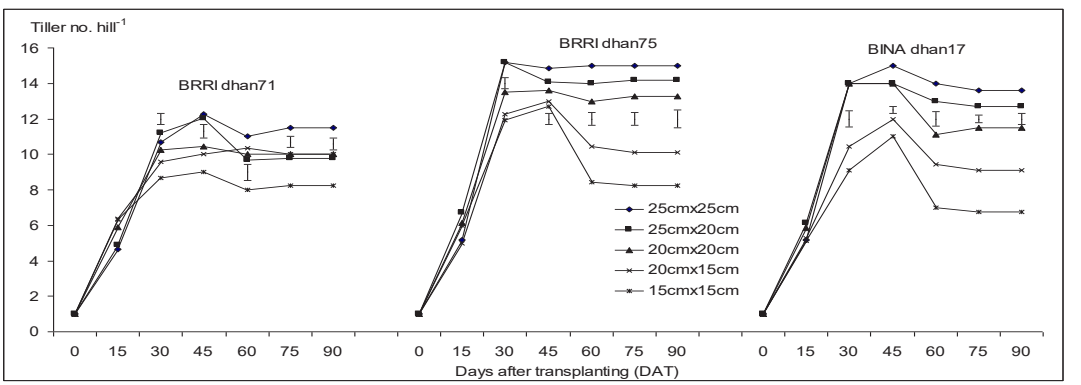
Fig. 3. Plant height at maturity as affected by Boro rice varieties (Vertical bar represents the Lsd (0.05) value).



Spacing

Fig. 4. Plant height at maturity of Boro rice varieties as affected by spacing (Vertical bar represents the Lsd (0.05) value).

Tiller number hill^{-1}: Tiller number per hill was recorded from transplanting to maturity with 15 days intervals in T. Aman and 20 days intervals in Boro seasons. Irrespective of variety and spacing, the number of tillers per hill increased sharply and reached the maximum at 30 to 45 DAT in T. Aman and 60 to 80 DAT in Boro seasons then gradually decreased due to dead of some unfertile tillers. Irrespective of spacing in T. Aman, BRRI dhan75 produced the highest number of tiller followed by BINA dhan17 and the lowest in BRRI dhan71. Irrespective of spacing in Boro, BRRI dhan28 produced the highest number of tillers followed by BRRI dhan86, BRRI dhan84 and the lowest in BRRI dhan81. Regardless of variety, wider spacing produced higher number of tillers per hill than closer spacing in all sampling dates (Fig. 5). The reason might be wide spaced plants received more nutrients, moisture and light thus produced higher number of tillers hill-1. Salam *et al.* (2019) and Mobasser *et al.* (2007) also reported that wider spacing produced maximum number of total tillers than closer spacing.



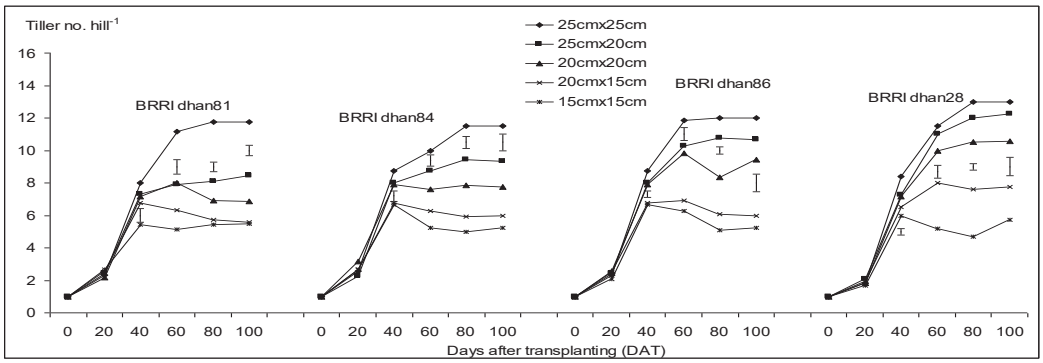


Fig. 5. Tiller number per hill of different short duration T. Aman and Boro rice varieties as affected by spacing (Vertical bars represent the Lsd (0.05) value).

