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Effect of variety, spacing and number of seedlings per hill on the yield potentials of transplant aman rice

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Abstract

An experiment was carried out at Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of Rajshahi during the kharif season to study the effect of variety, spacing and number of seedlings hill^{-1} on the yield potentials of transplant aman rice. The experiment consisted of three high yielding varieties viz. BRRI dhan32, BRRI dhan33 and BR11, four levels of spacing viz. 10cm×25cm, 15cm×25cm, 20cm×25cm and 25cm×25cm and four levels of number of seedlings hill^{-1} viz. 2 seedlings hill^{-1}, 3 seedlings hill^{-1}, 4 seedlings hill^{-1} and 5 seedlings hill^{-1}. A split-split plot design was used with three replications assigning the variety on the main plot, spacing to the sub-plots and number of seedlings hill^{-1} to the sub-sub plots. Variety had significant effects on almost all the yield component characters and yield. All the yield components characters except number of fertile spikelets panicle^{-1} were highest in case of variety BR11 and hence it produced the highest grain yield (5.92 tha^{-1}). Spacing had a significant influenced on the yield components and yield of rice. All the yield contributing characters were highest at 15cm×25cm spacing and thus it produced the highest grain yield (5.93 t ha^{-1}). Effect of the number of seedlings hill^{-1} was also significant on almost all the yield enhancing characters. The highest plant height, panicle length, fertile spikelets panicle^{-1} and 1000-grain weight were found when 2 seedlings were transplanted hill^{-1} and consequently it produced the highest grain yield (5.78 t ha^{-1})..

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Introduction

Rice (*Oryza sativa* L.) is the staple food of Bangladesh. The almost uneven topography and humid climate along with abundant monsoon offers a unique environment for the rice plant in Bangladesh. Bangladesh earns about 12.19% of her gross domestic product (GDP) from crop (AIS, 2007). The area under rice cultivation during 2005-2006 was about 6.463 million hectares with a total production of about 12.55 million tons (AIS, 2007). The yield of rice may be increased through improved agronomic manipulations such as proper spacing, proper number of seedlings hill^{-1} and judicious use of fertilizer especially nitrogen (BARI, 1995). Variety is the key component to produce higher yield of rice depending upon their differences in genotypic characters, input requirements and response, growth process and off course the prevailing environmental conditions during the growing season. The growth process of rice plants under a given agro-climatic condition differs with variety. Improper spacing reduces the yield up to 25-30 per cent (IRRI, 1967). The optimum spacing ensures the plant to grow in their both aerial and under ground parts through efficient utilization of solar radiation and nutrients (Miah *et al.,* 1990). Wider spacing allows more competition among crop plants and weeds. Consequently plant growth slows down and their grain yield decreases. The plant to plant and row to row distance determines the plant population unit^{-1} area which has direct effect on yield. Closer spacing hampers intercultural operations, more competition arises among the plants for nutrient, air and light as a result plants become weaker and thinner and consequently, yield is reduced. So, it is most importance to determine optimum spacing for maximizing the yield of rice. Number of seedling hill^{-1} is another important factor that influences plant population unit^{-1} area (Islam *et al,* 2002). Planting density in transplanted rice culture constitutes the number of seedlings hill^{-1}. The number of tillers and their growth is greatly affected both qualitatively and quantitatively by number of seedlings hill^{-1}. Optimum number of seedlings hill^{-1} may enable the rice plant to grow properly both in its aerial and underground parts by utilizing maximum solar energy, nutrients, space, water and also could reduce seedling cost of farmers (Azad, 2004). Therefore, optimum number of seedlings hill^{-1} also essential for higher yield of rice.

Therefore, the present piece of research work was undertaken to study the effect of variety, spacing and number of seedlings hill^{-1} on the yield components and yield of rice.

Materials and methods

An experiment was carried out at Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of Rajshahi during the kharif season to study the effect of variety, spacing and number of seedlings hill^{-1} on the yield potentials of transplant aman rice. The experiment consisted of three high yielding varieties viz. BRRI dhan32 (V_1), BRRI dhan33(V_2) and BR11(V_3), four levels of spacing viz. 10cm×25cm (S_1), 15cm×25cm (S_2), 20cm×25cm (S_3) and 25cm×25cm (S_4) and four levels of number of seedlings hill^{-1} viz. 2 seedlings hill^{-1} (H_1), 3 seedlings hill^{-1} (H_2), 4 seedlings hill^{-1} (H_3) and 5 seedlings hill^{-1}(H_4) . A split-split plot design was used with three replications assigning the variety on the main plot, spacing to the sub-plots and number of seedlings hill^{-1} to the sub-sub plots. Healthy seeds of each selected varieties were soaked in water in bucket for 24 hours and then taken out of water and spread thickly on polythene sheets and covered with wet gunny bags under dark condition for sprouting. The seeds started sprouting after 48 hours and sown in the seed beds after 72 hours. The sprouted seeds were sown uniformly in three well prepared separate seed bed. Proper care was taken to protect the seeds in the seed bed as and when necessary. The land of experimental plot was prepared by opening the soil with power tiller. The experimental land was fertilized with nitrogenous, phosphoric, potassic, sulphuric and zinc fertilizers @ 180, 100, 70, 60, and 10 kg ha^{-1} respectively, in the form of urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate. The whole amount of triple super phosphate, muriate of potash, gypsum and zinc sulphate were applied as basal dose at final land preparation. The whole amount of urea

