

Effect of Spacing on the Yield and Yield Contributing Characters of Four Varieties of Transplanted *Aman* Rice

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Abstract The research was carried out to study the effect of variety and spacing on the yield attributes of transplant *Aman* rice. The experiment was laid out in a randomized block design with three replications. Three levels of plant spacing viz. 25 x 15 cm² (S₁), 25 x 20 cm² (S₂) and 25 x 25 cm² (S₃) were used and four varieties viz. BRRI dhan30 (V₁), BRRI dhan31 (V₂), BRRI dhan32 (V₃) and Nizersail (V₄) were included in the study. Variety showed significant differences for all the characters under study. Out of four varieties of transplant *Aman* rice, BRRI dhan32 possessed the highest grain yield (4.27 ton ha⁻¹). The lowest grain yield was observed in Nizersail (2.96 ton ha⁻¹). BRRI dhan32 also produced the highest straw yield (6.22 ton ha⁻¹) whereas the lowest straw yield was obtained in BRRI dhan31 (5.21 ton ha⁻¹). The variety BRRI dhan32 also showed higher effective tillers hill⁻¹ (10.35), higher effective tillers m² (280.00) and higher number of grains panicle⁻¹ (129.10). The plant spacing exerted significant effect on the yield components of rice varieties. Highest grain yield (3.94 ton ha⁻¹) was obtained with the spacing S₂ (25 x 20 cm²), similarly similar spacing showed the highest effective tillers m² (192.60) while the widest plant spacing (25 x 25 cm²) produced the tallest plant (112.78cm), total tillers hill⁻¹ (15.15), effective tillers hill⁻¹ (11.05) and filled grains panicle⁻¹ (130.30). The interaction between variety and plant spacing had significant effect on the most of the characters under study except non-effective tillers hill⁻¹, panicle length, 1000-grain weight and straw yield. The results showed that highest grain yield (4.50 ton ha⁻¹) was obtained from combination of BRRI dhan32 and spacing (25 x 20 cm²) treatment followed by that of V₃S₁ (BRRI dhan32 and 25 x 15 cm² spacing) treatment. The BRRI dhan32 with wider spacing (25 x 25 cm²) performed better.

Key words

Aman rice, variety, spacing, yield

Among the three rice growing seasons, *Aman* covers about 52.46% of the total rice growing area and contributes to 44% of total rice production in the country [3]. Although, rice is the staple food of the people of this country, the average yield of rice in this country is around 2.03 ton ha⁻¹ [3]. The reasons for these are manifold: some are varietal, some are climatic and some are technological. Bangladesh is an over populated country and every year nearly 1.94 million people are added to its population of about 122 million [8]. As a result, rice production area is decreasing day by day due to high population pressure, urbanization and industrialization. On the other hand, to achieve the targeted rice production, there is no scope for further increase in rice area rather it will decrease due to use of arable land for infra-structural development. Therefore attempts should be taken to increase the yield through the use of modern production technologies, such as,

high yielding and modern varieties, optimum age of seedlings and proper spacing. Among these, use of improved varieties as well as optimum spacing are two of the most effective means to increase the yield of transplant *Aman* rice. Variety itself is a genetic factor which contributes a lot in producing yield and yield components of particular crop. Yield components are directly related to the variety and neighboring environments in which it grows. Bangladesh Rice Research Institute (BRRI) reported that grain yield of the modern transplant *aman* rice varieties contributed the yield up to 6.5 ton ha⁻¹ [6]. BRRI is working very hard on it and has released about 43 modern varieties of rice suitable for cultivation in one or more rice growing seasons of Bangladesh. It was found that BINA dhan6 contributed the highest grain yield of 8.9 ton ha⁻¹ among the modern varieties studied [5]. Spacing is another important factor that influences the

growth, development and yield of transplant *Aman* rice. Closer spacing not only hampers intercultural operation but also creates more competition among the plants for nutrients, air and light resulting in reduced yield. Optimum plant spacing ensures the plant to grow properly with their aerial and underground parts utilizing more solar radiation and nutrients [13]. It was reported that highest grain yield of 4.88 ton ha⁻¹ was documented with spacing 20 × 20cm² [16]. When the plant spacing exceeds an optimum level, competition for the growth factors among plants becomes severe. Consequently, the plant growth slows down and ultimately the grain yield decreases. The tillering and production habit depend to a great extent on the spacing of transplanting, which is responsible for the variation in yield of rice per unit area. Therefore, the present study was undertaken to find out the appropriate plant spacing for four transplanted (T.) *Aman* varieties for maximizing the yield and yield attribute.

