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Effect of plant spacing and nitrogen on yield of transplant aman rice var. BRRI dhan52

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ABSTRACT

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during the period from 10 July 2012 to 15 December 2012 to investigate the effect of plant spacing and nitrogen levels on yield and attributes yield of transplant aman rice cv. BRRI dhan52. The experiment comprised of four plant spacing viz. 25 cm × 20 cm, 25 cm × 15 cm, 20 cm × 20 cm and 20 cm × 15 cm, and five nitrogen levels viz. 0, 40, 80, 100 and 140 kg N ha^{-1}. BRRI dhan52 was used as planting material. Results revealed that plant spacing and N levels had significant effect on the studied crop characters and yield. The plant height, number of total tillers and effective tillers hill^{-1}, grains panicle^{-1}, grain and straw yields increased with increasing plant spacing and N levels. The highest plant height, number of total tillers and effective tillers hill^{-1} and grains panicle^{-1} was observed in the widest spacing of 25 cm × 20 cm resulting, the highest grain yield followed by 20 cm × 20 cm. In contrast, the closest spacing of 20 cm × 15 cm, produced the lowest values of the above mentioned plant parameters and also showed the lowest grain yield. The longest plant, highest number of total, effective tillers hill^{-1}, grains panicle^{-1}, grain and straw yields were observed with 100 kg N ha^{-1} followed by 140 kg N ha^{-1}. On the other hand, the shortest plant, lowest number of total tillers and effective tillers hill^{-1}, grains panicle^{-1}, grain and straw yields were observed with no nitrogen and the non-effective tillers hill^{-1} and sterile spikelet's panicle^{-1} were recorded the highest. In regard to interaction effect of spacing and N levels, the highest plant height, number of total and effective tillers hill^{-1} were observed in the widest spacing of 25 cm × 20 cm with 100 kg N ha^{-1} and resulting the highest grain yield. The lowest values of the above parameters were recorded in the narrowest plant spacing, 20 cm × 15 cm with no nitrogen application. Based on the experimental results, it may be concluded that 25 cm × 20 cm spacing with 100 kg N ha^{-1} would be the best treatments combinations regarding yield and yield attributes of BRRI dhan52.

Key words: *Transplant Aman rice, nitrogen levels, plant spacing, BRRI dhan52 and rice yield*

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I. Introduction

Rice (*Oryza sativa* L.) is the major food crop of Bangladesh. Area and production of rice in Bangladesh are about 10.37 million hectares and 25.16 million tons, respectively with an average yield of only 2.43 t ha^{-1}. Among the groups, transplanted Aman (T. *Aman*) rice covers about 50.92% of total rice area and

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contributes to 39.03% of total rice production in the country (Anonymous, 2009). The possibility of horizontal expansion of rice production area has come to a standstill (Hamid, 1991). Rice is grown in three cropping seasons in our country viz *Aus, Aman, Boro* rice. Total rice area in Bangladesh are 1112.87, 5645.64 and 4770 thousands hectare in *Aus, Aman, Boro* seasons respectively (BBS, 2011). Among these three rice crops; Transplant *aman* rice covers about 5645.64 thousands hectares of the total and contributes 12791.5 thousands metric tons of the total rice production in the country (BBS, 2011). For the unplanned population planning the area under rice cultivation in the country is decreasing day by day. Therefore, to get self-sufficiency in rice production it is imperative to increase rice yield in the country. Bangladesh is an agro-based country, earns about 23.46% of her gross domestic products (GDP) from agriculture (Kiron, 2003). Bangladesh is facing a chronic shortage of food over the year due to high population pressure, and the total rice area is continuously declining due to urbanization and industrialization. Moreover, some rice growing areas are now being used for cultivation of fishes as it is more profitable than that of rice production. Now it has become necessary to ensure food security for the increasing population. The soil and climate of Bangladesh are favorable for rice cultivation throughout the year but the yield of this crop is much below the potential level. The reasons are manifolds; some are varietals, some are technical and some are socio-economic in nature. Scientists in the National Agricultural Research System have been continuing their efforts to increase the yield per unit area through effective management practices. Proper management practices are the most effective means for increasing yield of Aman rice. Efficient fertilizer management gives higher yield of crop and reduces fertilizer cost (Hossain and Islam, 1986). Optimum dose of nitrogen fertilization plays a vital role in growth and development of rice plant. Its growth is seriously hampered when lower dose of nitrogen is applied, which drastically reduces yield (BRRI, 1990). On the other hand, excessive nitrogen fertilization encourages excessive vegetative growth which makes the plant susceptible to insect, pest and diseases, which ultimately reduces yield. So, it is essential to find out the optimum rate of nitrogen application for efficient utilization of this element by the plants for better yield. BRRI (1990) reported that nitrogen has a positive influence on the production of effective tillers plant^{-1}.

