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EFFECT OF VARIETY, ROW ARRANGEMENT AND NITROGEN DOSE ON THE PERFORMANCE OF TRANSPLANT *AMAN* RICE

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ABSTRACT

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The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh from July to December 2013 to observe the effect of variety, row arrangement and nitrogen dose on the performance of transplant *Aman* rice. The experiment comprised two varieties *viz.* BRRI dhan51 and BRRI dhan52, three row arrangements *viz.* single, double and triple row arrangement and four nitrogen doses viz. 0, 45, 60 and 75 kg N ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. Yield components and yield of transplant *Aman* rice were significantly influenced by variety, row arrangement, nitrogen dose and their interactions. BRRI dhan52 produced higher number effective tillers $hill^{-1}$ (8.52), grains $panicle^{-1}$ (112.14), 1000-grain weight (26.99 g) and grain yield (4.85 t ha^{-1}) compared to BRRI dhan51. The highest number of effective tillers $hill^{-1}$ (9.64), grains $panicle^{-1}$ (116.92) and grain yield (4.73 t ha^{-1}) were obtained in double row arrangement compared to other row arrangements. The lowest grain yield (4.61 t ha^{-1}) was obtained in triple row arrangement. Higher dose of nitrogen 75 kg N ha^{-1} produced the highest number of effective tillers $hill^{-1}$ (9.22), number of grains $panicle^{-1}$ (116.14) and the highest grain yield (4.99 t ha^{-1}) which was as good as 60 kg N ha^{-1} and the lowest values was obtained in control plot. Among the treatment combinations the highest grain yield (5.76 t ha^{-1}) was obtained from BRRI dhan52 transplanted in double row arrangement fertilized with 75 kg N ha^{-1}. So, cultivation of BRRI dhan52 in double row fertilized with 75 kg N ha^{-1} is the promising technique to obtain the highest grain yield.

Key words: *aman rice, variety, row arrangement, nitrogen dose, yield*

INTRODUCTION

Rice (*Oryza sativa* L.) is the most extensively cultivated crop in Bangladesh and it is the staple food for Bangladeshi people. In respect of area and production, Bangladesh ranks fourth among the rice producing countries of the world following China, India and Indonesia (FAO 2011). About 75.61% of cropped area of Bangladesh is used for rice production, with annual production of 33.83 million tons from 11.41 million hectares of land (BBS 2013). Transplant *Aman* rice covers 5.60 million hectares (49.08% of total rice area) of land with a production of 12.89 million tons (BBS 2013). Variety itself is the genetical factor which contributes a lot for producing yield components and yield of a particular crop. 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 the prevailing environmental conditions during the growing season. The growth process of rice plants under a given agro-climatic condition differs with variety. The Bangladesh Rice Research Institute has released 62 modern varieties of rice suitable for cultivation in one or more rice growing seasons of Bangladesh (BRRI 2013).

Row arrangement of transplant *Aman* rice may have a remarkable influence on its growth, yield components and yield. The rice production specialists opined that double row showed better performance over single and triple row (BRRI 1991; Hossain *et al*. 1990). Transplant *Aman* rice can be grown in both single and double row arrangements in order to obtain proper vegetative growth and yield (Sakar *et al*. 2011). Paul *et al*. (2002) reported that transplant *Aman* rice should preferably be grown in double row arrangement to obtain the highest grain yield. Nitrogen is one of the major nutrients, which is required in adequate amount at early, mid tillering and panicle initiation stage for better grain development. Nitrogen is the element most often required for high yield of rice (Haque *et al*. 2012; Saha *et al*. 2012 and Salahuddin *et al*. 2009). Many researchers have done many fertilizer experiments on the reaction of certain varieties to various nitrogen levels. Nitrogen fertilizer increases tillering and vegetative growth, grain and straw yields. Excess amount of nitrogen results in lodging of plant and reduction in yield. On the other hand, deficiency of nitrogen also hampers the production of rice (Eaqub and Mian, 1981; Bhuiya *et al*. 1989; Hussain *et al*. 1989, Islam *et al*. 1990). Almost all the soils of Bangladesh are low in organic matter and hence of nitrogen. At present, the farmers of Bangladesh use increased amount of nitrogen fertilizer to get higher yield. Extensive research works are necessary to find out appropriate variety, row arrangement and N dose to obtain satisfactory yield. The present study was undertaken to achieve the appropriate variety, row arrangement and nitrogen dose for maximization of rice yield.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during period from June 2013 to December 2013. The experimental site belongs to the Sonatola Soil Series of Old Brahmaputa Floodplain (AEZ 9) having non calcareous dark grey floodplain soil. The land was medium high with sandy loam texture having pH 5.9-6.5. The experiment comprised two varieties of transplant *Aman* rice *viz*. BRRI dhan51 and BRRI dhan52; three row arrangements *viz.* single row (row spacing 25cm), double row (row spacing 25-10-25cm) and triple row (row spacing 25-10-10-25cm) arrangement (Fig. 1)