Material and Method

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the *Aman* season. The experimental field was located 2475N latitude and 9050E longitude of 18 meter the sea level. The experimental plot belongs to the Agro-ecological region of the old Brahmaputra Floodplain (AEZ-9). The region occupies a large area of Brahmaputra sediments which were laid down before the river shifted into its present Jamuna channel about 200 years ago [7]. The soil of the experimental land belongs to the Sonatola series of non-calcareous dark grey floodplain type under old Brahmaputra Alluvial Floodplain. The experimental field was medium high land with moderate drained condition. The land was silty loam in texture having a soil pH 6.42. The experimental area was located under the sub-tropical climate, which is specialized by moderately high temperature and heavy rainfall during the *Kharif* season (April-September) and low rainfall with moderately low temperature during the *Rabi* season (October to March). Three spacings viz. 25 x 15 cm² (S₁), 25 x 20 cm² (S₂) and 25 x 25 cm² (S₃) were tried on four T. aman rice varieties viz. BRRI dhan30 (V₁), BRRI dhan31 (V₂), BRRI dhan32 (V₃) and Nizersail (V₄). The experiment was laid out in a randomized complete block design with three replications. Total number of unit plots were 36 and each plot size was 10m² (4m× 2.5 m). The Distance maintained between the unit plots and replications were 0.2m and 1m, respectively.

Description of rice cultivars

Rice variety BRRI dhan30, BRRI dhan31, BRRI dhan32 and Nizersail were used as the test crop.

BRRI dhan30: Bangladesh Rice Research Institute developed BRRI dhan30 for Aman season in 1994. Life cycle of this variety ranges from 140-145 days. The plant may attain a height of 120 cm. The panicle length varies from 25-30 cm. Each panicle bears about 160-165 grains. The ripe grains are golden in color. The variety produces the average grain yield up to 5 ton ha⁻¹.

BRRI dhan31: BRRI dhan31 is a High Yield Variety (HYV) of Seasonal Transplanting Aman rice the newly introduced hybrid has higher yield potential as compared to existing modern varieties. Bangladesh Rice Research Institute has developed rice line BR-11 and ARC 10550 by hybridization. After hybridization between BR- 11 and ARC 10550 advanced rice line BR 1725- 13-7-1-6 was developed.

BRRI dhan32: The variety BRRI dhan32 developed for cultivation in transplant Aman season. At first it was recommended for cultivation in the zone of Comilla in 1994. The plant height of this variety reaches up to 120 cm. Its life span is 130 days. Under appropriate cultural conditions this variety produces up to 5 ton ha⁻¹ grain yield.

Nizersail: A well established locally improved rice variety. It is highly photosensitive in nature. Nizersail is only adopted in transplanted *Aman* season. This cultivar matures at 150-160 days of planting. It attains a plant height of 155- 160 cm. The cultivar gives an average yield of 2.4-3.3 ton ha⁻¹.

The growing of crop and collection of data at harvest:

All agronomic practices were adopted according to the common recommendations for this crop. Data were collected following standard procedure. Plant characteristics and yield attributes such as plant height, total number of tillers hill⁻¹, effective tillers hill⁻¹, non-effective tillers hill⁻¹, grains panicle⁻¹, filled grains panicle⁻¹, unfilled grains panicle⁻¹, weight of 1000 grain, grain yield, straw yield and harvest index were examined for this study. The grain yield was measured from one square meter area in each plot and was converted into tons per hectare. The sun-dried straw was weighed from the same sample area harvested for grain yield and converted into tons per hectare. Harvest index was calculated by the following formula [4].