was applied as top dressing in three equal splits. The first split was applied at 20 days after transplanting (DAT), the second split at active tillering stage at 40 DAT and the third split at panicle initiation stage at 50 DAT. Thirty days old seedlings were transplanted in the well puddled plots as per treatments. Intercultural operation was done as and when necessary. The crop was harvested at full maturity when grains were filled properly. Five hills (excluding two border rows, hills and central 1 m^2 areas) were randomly selected from each unit plot and uprooted before harvesting for recording of necessary data. After sampling, a harvest area of 1m × 1m was selected in the middle portion of each unit plot for harvesting at full maturity. The harvested crop of each plot was separately bundled, properly tagged and then brought to the threshing floor to be threshed by pedal thresher. The grains were cleaned and then sun dried and the grain yield $plot^{-1}$ was taken at 14% moisture content.The collected data were analyzed statistically using the statistical package "MSTAST-C" program. The mean differences were adjudged by Duncans's Multiple Range Test (Steel and Toric, 1960).

Results and discussion

Plant height

Variety exhibited significant difference on plant height. Among the varieties BRRI dhan33 gave significantly the tallest plant (113.17cm), which is statistically identical with BR11 (111.25cm) (Table 1). The shortest plant was found in BRRI dhan32 variety (105.07cm). The results consistent with the findings of Bisne *et al.* (2006) who observed plant height differed significantly among the varieties. The plant height affected significantly by spacing . From the result it was observed that, the spacing 15cm×25cm produced the highest plant height (115.36cm). The closest spacing (10cm×25cm) produced the shortest plant (104.47cm), it might be due to more competition for nutrient, moisture, space and light among the plants in closest spacing (Table 2). Number of seedlings $hill^{-1}$ had also significant effect on plant height. Result revealed that the tallest plant (111.91cm) was obtained from 2 seedlings $hill^{-1}$ and the shortest one (108.13cm) was recorded from 5 seedlings $hill^{-1}$, which is statistically identical with the treatment 4 seedlings $hill^{-1}$ (Table 3).

Tillers $hill^{-1}$

The production of total tillers $hill^{-1}$ was significantly influenced by different varieties. The highest number of total tillers $hill^{-1}$ (12.23) was produced by BR11 and the lowest number of total tillers $hill^{-1}$ (10.17) was produced by BRRI dhan32 (Table 1). Production of total tillers $hill^{-1}$ was significantly influenced by spacing. The highest number of total tillers $hill^{-1}$ (13.28) was produced when the crop was transplanted at 15cm×25cm spacing and the lowest one (9.73) was observed in closest spacing (10cm×25cm). Production of total tillers $hill^{-1}$ was found to be increased when the plants were widely planted because wider spaced plants received more nutrients, moisture and light, which resulted in more tillers $hill^{-1}$. This result was in agreement with Haque (2002). Number of total tillers $hill^{-1}$ was significantly influenced by the number of seedlings $hill^{-1}$. The highest number of total tillers $hill^{-1}$ (12.13) was obtained when 5 seedlings were transplanted $hill^{-1}$ which was statistically similar to 4 seedlings $hill^{-1}$ and the lowest number of total tillers $hill^{-1}$ (9.79) was produced when 2 seedling was transplanted $hill^{-1}$ (Table 3). The number of total tillers $hill^{-1}$ increased with the increasing in the number of seedlings $hill^{-1}$. This result is in agreement with BRRI Report (1995) and Islam (2003).