and four nitrogen doses *viz*. 0, 45, 60 and 75 kg N ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. The size of each unit plot was 2.5m × 2.0m. Distance maintained between unit plots and replications were 0.75 m and 1 m, respectively. Seedlings were raised in well- prepared seedbed and transplanted in the main field as per experimental treatments on 5 August 2013. The experimental plots were fertilized by TSP (Triple Super Phosphate), MoP (Muriate of Potash), Gypsum, and $ZnSO_4$ during the final land preparation at the rates of 167, 62, 80 and 13 kg ha^{-1}. Only urea was applied as top dressing in three equal splits at 15, 30 and 45 days after transplanting (DAT). Weeding, supplemental irrigation, drainage and other intercultural operation were done as per requirements. The crop was harvested at full maturity (when 90% of the grain became golden in color) on 15 and 18 December 2013. Before harvesting five hills from each unit plot (excluding boarder rows and central $1m^2$ area) were randomly selected to record data on cop characters and yield components. The central 1m × 1m area was harvested to record data on grain and straw yields. The harvested crop was threshed by pedal thresher and the fresh weight of grain and straw were recorded plot-wise. The grains were cleaned and dried to a moisture content of 14%. Straws were also dried properly. Finally, grain and straw yields $plot^{-1}$ were recorded and converted to t ha^{-1}. The recorded data analyzed statistically using Analysis of variance with the help of computer package, MSTAT. The mean differences among the treatment means were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