Effect of variety on the yield and yield contributing characters of T. Aman and Boro seasons:

The interaction between variety and spacing was insignificant in all the parameters of yield and yield components. Therefore, only the main effect has been described and discussed below:

Effect of variety: The varietal differences in plant height might be due to heredity of the variety. The difference in the plant may occur due to varietal genetic character; it is similar to Sarkar (2014) variable plant height due to varietal differences. In T. Aman season, the highest number of tiller and panicle m^{-2} was recorded in BRRI dhan75 followed by BINA dhan17 and lowest in BRRI dhan71 (Table 1). In Boro season, BRRI dhan84 produced the highest number of tiller m^{-2} followed by BRRI dhan81 and BRRI dhan86 and; the lowest in BRRI dhan28. BRRI dhan28 gave the highest number of panicle m^{-2} followed by BRRI dhan84 and the lowest in BRRI dhan81 (Table 1). Salam *et al.* (2019) and Hossain *et al.* (2010) found that number of total tillers varied among the varieties and the authors opined that the probable causes of that variation due to varietal differences. Similar findings were observed by Yan (2002) and Akanda *et al*., (2020). In T. Aman season, the highest panicle length was observed in BRRI dhan71 followed by BINA dhan17 and the lowest in BRRI dhan75 (Table 1). In Boro season, the highest panicle length was obtained in BRRI dhan84 and the lowest in BRRI dhan81 which was identical with BRRI dhan86 (Table 1). In T. Aman season, filled grain $panicle^{-1}$ was highest in BRRI dhan71 and the lowest in BINA dhan17 whereas, the highest percentage of unfilled grain was recorded in BINA dhan17 and the lowest in BRRI dhan75 (Table 1). In Boro season, the highest number of filled grain $panicle^{-1}$ was recorded in BRRI dhan81 followed by BRRI dhan84, BRRI dhan86 and the lowest in BRRI dhan28 but highest percentage of unfilled grain was observed in BRRI dhan86 which was statistically identical to BRRI dhan84 and the lowest in BRRI dhan28 (Table 2).Variation in grain filling may have occurred due to adopted genetic, environmental, or cultural management practices (Chowhan, 2017). The results showed 1000-grain weight had significant effect due to variety. In T. Aman season, 1000-grain weight was the highest in BRRI dhan71 and the lowest in BRRI dhan75 (Table 1). In Boro season, the highest 1000-grain weight was recorded in BRRI dhan86 followed by BRRI dhan84 and

BRRI dhan28 and; the lowest in BRRI dhan81 (Table 2). This result is in agreement with the finding of Akanda *et al*., (2020) who stated that weight of 1000-grains differed due to the varietal differences.Variety had no significant effect on grain yield in T. Aman season but significant effect on Boro season (Table 2). BRRI dhan75 produced the highest grain yield followed by BRRI dhan71 and the lowest yield was recorded in BINA dhan17 in T. Aman season (Table 1). In Boro season, BRRI dhan84 produced the highest grain yield. and the lowest grain yield was recorded in BRRI dhan28 which was statistically similar to the yield of BRRI dhan81 and BRRI dhan86 (Table 2). Similar research findings were also reported by Salam *et al*. (2019) and Akanda *et al*., (2020) who observed variation in grain yield of rice due to varieties.

Table 1. Yield and yield components of rice cultivars as affected by variety T. Aman 2017 seasons

Variety	Tiller m^{-2}	Panicle m^{-2}	Panicle length (cm)	Grain $panicle^{-1}$	Unfilled spikelet (%)	1000 grain wt. (gm)	Grain yield (tha^{-1})
BRRI dhan71	218	215	24.39	94	17.05	23.35	5.48
BRRI dhan75	288	277	20.45	89	13.99	19.92	5.55
BINA dhan17	266	260	22.99	79	20.32	21.54	5.13
Lsd at 5%	12.70	12.36	0.77	8.39	4.31	0.72	ns

Table 2. Yield and yield components of rice cultivars as affected by variety Boro 2017-18 seasons