Effective tillers $hill^{-1}$

The number of effective tillers $hill^{-1}$ was significantly influenced by varieties. Results showed that, the variety BR11 produced maximum number of effective tillers $hill^{-1}$ (8.62) and the minimum was obtained from the variety BRRI dhan32,which is statistically identical with the variety BRRI dhan33 (Table 1). The variation in the production of effective tillers $hill^{-1}$ might be due to genetic make up of the varieties. This was confirmed by Chowdhury *et al.* (1993) who stated that ear bearing tillers $hill^{-1}$ varied with variety. The number of effective tillers $hill^{-1}$ varied significantly due to spacing. The highest number of

effective tillers hill^{-1} (9.37) was found at spacing 15cm×25cm. The lowest number of effective tillers hill^{-1} (6.91) was observed at10cm×25cm spacing (Table 2). In wider spacing plants absorbed more nutrient, moisture and light which resulted on more number of effective tillers hill^{-1}. This result was agreement with that view of Miah *et al.* (1990). Number of seedlings hill^{-1} had no significant influence on the effective tillers hill^{-1}. Numerically, the highest number of effective tillers hill^{-1} (8.08) was produced from 2 seedlings hill^{-1} and the lowest one (7.91) was obtained from 5 seedling hill^{-1} (Table 3).

Table 1. Effect of variety on different crop characteristics of transplant aman rice.

Variety	**Plant height (cm)**	**Tillers hill^{-1} (no.)**	**Effective tillers hill^{-1} (no.)**	**Panicle length (cm)**	**Fertile spikelets panicle^{-1} (no.)**	**1000- grain weight (g)**	**Grain yield (t ha^{-1})**
V_1	105.07b	10.17c	7.42b	23.23a	102.10	21.80b	5.12c
V_2	113.17a	11.29b	7.97b	24.39a	103.04	21.69b	5.50b
V_3	111.25a	12.23a	8.62a	23.48a	103.83	23.79a	5.92a
.LS	0.01	0.01	0.01	0.05	NS	0.01	0.01
LSD	4.60	0.83	0.63	1.36	-	1.17	0.19
CV (%)	2.91	6.19	6.02	4.18	3.77	4.50	4.11

Table 2. Effect of spacing on different crop characteristics of transplant aman rice.

Spacing (cm)	**Plant height (cm)**	**Tillers hill^{-1} (no.)**	**Effective tillers hill^{-1} (no.)**	**Panicle length (cm)**	**Fertile spikelets panicle^{-1} (no.)**	**1000- grain weight (g)**	**Grain yield (t ha^{-1})**
10 × 25	104.47d	9.73d	6.91d	23.07b	96.14c	21.57b	5.04d
15 × 25	115.36a	13.28a	9.37a	24.21a	110.97a	23.09a	5.93a
20 × 25	111.28b	11.27b	8.12b	23.93a	104.34b	22.80a	5.66b
25× 25	108.22c	10.64c	7.61c	23.59ab	100.51bc	22.24b	5.42c
.LS	0.01	0.01	0.01	0.01	0.01	0.01	0.01
LSD	3.02	0.58	0.42	0.81	6.30	0.55	0.18
CV (%)	2.91	6.19	6.02	4.18	3.77	4.50	4.11

LS= level of significance LSD= Least significance difference CV= Coefficient of variation.

❖ In a column figures having similar letters (S) or without letters (s) do not differ significantly as per DMRT

Table 3. Effect of number of seedling hill^{-1} on different crop characteristics of transplant aman rice.

No. of seedling	**Plant height (cm)**	**Tillers hill^{-1} (no.)**	**Effective tillers hill^{-1} (no.)**	**Panicle length (cm)**	**Fertile spikelet panicle^{-1} (no.)**	**1000- grain weight (g)**	**Grain yield (t ha^{-1})**
2 hill^{-1}	111.91a	9.79c	8.08	24.40a	105.29a	22.75a	5.78a
3 hill^{-1}	110.72b	11.08b	8.05	24.10ab	103.66ab	22.59a	5.60b
4 hill^{-1}	108.57c	11.94a	7.98	23.53b	102.37bc	22.30ab	5.41c
5 hill^{-1}	108.13c	12.13a	7.91	22.76c	100.64c	22.06b	5.26d
LS	0.01	0.01	NS	0.01	0.01	0.05	0.01
LSD	1.98	0.62	-	0.62	2.42	0.47	0.14
CV (%)	2.91	6.19	6.02	4.18	3.77	4.50	4.11

❖ In a column figures having similar letters (S) or without letters (s) do not differ significantly as per DMRT

LS= Level of significance, CV= Co-efficient of variation, LSD=least significance difference

Panicle length

The panicle length varied significantly due to different varieties. Results revealed that, BRRI dhan33 produced the longest panicle (24.39cm), which was statistically similar with the variety BRRI dhan32 and BR11. Spacing had significant effect on

panicle length . Result showed that the highest panicle length (24.21cm) was produced from 15cm×25cm spacing, which was statistically similar with the spacing 20cm×25cm and the lowest panicle (23.07cm) was produced from 10cm×25cm spacing (Table 2). Number of seedlings hill^{-1} had significant effect on the length of the panicle . The highest panicle length (24.40cm) was obtained from 2 seedlings hill^{-1} and the lowest (22.76cm) from 5 seedlings hill^{-1} (Table 3).