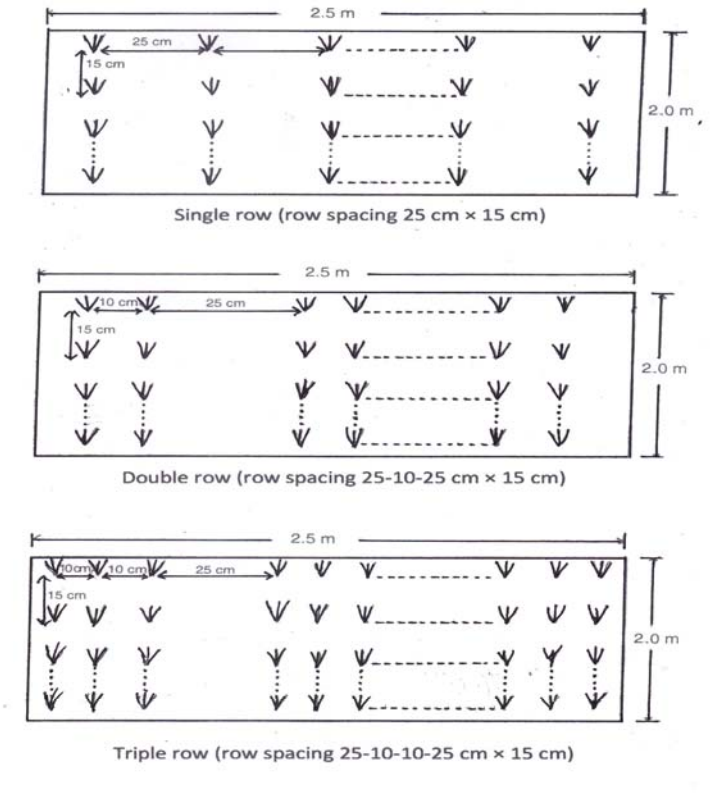

Fig. 1. Diagrammatic presentation of row arrangement

RESULTS AND DISCUSSION

Varietal performance: Crop characters, yield contributing characters and yield of transplant *Aman* rice were significantly influenced by variety (Table 1). BRRI dhan52 produced significantly taller plant (106.51 cm), higher number of total tillers $hill^{-1}$ (9.95), number of effective tillers $hill^{-1}$ (8.52), non-effective tillers $hill^{-1}$ (1.44), longer panicle (20.14), higher number of grains $panicle^{-1}$ (112.14) and 1000-grain weight (26.99 g) compared to BRRI dhan51 (Table 1). Similar results were reported by Kirttania *et al*. 2013 and Tyeb *et al*. 2013. Higher number of sterile spikelets $panicle^{-1}$ (16.18) was produced in BRRI dhan51 compared to BRRI dhan52 (12.88). Chowdhury *et al.* (1993) and BINA (1993) also reported that number of sterile spikelets $panicle^{-1}$ differed due to varietal differences. BRRI dhan52 produced higher grain yield (4.85 t ha^{-1}) compared to BRRI dhan51 (4.48 t ha^{-1}). Higher yield in BRRI dhan52 was attributed to more effective tillers $hill^{-1}$, grains $panicle^{-1}$ and 1000-grain weight (Table 1). Similar results were reported elsewhere (Kirttania *et al.* 2013; Tyeb *et al*. 2013 and Mondal *et al*. 2013). The highest straw yield (5.62 t ha^{-1}), biological yield (10.48 t ha^{-1}) and maximum harvest index (46.31%) were recorded in BRRI dhan52 and the minimum values were produced by BRRI dhan51 (Table 1). Higher grain yield was the main reason for the increasing harvest index in BRRI dhan52. Kirttania *et al*. (2013) and Tyeb *et al*. (2013) also reported that variety had great influence in harvest index.

Effect of row arrangement: Crop characters, yield contributing characters and yield of transplant *Aman* rice were significantly affected by row arrangement (Table 2). The tallest plant (104.41 cm) was obtained in single row arrangement and the shortest (103.89 cm) was recorded in triple row arrangement which was statistically identical to double row planting (Table 2). Similar results were reported by Sakar *et al*. (2011). The highest number of total tillers hill^{-1} (10.77) and effective tillers hill^{-1} (9.64) were obtained from double row arrangement compared to other row arrangements and the lowest values were recorded in triple row arrangement (Table 2). Similar results were reported elsewhere (Karmakar *et al*. 2002; Paul *et al*. 2002; Dutta *et al*. 2003 and Hossain *et al*. 2003). The highest number of non-effective tillers hill^{-1} (1.61) was observed in single row arrangement and the lowest one (1.40) was found in triple row arrangement. The highest panicle length (20.41 cm) was observed in triple row arrangement and the shortest one (20.16 cm) was in double row arrangement. The highest number of grains panicle^{-1} (116.92) was recorded in double row arrangement followed by single row arrangement (107.68) and the lowest one (98.10) was recorded in triple row arrangement while the highest number of sterile spikelets panicle^{-1} (19.82) was produced in triple row arrangement and the lowest one (11.35) in double row arrangement (Table 2). The highest grain yield (4.73 t ha^{-1}) was recorded in double row arrangement followed by single row arrangement (4.66 t ha^{-1}) and the lowest one (4.61 t ha^{-1}) was obtained in triple row arrangement. In case of double row arrangement plant received optimum nutrients than that of triple row arrangement where plant competition for nutrients was very high. This might reduce the yield in triple row arrangement. In triple row, production of effective tillers hill^{-1} was reduced probably due to higher population density might decrease grain yield. The highest number of effective tillers hill^{-1} and grains panicle^{-1} contributed mainly to the highest grain yield in double row arrangement. Straw yield and biological yield were the highest (5.63 and 10.36 t ha^{-1}, respectively) in double row arrangement where as the lowest values were recorded in triple row arrangement (Table 2). Similar result were also reported by Sarker (2003) in rice who reported that double row arrangement produced the highest straw and biological yields in rice. The highest harvest index was recorded in triple row arrangement (46.82%) which was as good as single row arrangement (46.28%) and the lowest one (45.61%) was recorded in double row arrangement.