Plant spacing is also an important factor that needs to be considered during transplanting of rice. Rice plants compete among themselves for space, nutrients, water, sunlight, air another factors such as photosynthesis and respiration under densely planted condition. Proper spacing may help receive maximum leaf Area Index (LAI), light interceptions etc. are better for photosynthesis as well as yield of rice. Some of them use very closer plant spacing and others are using wider plant spacing. Optimum plant spacing ensures the plants to grow properly both in their aerial and underground parts through efficient utilization of solar radiation and nutrients (Mia*h et al*., 1990). BRRI dhan52 is a new variety released by BRRI which can be grown in the lower regions and flooded regions of Bangladesh, because it is a submergence tolerant variety. As if, it is submergence tolerant variety so can be grown in the lower regions and flooded regions of Bangladesh for the increasing production of rice. It can play an important role to cover the shortage of food and ensuring food security. The experiment was conducted to investigate the effect of plant spacing and nitrogen levels on the yield of transplant Aman rice cv. BRRI dhan52

II. Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh during the period from 10 July 2012 to 15 December 2012 to investigate the effect of plant spacing and nitrogen levels on the yield of transplant Aman rice cv. BRRI dhan52. The experimental site belongs to the Agro-ecological zone of the Old Brahmaputra Floodplain (AEZ 9) having dark grey soil (UNDP and FAO, 1988). The experimental area has sub-tropical climate characterized by heavy rainfall during the months from June to September and scanty rainfall during the rest of the year. The experiment comprised of four plant spacing viz. 25 cm × 20 cm, 25 cm × 15 cm, 20 cm × 20 cm and 20 cm × 15 cm, and five nitrogen levels *viz*. 0, 40, 80, 100 and 140 kg Nha^{-1}. The variety BRRI dhan52 used as a planting material. The experiment was laid out in a randomized complete block design with three replications. The size of a unit plot was (4.0 m×2.5 m). The distances between replications and between plots were 1m and 0.75m respectively. Intercultural operations such as gap filling, weeding, crop protection measures, mater management were done as when as

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required. Data were collected on plant height, total tillers hill^{-1}, effective fillers hill^{-1}, non-effective fillers hill^{-1}, panicle length, total grains panicle^{-1}, number of unfilled grains panicle^{-1}, number of filled grains panicle^{-1}, 1000-grain weight, grain yield, straw yield, biological yield, harvest index at the time of harvest. All the collected data were analyzed by following the analysis of variance (ANOVA) technique and mean differences were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) using a computer operated statistical programme named MSTAT-C.