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Grain yield} + \text{Straw yield}} \times 100$$

Statistical analysis: Data recorded for different parameters were compiled and tabulated in proper form for statistical analysis. The collected data were statistically analyzed program MSTAT-c and the significance of mean differences was adjusted by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussions

Effect of variety on plant characteristics

Plant height: It was evident from Table 1 that the height of the plant was significantly influenced by variety. The data showed that Nizersail produced the tallest plant (124.80 cm) which was followed by BRRI dhan32 (113.10 cm) of the variety BRRI dhan30 produced the shortest plant (97.94). The varietal differences in plant height might be due to heredity or varietal character. Similar results were also reported by BRRI (1991) that plant height was different due to varietal variation.

Number of total tillers hill⁻¹: From the experimental results it was found that number of total tillers hill was significantly influenced by variety (Table 1). Among the four varieties BRRI dhan32 produced the maximum number of total tillers hill (13.77) which was statistically identical with BRRI dhan30 (13.68). The minimum number of total hill was produced by Nizersail (12.49) and it was identically followed by

BRRI dhan31 (12.57). This confirms the report of Babiker (1986) that variable effects of variety on the total tillers hill⁻¹.

Number of total tillers m⁻²: Number of total tillers m⁻² was significantly influenced by the variety (Table 1). The highest number of total tillers (280.00) was produced by BRRI dhan32 which was identically followed by BRRI dhan30. The lowest number of total tillers m⁻² (234.14) was observed by BRRI dhan31. Similar findings were observed by Yan (2002).

Number of effective tillers hill⁻¹: It was evident (Table 1) that variety had significant effect on number of effective tillers hill⁻¹. The results showed that the variety BRRI dhan32 produced the maximum number of effective tillers hill⁻¹ (10.35) followed by BRRI dhan30 (9.26) and BRRI dhan31 (8.89). The lowest effective tillers was found in local variety Nizersail this confirms the report of Sawnat *et al.* (1986), who reported that variable effect of variety on the number of effective tillers hill⁻¹.

Table 1: Variety performances on yield contributing characters of rice varieties

Variety	Plant height (cm)	Total tillers hill ⁻¹ (no.)	Total tillers m ⁻² (no.)	Effective tillers hill ⁻¹ (no.)	Effective tillers m ⁻² (no.)	Non-effective tillers hill ⁻¹ (no.)	Grain yield (ton ha ⁻¹)	Straw yield (ton ha ⁻¹)
BRRI dhan30 (V1)	97.94d	13.68a	276.66a	9.26b	183.02d	4.41b	3.91b	5.80b
BRRI dhan31 (V2)	100.90c	12.57b	234.14c	8.89b	176.52c	3.67c	3.75b	5.21c
BRRI dhan32 (V3)	113.10b	13.77a	280.00a	10.35a	207.68a	3.42c	4.27a	6.22a
Nizersail (V4)	124.80a	12.49b	257.30b	7.64c	154.00d	4.85a	2.96c	6.06a
Level of Significance	**	**	*	**	**	**	**	**
CV (%)	0.809	0.372	1.72	0.180	2.11	0.090	0.057	0.084

Figures in a column, having the same letter (s) do not differ significantly.

* = Significant at 5% level of Significance

** = Significant at 1% level of Significance

Number of effective tillers m⁻²: Number of effective tillers m⁻² was significantly influenced by variety (Table 1). The maximum number of effective tillers m⁻² (207.68) was obtained from BRRI dhan32 followed by the results produced with BRRI dhan30, the minimum number of effective tillers m⁻² (154.00) was obtained from Nizersail.

Number of non-effective tillers hill⁻¹: The result revealed that variety had shown significant effect on non-effective tillers hill⁻¹ (Table 1). Nizersail produced the highest non-effective tillers hill⁻¹ (4.85) statistically followed by BRRI dhan30 (4.41). BRRI dhan32 produced the lowest non-effective tillers hill (3.42) which was similar to BRRI dhan31.