Effect of nitrogen: Nitrogenous fertilizer also influenced on crop characters, yield components and yield of transplant *Aman* rice (Table 3). The tallest plant (103.70 cm) was obtained with 60 kg N ha^{-1} which was statistically identical to 75 kg N ha^{-1} and the shortest plant was (100.22 cm) observed in control plot (Table 3). Nitrogen induced maximum vegetative growth with higher dose of nitrogen. Plant height increased progressively with increased doses of nitrogen up to 60 kg ha^{-1} subsequently little decreased with 75 kg N ha^{-1} that means 60 kg N ha^{-1} enough for optimum plant height. The highest number of total tillers hill^{-1} (10.42), effective tillers hill^{-1} (9.22) and grains panicle^{-1} (116.14) were produced in 75 kg N ha^{-1}, which was statistically identical with 60 kg N ha^{-1} while the lowest values were obtained in control treatment (Table 3). This result corroborates with that of Kamal *et al.* (1988) who reported that the highest rate of nitrogen fertilizer gave the maximum number of tillers hill^{-1} compared to other nitrogen rates. Nitrogen helped in proper filling of seeds which resulted in higher plump seed and thus the number of grains panicle^{-1}. The highest number of non-effective tillers hill^{-1} (1.60) and sterile spikelets panicle^{-1} (16.81) were recorded in 0 kg N ha^{-1} and the lowest values were found in 75 kg N ha^{-1}. The highest grain yield (5.14 t ha^{-1}) was obtained in 75 kg N ha^{-1} which was as good as 60 kg N ha^{-1}and the lowest one (3.79 t ha^{-1}) was recorded in control plot (Table 3). Grain yield increased with the increase in nitrogen level up to 75 kg N ha^{-1}. Increment of grain yield by the application of nitrogen up to a certain level was reported by Maskina *et al.* (1986). Straw yield exhibited similar trend as that of grain yield.

Interactions: The crop characters, yield contributing characters and yield of transplant *Aman* rice were significantly affected by different interactions between treatments (Table 4). The tallest plant (109.25 cm), number of non-effective tillers hill^{-1} (1.92) and number of grains panicle (120.31) were found in the treatment combination of BRRI dhan52 with triple row arrangement while the number of total tillers^{-1} (12.34) and number of effective tillers hill^{-1} (11.33) were found statistically identical in the combination of BRRI dhan52 with double row arrangement (Table 2) compared to other sets of treatment (Table 4). The highest grain yield (4.99 t ha^{-1}) was obtained from the combination of BRRI dhan52 with double row arrangement and the lowest grain yield (4.47 t ha^{-1}) was obtained from the combination of BRRI dhan51 with single row arrangement. BRRI dhan52 fertilized with 75 kg N ha^{-1} produced the tallest plant (107.09 cm), the highest number of grains panicle^{-1} (124.76) and the highest grain yield (5.40 t ha^{-1}) compared to other treatment combinations (Table 5). The highest number of total tillers hill^{-1} (13.40), number of effective tillers hill^{-1} (12.54), grains panicle^{-1} (136.56) and the highest grain yield (5.36 t ha^{-1}) were obtained from the combination of double row arrangement with 75 kg N ha^{-1} and the lowest grain yield (3.89 t ha^{-1}) and other characters were obtained from the combination of triple row arrangement with 0 kg N ha^{-1} (Table 6). BRRI dhan52 in double row arrangement fertilized with 75 kg N ha^{-1} produced the highest number of total tillers hill^{-1} (15.35), effective tillers hill^{-1} (14.67), grains panicle^{-1} (141.17) and the highest grain yield (5.76 t ha^{-1}) among all combinations. The lowest grain yield (3.17 t ha^{-1}) was obtained in BRRI dhan51 transplanted in double row arrangement in control plot (Table 7).