III. Results and Discussion

Effects of plant spacing

Plant height and effective tiller number decreased with decreasing plant spacing whereas reverse trend was observed in number of non-effective tillers hill^{-1}. The highest plant height (108.3 cm) and effective tiller (5.29) was recorded in wider spacing of 25 cm × 20 cm. However, spacing showed insignificant effect on number of total tillers hill^{-1} in 25 cm×20 cm (7.12), 25 cm×15 cm (7.14) and 20 cm×20 cm (7.16) except the spacing 20 cm×15 cm (6.73). The similar result was found from the findings of Miah *et al.* (1990). In contrast, closer spacing, 20 cm×15 cm, performed the lowest plant height and number of effective tiller hill^{-1}. Panicle length, number of filled grains panicle^{-1} 1000-grain weight decreased significantly with decreasing plant spacing. On the other hand, number of unfilled grain increased with decreasing plant spacing. The highest panicle length (24.63) and number of effective tillers hill^{-1}(5.29) were recorded in wider spacing of 25 cm×20 cm while the lowest panicle length (22.58 cm) and number of effective tillers hill^{-1} (4.60) were recorded in closer spacing 20 cm×15 cm (Verma *et al.* (2002). Similarly, biological yield and grain yield decreased with decreasing plant spacing. The highest biological (9.69 tha^{-1}) and grain yield (4.247 tha^{-1}) were observed in wider spacing of 25 cm × 20 cm and the lowest was recorded in the closer spacing of 20 cm × 15 cm. Harvest index was greater in closer spacing (44.63) than the wider spacing (43.46).

Effect of nitrogen levels

Different levels of N application showed a profound influence on morphological, yield and yield attributes and harvest index of T. Aman rice. Results revealed that plant height, total tiller number, effective tiller number and panicle length increased with increasing nitrogen doses till 100 kg N ha^{-1} followed by a decline. The plant height was influenced significantly due to application of nitrogen level (Table 02). The highest plant height (107.7 cm) was obtained from 140 kg N ha^{-1} while the shortest plant height (102.8 cm) was from control treatment (Table 02). Excess of nitrogen in the treatment of 140 kg N ha^{-1} might have encouraged more vegetative growth of plant producing the tallest plant Chopra and Chopra (2004). Rate of nitrogen had significant effect on the production of effective tillers hill^{-1}. The highest number of effective tillers hill^{-1} (5.450) was obtained from 100 kg N ha^{-1} followed by 140 kg N ha^{-1}. The lowest number of effective tillers hill^{-1} (4.363) found from control treatment or no nitrogen. The highest number of non-effective tillers hill^{-1} (2.458) was obtained from 0 kg N ha^{-1} and the lowest number of non-effective tillers hill^{-1} (1.7) was found from 100 kg N ha^{-1}. Nitrogen rate had significant effect on the number of total tillers hill^{-1}. The highest number of total tillers hill^{-1} (7.250) was obtained from 140 kg N ha^{-1} and followed by 100 kg N ha^{-1}. The lowest number of total tillers hill^{-1} (6.820) was found from control. This result is in agreement with the findings of Idris and Matin (l990). Significantly the longest panicle (25.18cm) was found from 100 kg N ha^{-1} and the shortest panicle (22.56 cm) was obtained from control (Table 02). Similar result was found from the findings of Sharma and Mishra (1986). The highest number of grains panicle^{-1} (120.3) was obtained from 100 kg N ha^{-1} while the lowest number of grains panicle^{-1} (113.5) was recorded from the control. The maximum number of unfilled grains panicle^{-1} (18.36) was recorded from 0 kg N ha^{-1} while the minimum number of unfilled grains panicle^{-1} (16.68) was found with 40 kg N ha^{-1}. Apparently the highest 1000-grain weight was found 120 kg N ha^{-1} (25.33) and the lowest 1000-grain weight was found from the control (24.12) (Table 02). The result indicated that the increment of nitrogen increased the 1000-grain weight. Similar result was found from the findings of Lawal and Lawal (2002). Rate of nitrogen had significant effect on grain yield of BRRI dhan52. The highest grain yield (4.389 t ha^{-1}) was obtained from 100 kg N ha^{-1}and the lowest grain yield (3.699 t ha^{-1}) was obtained