Grain yield (ton ha⁻¹): Variety had significant effect on grain yield (Table 1). It was evident from BRRI dhan32 produced the highest grain yield (4.27 ton ha⁻¹) which was contributed from higher number of effective tillers hill⁻¹, higher number of grains panicle⁻¹ and more weight of 1000-grain. The lowest grain yield was obtained from Nizersail (2.96 ton ha⁻¹) BRRI dhan30

and BRRI dhan31 produced the second highest grain yield (3.91 ton ha⁻¹). Similar results were also obtained from Alam (1988) and Hossain *et al.* (1991).

Straw yield (ton ha⁻¹): It was observed that the yield of straw was significantly different due to variety (Table 1). The variety BRRI dhan32 produced the highest straw yield (6.22 ton ha⁻¹) BRRI dhan31 produced the lowest straw yield (5.21 ton ha⁻¹).

Panicle length: The panicle length varied significantly due to variety shown in Table 2. It was observed that Nizersail produced the longest panicle (24.53 cm) followed by the variety BRRI dhan32 (23.15 cm). The shortest panicle was observed by variety BRRI dhan30 (22.54 cm) and it was similar to BRRI dhan31.

Number of filled grains panicle⁻¹: The results showed that variety had shown highly significant effect on number of grains panicle⁻¹ (Table 2). It was revealed that BRRI dhan32 gave significantly the highest filled grains panicle⁻¹ (129.10) which proved to be similar to that of BRRI dhan31. BRRI dhan30 produced the lowest number of grains panicle⁻¹ (112.00).

Table 2: The performances on yield contributing characters of rice varieties

Variety	Panicle length (cm)	Filled grain panicle ⁻¹ (no.)	Unfilled grain panicle ⁻¹ (no.)	1000-grain weight (g)	Harvest index (%)
BRRi dhan30 (V1)	22.54b	112.00c	15.19b	21.23b	40.24b
BRRi dhan31 (V2)	22.54b	123.50ab	17.73a	23.56a	41.88a
BRRi dhan32 (V3)	23.15ab	129.10a	10.89c	21.51b	40.71b
Nizersail (V4)	24.53a	119.00b	7.95d	16.45c	31.83c
Level of Significance	**	**	**	**	**
CV (%)	0.456	1.930	0.185	0.521	0.356

Figures in a column, having the same letter (s) do not differ significantly.

** = Significant at 1% level of Significance

NS= Non Significant

Number of unfilled grains panicle⁻¹: The results showed a significant effect in respect of the number of unfilled grains panicle⁻¹ (Table 2). BRRi dhan31 produced the highest number of unfilled grains panicle (17.73). Lowest number of unfilled grains panicle was (7.95) produced by Nizersail. BRRi dhan30 and BRRi dhan32 produced intermediate number of grains panicle⁻¹.

Weight of 1000-grains (g): The results showed 1000-grain weight had highly significant due to variety (Table 2). It was revealed that BRRi dhan31 produced the heaviest grain (23.56). The smallest grain (16.45) was produced by Nizersail. This result is in agreement with the finding of Rafey *et al.*, (1989) who stated that weight of 1000-grains differed due to the varietal differences.

Harvest index (%): It was found that variety had significant effect on harvest index (Table 2). It is evident that BRRi dhan31 produced the highest harvest

index (41.88%) which was followed by BRRi dhan30 and BRRi dhan32. The lowest harvest index was obtained from Nizersail (31.83%). It was reported that variety had a great influence on harvest index. Harvest index had been reported to decrease with the increase in plant height [19].

Effect of spacing on plant characteristics

Plant height: The plant height was significantly influenced by spacing (Table 3). It was observed that wider spacing S₃ (25 x 25 cm²) produced the tallest plant (112.78 cm) followed by S₂ (25 x 20 cm²), S₁ (25 x 15 cm²). The closest spacing S₁ (25 x 15 cm²) produced the shortest plant (105.50 cm). This might be due to the fact that widely spaced plants get more light, air and soil nutrients which facilitated the plant to develop fully. Similar results were also found by Miah (1990) who reported that plant height significantly influenced by spacing.