Table 1. Effect of variety on the crop characters, yield components and yield of transplant *Aman* rice

Variety	Plant height (cm)	Number of total tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length (cm)	Number of grains panicle^{-1}	Number of sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
BRRI dhan51	98.12b	8.13b	6.80b	1.33b	19.93b	102.99b	16.18a	22.72	4.48b	5.20b	9.68b	46.16
BRRI dhan52	106.51a	9.95a	8.52a	1.44a	20.14a	112.14a	12.88b	26.99	4.85a	5.62a	10.48a	46.31
CV(%)	11.33	6.100	14.710	3.800	9.850	15.830	3.810	3.75	3.66	15.52	7.73	9.45
Level of significance	**	**	**	*	**	**	**	NS	**	**	**	NS

In a column, figures having same letter (s) or without letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per DMRT
*= Significant at 5% level of probability
**= Significant at 1% level of probability
NS = Not significant

Table 2. Effect of row arrangement on the crop characters, yield components and yield of transplant *Aman* rice

Row Arrangement	Plant height (cm)	Number of total tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length (cm)	Number of grains panicle^{-1}	Number of sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
Single row	104.41a	9.45b	7.84b	1.61a	20.16ab	107.68b	12.41b	24.67	4.66b	5.39b	9.82b	46.28
Double row	103.89ab	10.77a	9.64a	1.13c	19.55b	116.92a	11.35c	24.90	4.73a	5.63a	10.36a	45.61
Triple row	98.64b	6.90c	5.51c	1.40b	20.41a	98.10c	19.82a	24.99	4.61b	5.22b	10.05ab	46.82
CV(%)	11.33	6.100	14.710	3.800	9.850	15.830	3.810	3.75	3.66	15.52	7.73	9.45
Level of significance	**	**	*	**	**	**	**	NS	**	**	**	NS

In a column, figures having same letter (s) or without letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per DMRT
*= Significant at 5% level of probability
**= Significant at 1% level of probability
NS = Not significant

Table 3. Effect of nitrogen dose on the crop characters, yield components and yield of transplant *Aman* rice

Nitrogen dose (kg ha^{-1})	Plant height(cm)	Number of total tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length (cm)	Number of grains panicle^{-1}	Number of sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
0	100.22c	6.50c	4.90c	1.60a	19.88	98.19c	16.81a	24.77	3.79c	4.68b	8.47	44.71
45	102.15b	8.97b	7.48b	1.49ab	20.19	100.92b	14.41b	24.80	4.63b	5.62a	10.25	45.19
60	103.70a	10.28a	9.04a	1.24b	19.98	115.01ab	13.59c	24.96	5.11a	5.66a	10.77	47.55
75	103.19ab	10.42a	9.22a	1.20b	20.11	116.14a	13.30c	24.90	5.14a	5.69a	10.83	47.49
CV(%)	11.33	6.100	14.710	3.800	9.850	15.830	3.810	3.75	3.66	15.52	7.73	9.45
Level of significance	**	**	**	*	NS	**	**	NS	**	**	NS	NS

In a column, figures having same letter (s) or without letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per DMRT
*= Significant at 5% level of probability
**= Significant at 1% level of probability
NS = Not significant

Table 4. Interaction between variety and row arrangement on the crop characters, yield components and yield of transplant *Aman* rice

Interaction (Variety × Row arrangement)	Plant height (cm)	Number of total tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length (cm)	Number of grains panicle^{-1}	Number of sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
$V_1 \times R_1$	99.56c	8.21d	6.90d	1.31b	20.14	95.04d	15.23	22.14	4.47c	5.15	9.54	46.38
$V_1 \times R_2$	99.67c	9.20c	7.94c	1.26b	19.41	118.63ab	12.77	22.82	4.47c	5.40	9.87	45.15
$V_1 \times R_3$	95.12d	6.97e	5.55e	1.42ab	20.25	95.30d	20.54	23.20	4.49c	5.05	9.63	46.96
$V_2 \times R_1$	102.16b	6.83e	5.46e	1.38b	20.57	100.89c	19.10	27.20	4.72b	5.38	10.10	46.67
$V_2 \times R_2$	108.11a	12.34a	11.33a	1.01b	19.68	115.21b	9.93	26.98	4.99a	5.87	10.86	46.06
$V_2 \times R_3$	109.25a	10.69b	8.77b	1.92a	20.17	120.31a	9.59	26.79	4.84ab	5.62	10.47	46.19
CV (%)	11.33	6.100	14.710	3.800	9.850	15.830	3.810	3.75	3.66	15.52	7.73	9.45
Level of significance	*	**	**	*	NS	**	NS	NS	**	NS	NS	NS