Fertile spikelets panicle^{-1}

Number of fertile spikelets panicle^{-1} did not influenced significantly due to variety. However, BR11 produced the highest number of fertile spikelets panicle^{-1} (103.83), while BRRI dhan32 produced the lowest number (102.10) of fertile spikelets panicle^{-1} (Table 1). Number of fertile spikelets panicle^{-1} was significantly influenced by spacing. It was found that the spacing of 15cm×25cm produced the highest number of fertile spikelets panicle^{-1} (110.97) and second highest was in 20cm×25cm spacing. The lowest one (96.14) was obtained in 10cm×25cm spacing (Table 2). This increased in the number of fertile spikelets panicle^{-1} in wider spacing might be due to more availability of space, light, air, water and nutrients. Rekhasshari *et al.* (1997) found that the highest number of fertile spikelets panicle^{-1} was observed in wider spacing. Number of fertile spikelets panicle^{-1} showed significant response due to the number of seedlings hill^{-1}. It was observed that the highest number of fertile spikelets panicle^{-1} (105.29) was produced when 2 seedlings were transplanted hill^{-1} and the lowest one (100.64) was produced when 5 seedlings hill^{-1} were transplanted (Table 3). Result showed that increase in number of seedlings hill^{-1} produced fewer number of fertile spikelets panicle^{-1}. This result is in similar to that of Islam (2003).

1000-grain weight

Variety had significant effect on 1000-grain weight of transplant aman rice. Result revealed that BR11 produced the highest 1000-grain weight (23.79g) and BRRI dhan33 produced the lowest (21.69g) which was statistically identical with the variety BRRI dhan32 (Table 1). There was significant effect of spacing on the weight of 1000-grain . The maximum weight of 1000-grain (23.09g) was obtained from 15cm×25cm spacing which was statistically identical with the spacing 20cm×25cm and the minimum (21.57g) was found in spacing 10cm×25cm which was also statistically identical with the spacing 25cm×25cm (Table 2). Number of seedlings hill^{-1} had significant effect on the weight of 1000-grain. Result showed that the maximum weight of 1000-grain (22.75g) was observed from 2 seedlings hill^{-1} which was statistically identical with 3 seedlings hill^{-1} and the minimum weight of 1000-grain (22.06g) from 5 seedlings hill^{-1} (Table 3).

Grain yield

Grain yield was influenced significantly by different varieties. The highest grain yield (5.92 t ha^{-1}) was produced by BR11and the lowest grain yield (5.12 t ha^{-1}) was produced by the variety BRRI dhan32 which was statistically identical with the variety BRRI dhan33 (Table 1). The variety BR11produced the highest grain yield, it might be due to the highest number of total tillers hill^{-1}, number of effective tillers hill^{-1} and 1000-grain weight and lowest number of sterile spikelets panicle^{-1}. Grain yield was significantly affected by the spacing. Result showed that the highest grain yield (5.93 t ha^{-1}) was found from 15cm×25cm spacing, whereas the lowest grain yield (5.04 t ha^{-1}) was exhibited from the closest spacing 10cm×25cm (Table 2). The highest yield contributing characters such as number of total tillers hill^{-1}, number of effective tillers hill^{-1}, panicle length, fertile spikelets panicle^{-1} and 1000-grain weight probably contributed to the highest grain yield (6.62 t ha^{-1}) at 15cm×25cm spacing. The yield was the lowest at 10cm×15cm spacing because of the lowest number of effective tillers hill^{-1}, fertile spikelets panicle^{-1} and highest number of non-effective tillers hill^{-1} and number of sterile spikelets panicle^{-1}. Islam *et al.* (2002) and Azad (2004) obtained that the highest grain yield by using 25cm × 20cm spacing. Number of seedlings hill^{-1} had a significant effect on the grain yield . Grain yield was maximum (5.78 t ha^{-1}) incase of two seedlings hill^{-1} and

the lowest was produced by 5 seedlings hill^{-1} (5.26 t ha^{-1}) (Table 3). Two seedlings hill^{-1} was the best treatment to get the highest yield per unit area; it might be due to the highest panicle length, number of fertile spikelets panicle^{-1} and 1000-grain yield and lowest number of sterile spikelets panicle^{-1}. Similar results were also obtained by Hossain and Haque (1990) and Islam *et al.* (2002).

In fine, it can be suggested that farmers may transplant BR11 rice variety maintaining a spacing of 15cm×25cm with 2 seedlings hill^{-1} to achieve higher yield of transplant aman rice.

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