Table 3: Effect of spacing on yield parameters of different rice varieties

Spacing (cm ²)	Plant height (cm)	Total tillers hill ⁻¹ (no.)	Total tillers m ⁻² (no.)	Effective tillers hill ⁻¹ (no.)	Effective tillers m ⁻² (no.)	Non-effective tillers hill ⁻¹ (no.)	Grain yield (ton ha ⁻¹)	Straw yield (ton ha ⁻¹)
25 x 15 (S ₁)	105.50c	10.81c	288.27a	6.42c	171.22c	4.38a	3.62b	5.81
25 x 20 (S ₂)	109.30b	13.42b	268.40b	9.63b	192.60a	3.79c	3.94a	5.86
25 x 25 (S ₃)	112.78a	15.15a	242.40c	11.05a	176.80b	4.10b	3.61b	5.79
Level of Significance	**	**	**	**	**	**	**	NS
CV (%)		0.050	0.952	0.073	1.83	0.154	0.160	-

Figures in a column, having the same letter (s) do not differ significantly.

** = Significant at 1% level of Significance

NS= Non Significant

Number of total tillers hill⁻¹: Plant spacing had shown a highly significant effect on the formation of total tillers hill (Table 3). A linear increasing trend of tillers hill⁻¹ with the widening of plant spacing was recorded. It was observed that, the widest spacing S₃ (25 x 25 cm²) produced the highest number of total tillers hill⁻¹ (15.15) followed by S₂ (25 x 20 cm²) (13.42). The closest spacing S₁ (25 x 15 cm²) produced the least number to total tillers hill⁻¹ (10.81). Wider spaced plants received more nutrient, moisture and light which led the plants to produce more tillers plant⁻¹. This result is in agreement with that of BRRi [6].

Number of total tillers m⁻²: The Results showed that there was significant difference in total number of tillers m⁻² due to spacing (Table 3). The highest number of total tiller m⁻² (288.27) was produced by closest spacing S₁ (25 x 15 cm²) and the lowest total number of tillers m⁻² (242.40) was obtained from wider spacing S₃ (25 x 25 cm²).

Number of effective tillers hill⁻¹: It was found (Table 3) that number of effective tillers hill⁻¹ differed significantly due to different spacing used. From the experimental results it can be said that the widest spacing S₃ (25 x 25 cm²) produced the highest number

of effective tillers hill⁻¹ (11.05 cm). The closest spacing S₁ (25 x 15 cm²) produced the lowest number of effective tillers hill⁻¹ (6.42). The medium and normally practiced spacing S₂ (25 x 20 cm²) produced the intermediate number of effective tillers hill⁻¹ (9.63). Similar results were also reported by Quddus and Huda [14].

Number of effective tillers m⁻²: Effective tillers m⁻² was significantly affected by the plant spacing (Table 3). The highest number of effective tillers m⁻² (192.60) was obtained from 25 x 20 cm² spacing that followed by wider spacing (25 x 25 cm²). The lowest number of effective tillers m⁻² (171.22) was found from 25 x 15 cm² spacing.

Number of non-effective tillers hill⁻¹: It was found that non-effective tillers hill⁻¹ was significantly influenced by spacing (Table 3). The highest number of non-effective tillers hill⁻¹ (4.38) was obtained from closest spacing (25 x 15 cm²) and the lowest number of non-effective tillers hill⁻¹ (3.79) was found in 25 x 20 cm² spacing which is statistically similar to wider spacing. The wider spacing showed the number of non-effective tillers hill⁻¹ intermediate. The result was in agreement with the findings of Grist (1975) who reported that number of non-effective tillers hill⁻¹ was found statistically identical under different spacing.

Table 4: Effect of spacing on yield parameters of different rice varieties

Spacing (cm ²)	Panicle length (cm)	Filled grain panicle ⁻¹ (no.)	Unfilled grain panicle ⁻¹ (no.)	1000-grain weight (g)	Harvest index (%)
25 x 15 (S ₁)	23.17	110.50c	14.77a	20.67	38.26b
25 x 20 (S ₂)	23.89	121.80b	13.99b	20.86	40.08a
25 x 25 (S ₃)	23.70	130.30a	10.06c	20.53	38.41b
Level of Significance	NS	**	**	NS	**
CV (%)	-	1.83	0.156	-	0.239

Figures in a column, having the same letter (s) do not differ significantly.