In a column, figures having same letter (s) or without letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per DMRT
*= Significant at 5% level of probability
**= Significant at 1% level of probability
NS = Not significant. V_1 = BRRI dhan51; V_2 = BRRI dhan52; R_1= Single row arrangement; R_2= Double row arrangement; R_3= Triple row arrangement

Table 5. Interaction between variety and nitrogen dose on the crop characters, yield components and yield of *Aman* rice

Interaction (Variety × Nitrogen dose)	Plant height (cm)	Number of total tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length (cm)	Number of grains panicle^{-1}	Number of sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
$V_1 \times N_0$	95.77d	5.49	3.96	1.53	19.84	96.16de	18.93a	22.56	3.42f	4.34	7.77d	44.04
$V_1 \times N_1$	97.21d	8.10	6.85	1.25	20.29	94.51e	13.93bc	22.42	4.53d	5.60	10.13b	44.79
$V_1 \times N_2$	100.20c	9.69	8.40	1.29	19.69	113.78b	16.51ab	22.91	5.08b	5.39	10.47b	48.61
$V_1 \times N_3$	99.28c	9.24	7.99	1.25	19.92	107.52c	15.34b	22.98	4.88c	5.47	10.35b	47.20
$V_2 \times N_0$	104.66b	7.50	5.83	1.67	19.92	100.21d	14.68b	26.97	4.16e	5.01	9.17c	45.38
$V_2 \times N_1$	107.09a	9.85	8.12	1.73	20.08	107.33c	14.89b	27.17	4.72c	5.65	10.37b	45.58
$V_2 \times N_2$	107.19a	10.87	9.68	1.18	20.26	116.25b	10.66d	27.00	5.14b	5.93	11.07a	46.49
$V_2 \times N_3$	107.09a	11.61	10.44	1.16	20.29	124.76a	11.27cd	26.82	5.40a	5.91	11.30a	47.78
CV(%)	11.33	6.100	14.710	3.800	9.850	15.830	3.810	3.75	3.66	15.52	7.73	9.45
Level of significance	**	NS	NS	NS	NS	**	**	NS	**	NS	**	NS

In a column, figures having same letter (s) or without letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per DMRT

*= Significant at 5% level of probability

**= Significant at 1% level of probability

NS = Not significant

V_1 = BRRI dhan51 N_0= 0 kg N ha^{-1} N_1= 45 kg N ha^{-1} N_2= 60 kg N ha^{-1} N_3= 75 kg N ha^{-1}

V_2 = BRRI dhan52

Table 6. Interaction between row arrangement and nitrogen dose on the crop characters, yield components and yield of transplant *Aman* rice