Variety	Tiller m^{-2}	Panicle m^{-2}	Panicle length (cm)	Grain $panicle^{-1}$	Unfilled spikelet (%)	1000 grain wt. (gm)	Grain yield (tha^{-1})
BRRI dhan81	215	206	21.75	142.00	12.74	20.48	6.07
BRRI dhan84	236	229	25.21	141.94	18.51	21.90	6.32
BRRI dhan86	213	210	23.41	125.92	18.70	23.00	5.97
BRRI dhan28	260	248	21.88	111.46	16.20	21.82	5.95
Lsd at 5%	18.38	17.73	0.84	9.69	1.79	0.43	0.23

Effect of spacing: In T. Aman season, all the parameters except panicle length and 1000 grain weight were significantly affected by spacing. Closest spacing (15 cm × 15 cm) produced the highest number of tiller and panicle m^{-2}; and percent unfilled grain which was gradually decreased with increasing spacing. Closer spacing covers maximum number of hills per unit area consequently produces maximum tillers (Paul *et al*., 2017; Verma *et al*., 2002; Saha *et al.,* 2020). The highest grain yield (5.7 tha^{-1}) was observed in closer spacing (20 cm × 15 cm) which was statistically identical with the yield of (15 cm × 15 cm) and (20 cm × 20 cm) spacing. The grain yield gradually decreased with increasing spacing. It was the lowest (4.85 tha^{-1}) in widest (25 cm × 25 cm) spacing which was statistically identical with the yield obtained from (25 cm × 20 cm) and (20 cm × 20 cm) (Table 3) and Boro season, the highest number of tiller and panicle was

observed in closest spacing (15 cm × 15 cm) which was statistically identical to (20 cm × 20 cm) spacing. The tiller and panicle number decreased with increasing spacing. Plants grown as widest (25 cm × 25 cm) spacing produced the longest panicle and the highest number of filled grain panicle^{-1} whereas the highest percentage of unfilled grain was recorded in closest (15 cm × 15 cm) spacing. The highest 1000 grain weight was observed in (25 cm × 20 cm) spacing which was insignificant to other spacings except the closest (15 cm × 15 cm) spacing. The plants grown as (20 cm × 20 cm) spacing produced the highest grain yield (6.42 tha^{-1}) and closer or wider than (20 cm × 20 cm) spacing decreased yield significanly (Table 4). It might be due to the fact that the closer row spacing provided highest grain yield and straw yield which resulted in the highest biological yield (Paul *et al.,* 2017; Halder *et al.,* 2018; Saha *et al.,*2020).

Table 3. Yield and yield components of rice as affected by spacing T. Aman 2017

Spacing	Tiller m^{-2}	Panicle m^{-2}	Panicle length (cm)	Grain panicle^{-1}	Unfilled spikelet (%)	1000 grain wt. (gm)	Grain yield (tha^{-1})
15 cm × 15 cm	312	306	22.48	75	22.74	21.54	5.76
20 cm × 15 cm	266	257	22.83	87	16.74	21.70	5.79
20 cm × 20 cm	255	250	22.57	88	16.30	21.27	5.46
25 cm × 20 cm	232	229	22.43	90	15.90	21.41	5.07
25 cm × 25 cm	221	212	22.75	96	13.93	22.11	4.85
Lsd at 5%	16.40	15.97	ns	10.83	5.57	ns	0.63

Table 4. Yield and yield components of rice as affected by spacing Boro 2017-18 seasons

Spacing	Tiller m^{-2}	Panicle m^{-2}	Panicle length (cm)	Grain panicle^{-1}	Unfilled spikelet (%)	1000 grain wt. (gm)	Grain yield (tha^{-1})
15 cm × 15 cm	278	268	22.69	122.79	18.63	21.20	5.91
20 cm × 15 cm	246	238	22.65	128.48	17.63	21.94	6.08
20 cm × 20 cm	230	224	23.06	127.11	16.22	21.97	6.42
25 cm × 20 cm	211	203	23.00	132.42	15.49	21.99	6.04
25 cm × 25 cm	191	184	23.92	140.84	14.73	21.89	5.95
Lsd at 5%	20.65	19.83	0.95	10.83	2.00	0.48	0.26

CONCLUSION

The experimental results concluded that BRRI dhan75 transplanted at 20 cm × 15 cm spacing in T. Aman season and BRRI dhan84 transplanted at 20 cm × 20 cm spacing in Boro season could be a higher grain yield.

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