** = Significant at 1% level of Significance

NS = Non Significant

Grain yield (ton ha⁻¹): It was found that spacing within the range of present study had significant effect on grain yield (Table 3). It was observed the spacing S₂ (25 x 20 cm²) produced the highest grain yield (3.94 ton ha⁻¹). The spacing S₃ (25 x 25 cm²) produced the lowest grain yield (3.61 ton ha⁻¹). The grain yield became the highest because of greater number of hill per unit area.

Straw yield (ton ha⁻¹): The results showed that the spacing had non-significant effect on straw yield (Table 3). It was evident that spacing S₂ (25 x 20 cm²) produced the highest straw yield (5.86 ton ha⁻¹) and S₃ (25 x 25 cm²) produced the lowest straw yield (5.79 ton ha⁻¹). It might be attributed due to greater number of plants in closely spaced plots. Similar results were demonstrated by Smith (1970) that the straw yield increased when spacing was decreased.

Panicle length: The panicle length was unaffected significantly under different spacing (Table 4). It was revealed that the panicle length was numerically longer (23.89 cm) at the spacing of S₂ (25 x 20 cm²) and shortest panicle was found (23.17 cm) at the closest spacing S₁ (25 x 15 cm²). This observation was in agreement with that of Liou (1987) who stated that panicle length was significantly influenced by plant population.

Number of filled grains panicle⁻¹: Spacing showed significant effect on number of filled grains panicle⁻¹. It was observed that the widest spacing S₃ (25 x 25 cm²) produced the highest number of filled grains panicle⁻¹ (130.30). The lowest number of filled grains panicle⁻¹ (110.50) was produced by the closest spacing S₁ (25 x

15 cm²). This observation was in agreement with that of Quddus and Huda (1975) and Rao *et al.* (1990) who stated that wider spacing produced higher number of filled grains panicle⁻¹. Since fertility of spikelet and development of grains depend on environmental factors such as nutrition, moisture and light, wider spacing possible facilitated to supply of more food materials, moisture and light for the plant ultimately for development of grain comparing to closer spacing (Table 4).

Number of unfilled grains panicle⁻¹: It was observed that spacing had significant effect on unfilled grains panicle⁻¹ (Table 4). The closest spacing S₁ (25 x 15 cm²) produced the highest number of unfilled grains panicle⁻¹ (14.77). The lowest number of unfilled grains panicle⁻¹ (10.06) was produced by the widest spacing S₃ (25 x 25 cm²) which was followed by spacing S₂ (25 x 20 cm²).

Weight of 1000-grains (g): It was observed from the spacing had no significant effect on 1000-grain weight (Table 4). This result is in agreement with the findings of Hu and Theseng (1982) who stated that spacing had no significant effect on 1000-grain weight.

Harvest index (%): The variation due to the spacing was significant in terms of harvest index (Table 4). It was evident that the highest harvest index (40.08%) was recorded in S₂ (25 x 20 cm²) spacing. The lowest harvest index (38.26%) was observed from closest spacing S₁ (25 x 15 cm²).

Interaction effect of variety and spacing

Plant height: The results showed that the plant height was significantly influenced by interaction of variety

and spacing (Table 5). Nizersail showed the longer plant height under all the spacing. BRRI dhan31 produced the shortest plant height of 93.59 cm under closest spacing. The variety Nizersail produced significantly better results at all spacing numerically the longest was recorded 127.00 cm at S₃ (25 x 25 cm²) spacing followed by S₂ (25 x 20 cm²) and S₁ (25 x 15 cm²) as well.

Number of total tillers hill⁻¹: Result revealed that total tiller hill⁻¹ was found statistically significant influenced by the interaction between variety and spacing. BRRI dhan32 produced that highest total tiller hill⁻¹ (16.27) under wider spacing (25 x 25 cm²) which was

statistically identical with BRRI dhan31 and BRRI dhan30 under the same spacing. BRRI dhan31 showed the lowest total tiller hill⁻¹ under S₁ (25 x 15 cm²) spacing (Table 5).