Interaction (Row arrangement × Nitrogen dose)	Plant height (cm)	Number of total tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length (cm)	Number of grains panicle^{-1}	Number of sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
$R_1 \times N_0$	96.42	4.53f	3.10f	1.43	19.88	98.86ef	25.12a	24.65	3.89e	4.77d	8.66f	44.95
$R_1 \times N_1$	98.65	7.95de	6.44de	1.50	21.01	92.28g	18.83b	24.59	4.57d	5.30c	9.87e	46.28
$R_1 \times N_2$	99.64	7.57e	6.43de	1.14	20.31	102.46e	17.50bc	24.61	5.04bc	5.31c	10.35cde	48.68
$R_1 \times N_3$	99.85	7.57e	6.05e	1.51	20.43	98.79ef	17.83bc	24.82	4.94c	5.49c	10.42cd	47.36
$R_2 \times N_0$	101.47	6.86e	5.78e	1.09	19.69	94.28fg	10.84de	24.61	3.69e	4.49d	8.18f	44.87
$R_2 \times N_1$	104.63	10.02bc	8.77c	1.26	19.53	111.57d	14.48cd	24.78	4.67d	6.03a	10.70bcd	43.64
$R_2 \times N_2$	104.98	12.80a	11.47b	1.33	19.44	125.27b	10.07e	25.16	5.22ab	5.98ab	11.19ab	46.77
$R_2 \times N_3$	104.48	13.40a	12.54a	0.86	19.53	136.56a	10.00e	25.06	5.36a	6.03a	11.39a	47.15
$R_3 \times N_0$	102.76	8.09de	5.81e	2.28	20.07	101.43e	14.46cd	25.04	3.80e	4.78d	8.57f	44.32
$R_3 \times N_1$	103.16	8.95cd	7.24d	1.70	20.03	98.91ef	9.92e	25.02	4.65d	5.53bc	10.18de	45.64
$R_3 \times N_2$	106.47	10.47b	9.23c	1.24	20.17	117.30c	13.19de	25.09	5.08bc	5.69abc	10.77bc	47.20
$R_3 \times N_3$	105.23	10.30b	9.06c	1.24	20.36	113.07cd	12.07de	24.83	5.12bc	5.56abc	10.68bcd	47.96
CV (%)	11.33	6.100	14.710	3.800	9.850	15.830	3.810	3.75	3.66	15.52	7.73	9.45
Level of significance	NS	**	*	NS	NS	**	**	NS	**	**	**	NS

In a column, figures having same letter (s) or without letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per DMRT

*= Significant at 5% level of probability

**= Significant at 1% level of probability

NS = Not significant

R_1= Single row arrangement

R_2= Double row arrangement

R_3= Triple row arrangement

N_0= 0 kg N ha^{-1} N_1= 45 kg N ha^{-1} N_2= 60 kg N ha^{-1} N_3= 75 kg N ha^{-1}

Table 7. Interaction between variety, row arrangement and nitrogen dose on the crop characters, yield components and yield of transplant *Aman* rice

Interaction (V×R×N)	Plant height (cm)	Number of total tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length (cm)	Number of grains panicle^{-1}	Number of sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
$V_1 \times R_1 \times N_0$	97.32	7.25efg	5.37ijk	1.88	20.63	103.61ef	19.00cd	21.89	3.57k	4.38	7.86k	44.88
$V_1 \times R_1 \times N_1$	98.12	7.20efg	6.25ghi	0.95	20.03	81.23i	11.27efg	21.88	4.53ghi	5.58	9.85ghi	44.81
$V_1 \times R_1 \times N_2$	102.10	9.87cd	8.67de	1.20	19.87	100.82efg	16.03de	22.31	4.95def	5.31	10.24e-h	48.26
$V_1 \times R_1 \times N_3$	100.70	8.53de	7.33efg	1.20	20.03	94.53gh	14.63d-g	22.47	4.84efg	5.34	10.21e-h	47.56
$V_1 \times R_2 \times N_0$	96.50	5.89fg	4.42jk	1.47	19.53	87.62hi	10.60efg	22.30	3.17L	4.32	7.49k	42.35
$V_1 \times R_2 \times N_1$	100.23	8.27de	7.00fgh	1.27	19.65	116.90c	18.43cd	22.25	4.42hi	6.00	10.42d-g	42.41
$V_1 \times R_2 \times N_2$	101.49	11.20bc	9.94cd	1.26	19.33	138.05ab	10.62efg	23.28	5.33bc	5.57	10.91b-f	49.11
$V_1 \times R_2 \times N_3$	100.47	11.45bc	10.41c	1.04	19.13	131.96b	11.42efg	23.45	4.97def	5.70	10.66c-g	46.74
$V_1 \times R_3 \times N_0$	93.48	3.33h	2.10L	1.23	19.36	97.26fg	27.20a	23.50	3.53k	4.33	7.95k	44.90
$V_1 \times R_3 \times N_1$	93.28	8.82de	7.30efg	1.53	21.18	85.40i	12.10efg	23.14	4.65fgh	5.20	10.12fgh	47.16
$V_1 \times R_3 \times N_2$	97.02	8.00de	6.58ghi	1.42	19.86	102.46efg	22.90abc	23.14	4.96def	5.28	10.26e-h	48.47
$V_1 \times R_3 \times N_3$	96.68	7.73ef	6.23ghi	1.50	20.60	96.08fg	19.97bcd	23.01	4.83efg	5.38	10.18e-h	47.30
$V_2 \times R_1 \times N_0$	108.21	8.93de	6.26ghi	2.68	19.52	99.24efg	9.93efg	27.41	4.02j	5.17	9.45hij	43.76
$V_2 \times R_1 \times N_1$	108.20	10.69bc	8.23ef	2.46	20.02	116.58c	8.57g	27.31	4.76e-h	5.48	9.88ghi	46.47
$V_2 \times R_1 \times N_2$	110.84	11.07bc	9.79cd	1.28	20.48	133.79b	10.35efg	26.91	5.20bcd	6.07	10.45d-g	46.15
$V_2 \times R_1 \times N_3$	109.76	12.07b	10.79c	1.28	20.68	131.61b	9.52fg	27.16	5.39b	5.77	10.63c-g	48.36
$V_2 \times R_2 \times N_0$	106.43	7.83e	7.13fgh	0.70	19.85	100.95efg	11.08efg	26.91	4.20ij	4.67	8.87j	47.39
$V_2 \times R_2 \times N_1$	109.03	11.78b	10.54c	1.24	19.40	106.24de	10.53efg	27.31	4.92def	6.06	10.98b-e	44.86
$V_2 \times R_2 \times N_2$	108.46	14.40a	13.00b	1.40	19.55	112.49cd	9.53fg	27.05	5.10b-e	6.38	11.48ab	44.43
$V_2 \times R_2 \times N_3$	108.50	15.35a	14.67a	0.68	19.92	141.17a	8.59g	26.66	5.76a	6.35	12.11a	47.55
$V_2 \times R_3 \times N_0$	99.36	5.73g	4.11k	1.63	20.41	100.45efg	23.04abc	26.58	4.25ij	5.20	9.19ij	44.99
$V_2 \times R_3 \times N_1$	104.02	7.07efg	5.59hij	1.48	20.83	99.17efg	25.57ab	26.89	4.48hi	5.40	10.24e-h	45.40
$V_2 \times R_3 \times N_2$	102.27	7.13efg	6.27ghi	0.87	20.77	102.46efg	12.10efg	27.05	5.11b-e	5.34	11.27bc	48.90
$V_2 \times R_3 \times N_3$	103.01	7.40efg	5.87ghi	1.53	20.27	101.49efg	15.70def	26.64	5.04cde	5.59	11.17bcd	47.41
CV(%)	11.33	6.100	14.710	3.800	9.850	15.830	3.810	3.75	3.66	15.52	7.73	9.45
Level of sig.	NS	**	**	NS	NS	**	**	NS	**	NS	**	NS

In a column, figures having same letter (s) or without letter (s) do not differ significantly whereas figures with dissimilar letter (s) differ significantly as per DMRT

*= Significant at 5% level of probability

**= Significant at 1% level of probability NS = Not significant

V_1= BRRI dhan51, V_2= BRRI dhan52. R_1= Single row arrangement, R_2= Double row arrangement, R_3= Triple row arrangement; N_0= 0 kg N ha^{-1}, N_1= 45 kg N ha^{-1} , N_2= 60 kg N ha^{-1} , N_3= 75 kg N ha^{-1}

CONCLUSION

The results revealed that BRRI dhan52 was superior to BRRI dhan51 in terms of grain yield. Transplant *Aman* rice transplanted in double row arrangement gave the highest yield compared to single and triple row arrangement. Application of 75 kg N ha^{-1} produced the highest grain yield which was as good as 60 kg N ha^{-1}. Among the treatment combinations the highest grain yield was obtained from BRRI dhan52 in double row arrangement with 75 kg N ha^{-1}. From the study it can be concluded that BRRI dhan52 cultivated in double row arrangement fertilized with 75 kg N ha^{-1} appears to be a promising practice to obtain the highest grain yield.

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