Number of total tillers m⁻²: The number of total tillers m⁻² was significantly influenced by the interaction between variety and spacing (Table 5), BRRI dhan32 produced the highest total tillers m⁻² (314.70) under closest spacing (25 x 15 cm²) which was statistically identical with Nizersail with same spacing and BRRI dhan30 at 25 x 20 cm² spacing. BRRI dhan31 showed the lowest total tillers m⁻² (209.12) with 25 x 20 cm² spacing.

Table 5: Interaction effect of variety and spacing on the yield attributes of different rice varieties

Interaction	Plant height (cm)	Total tillers hill ⁻¹ (no.)	Total tillers m ⁻² (no.)	Effective tillers hill ⁻¹ (no.)	Effective tillers m ⁻² (no.)	Non-effective tillers hill ⁻¹ (no.)	Panicle length (cm)	Filled grain panicle ⁻¹ (no.)	Unfilled grain panicle ⁻¹ (no.)	1000-grain weight (g)	Grain yield (ton ha ⁻¹)	Straw yield (ton ha ⁻¹)	Harvest index (%)
V ₁ S ₁	96.57gh	10.67ef	284.57b	5.89g	157.10d	4.78	21.83	106.50g	18.50a	21.22	3.70de	5.70	39.36ef
V ₁ S ₂	98.15g	14.87a-c	297.40a	10.40cd	208.00ab	4.47	22.79	114.40e-g	16.00b	21.35	4.20ab	5.97	41.30b-d
V ₁ S ₃	99.10fg	15.50ab	248.00d	11.50d	184.00c	4.40	23.00	114.90d-g	11.07e	21.13	3.83c-e	5.73	40.06d-f
V ₂ S ₁	93.59h	9.30f	248.03d	5.90de	157.4b	3.40	23.93	108.00fg	18.27a	23.53	3.70de	5.40	40.66c-e
V ₂ S ₂	103.00ef	13.07cd	209.12e	5.89de	197.80b	3.18	23.24	128.50bc	18.60a	23.84	3.97b-d	5.27	42.97a
V ₂ S ₃	106.10de	15.33ab	245.28b	10.90bc	174.40c	4.43	23.23	133.90b	16.33b	23.30	3.06e	4.97	42.01a-c
V ₃ S ₁	108.90cd	11.80de	3014.70a	7.99f	213.10a	3.81	22.57	114.50e-g	13.60c	21.53	4.25ab	6.13	40.94b-d
V ₃ S ₂	114.50e-g	13.60c	21.53	4.25ab	6.13	40.94b-d	114.50e-g	125.50b-d	12.50d	21.63	4.50a	6.13	42.33ab
V ₃ S ₃	119.00b	16.27a	260.32c	12.81a	204.00ab	3.46	23.87	147.20a	6.58g	21.37	4.07bc	6.40	38.87f
V ₄ S ₁	123.00ab	11.47be	305.91a	5.93g	157.10d	5.54	24.36	113.00fg	8.73f	16.41	2.85f	6.03	32.04h
V ₄ S ₂	124.50a	12.50de	250.00d	8.00f	160.00d	4.52	24.53	119.00c-f	8.87f	16.63	3.10f	6.10	33.70g
V ₄ S ₃	127.00a	13.50b-d	216.00e	8.99e	143.80e	4.51	24.69	125.00b-e	6.27g	16.31	2.95f	6.07	32.71gh
Level of Significance	**	**	**	**	**	NS	NS	**	**	NS	**	NS	*
CV (%)	1.403	0.645	2.35	0.313	3.666	-	9.545	3.35	0.320	-	0.100	-	0.474

Figures in a column, having the same letter (s) do not differ significantly.

* = Significant at 5% level of Significance, ** = Significant at 1% level of Significance, NS= Non Significant

V₁=BRRI dhan30, V₂= BRRI dhan31, V₃= BRRI dhan32, V₄= Nizersail

S₁=25 x 15 cm², S₂= 25 x 15 cm², S₃= 25 x 15 cm²

Number of effective tillers hill⁻¹: It was found that interaction effect of variety and spacing had significant effect on effective tillers hill⁻¹. BRRI dhan32 possessed the highest effective tillers hill⁻¹ (12.81 cm) under the wider spacing (25 x 25 cm²). BRRI dhan30 possess the lowest under S₁ (25 x 15 cm²) closer spacing which was statistically identical with that of Nizersail with same spacing (Table 5).

Number of effective tillers m⁻²: The results showed that the interaction between variety and spacing was highly significant on the production of number of effective tillers m⁻² (Table 5). The maximum number of effective tillers m⁻² (213.10) was obtained from BRRI dhan32 with the closest spacing (25 x 15 cm²).The

lowest number of effective tillers m⁻² (143.80) was found from Nizersail with wider spacing 25 x 25 cm².

Number of non-effective tillers hill⁻¹: Interaction effect of variety and spacing showed no significant effect on non-effective tillers hill (Table 5).

Panicle length: Interaction showed that between variety and spacing had no significant effect on panicle length (Table 5).

Number of filled grains panicle⁻¹: The effect of interaction between variety and spacing had significant effect on the formation of the filled grains panicle⁻¹ (Table 5). BRRI dhan32 produced the highest filled grains panicle⁻¹ (147.20) under wider spacing (25 x 25 cm²). BRRI dhan30 and BRRI dhan31 showed the

lowest filled grains panicle⁻¹ 106.50 and 108.00, respectively under closest (25 x 15 cm²) spacing.

Number of unfilled grains panicle⁻¹: Results showed that the effect of interaction of variety and spacing had significant effect on the number unfilled grain panicle. BRRI dhan31 had the highest unfilled grain panicle⁻¹ (18.60) from S₂ (25 x 20 cm²) spacing which was identical with BRRI dhan30 and BRRI dhan32. Nizersail showed the lowest unfilled grains panicle and wider S₃ (25 x 25 cm²) spacing (Table 5).

Weight of 1000-grains (g): Results showed that the effect of interaction of variety and spacing had no significant effect on 1000-grain weight (Table 5).

Grain yield (ton ha⁻¹): Grain yield was highly influenced by the interaction between variety and spacing (Table 5). BRRI dhan32 showed the highest grain yield (4.50 ton ha⁻¹) with S₂ (25 x 20 cm²) spacing, statistically followed by same variety with S₁ (25 x 15 cm²) spacing and BRRI dhan30 with S₂ (25 x 20 cm²) spacing. The lowest one (2.85 ton ha⁻¹) was obtained from Nizersail under closest spacing S₁ (25 x 15 cm²).

Straw yield (ton ha⁻¹): The effect of interaction between variety and spacing showed no significant effect on straw yield (Table 5).

Harvest index (%): Harvest index was significantly influenced by the interaction between variety and spacing (Table 5). Results indicated that the highest harvest index (42.97%) was obtained from BRRI dhan31 with S₂ (25 x 20 cm²) spacing which was statistically followed by BRRI dhan32. The lowest harvest index (32.04%) was recorded in Nizersail variety with closest spacing S₁ (25 x 15 cm²).

Conclusions

Among the four varieties of transplant *Aman* rice, BRRI dhan32 gave the highest grain yield. BRRI dhan32 produced the highest straw yield, number of grains panicle⁻¹, total tillers hill⁻¹, effective tillers hill⁻¹ and effective tillers m⁻². Nizersail produced the tallest plant (124.80 cm). The widest plant spacing (25 x 25 cm²) recorded the tallest plant height, maximum number of total tillers hill⁻¹, highest effective tillers hill⁻¹, maximum filled grains panicle⁻¹, lowest unfilled grains panicle⁻¹, lowest grain yield and straw yield. The closest plant spacing S₁ (25 x 15 cm²) produced the shortest plant height, shortest panicle, length number of total tillers hill⁻¹, effective tillers hill⁻¹, grains panicle⁻¹ but highest number of unfilled grains panicle from plant spacing of S₃ (25 x 25 cm²). Based on the result of the present study it found that among the three spacing S₂ (25 x 20 cm²) was found to be the best for transplant *Aman* rice cultivation. On the other hand, BRRI dhan32 was found to be a promising rice variety for higher grain yield in transplant *Aman* season. It can, therefore, be concluded that BRRI dahn32 with the spacing of S₂ (25 x 20 cm²) was found to be the best

possible combination for achieving higher grain yield per unit area.

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