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from the control. The increase in grain yield from 100 kg N ha^{-1} might be due to the cumulative effect of the highest number of total grains $panicle^{-1}$, 1000-grain weight, longest panicle length and the highest number of effective tillers $hill^{-1}$ obtained from the supply of more nitrogen for the plants. Similar result was found from the findings of Singh *et al.* (2000). The highest straw yield (5.850 t ha^{-1}) was observed from 140 kg N ha^{-1}. The lowest straw yield (4.587 t ha^{-1}) was produced in control treatment. Similar result was found from the findings of Sarker *et al.* (2001). With the increment of nitrogen from 0 kg N ha^{-1} to 140 kg N ha^{-1} biological yield was increased (Table 02). The highest biological yield (10.24 t ha^{-1}) was obtained from 100 kg N ha^{-1} followed by 140 kg N ha^{-1} (9.619 t ha^{-1}) and the lowest biological yield (8.28 t ha^{-1}) was obtained from the control. The experimental results showed that the highest harvest index (44.67%) was obtained from the control and the lowest harvest index was found (42.88%) with 100 kg N ha^{-1}.

Interaction effect of plant spacing and N levels

Interaction effect of plant spacing and N levels showed significant variations on number of total tillers $hill^{-1}$, effective tillers $hill^{-1}$, non-effective tillers $hill^{-1}$, number of filled grains $panicle^{-1}$, number of unfilled grains $panicle^{-1}$, grain yield and straw yield whereas plant height, 1000-grain weight and harvest index were insignificant. The highest number of effective tillers $hill^{-1}$ (5.73) was produced from 100 kg N ha^{-1} with 25 cm x 20 cm spacing and the lowest one (4.03) was obtained from the control with 25 cm x 15 cm spacing (Table 03). Results showed, the highest number of non-effective tillers $hill^{-1}$ (2.73) was obtained from control with 25 cm x 20 cm spacing followed by 40 kg N ha^{-1} with 20 cm x 15 cm and the lowest number of non-effective tillers $hill^{-1}$ (1.67) was found from 100 kg N ha^{-1} with 25 cm x 20 cm spacing (Table 03). Number of total tillers $hill^{-1}$ was significantly influenced by nitrogen rate and plant spacing. The highest number of total tillers $hill^{-1}$ (7.4) was obtained from 100 kg N ha^{-1} with 25 cm x 20 cm spacing which was identical to l40 kg N ha^{-1} with 25 cm x 15 cm spacing. The lowest number of total tiller $hill^{-1}$ (6.46) was obtained from control treatment with 20 cm x 15 cm spacing (Table 03). The experimental results showed that the interaction effect of rate of nitrogen and plant spacing was significant on panicle length. The longest panicle (25.94 cm) was obtained from 100 kg N ha^{-1} with wider spacing of 25 cm x 20 cm, whereas the shortest panicle was (22.25 cm) obtained from the control with 25 cm x 15 cm (Table 03). Interaction of rate of nitrogen and plant spacing showed significant variation on the number of filled grains $panicle^{-1}$. The highest number of filled grains $panicle^{-1}$ (120.9) was recorded in the interaction of 100 kg N ha^{-1} with 25 cm x 20 cm spacing followed by 120 kg N ha^{-1} with 20 cm x 20 cm spacing (120.5) and the lowest one (120.9) was observed from the combination of the control with 20 cm x 15 cm spacing (Table 03). Number of unfilled grains panicle was significantly influenced by the interaction between rate of nitrogen and plant spacing. Numerically the highest number of unfilled grains $panicle^{-1}$ (19.04) was recorded in 0 kg N ha^{-1} with 20 cm x 15 cm spacing followed by 0 kg N ha^{-1} with 25 cm x 15 cm and the lowest one (16.33) was obtained from 100kg N ha^{-1} with 25 cm x 20 cm spacing (Table 03). Interaction of rate of nitrogen and spacing showed significant variation on the number of grains $panicle^{-1}$. The highest number of grains $panicle^{-1}$ (137.2) was recorded in the interaction of 100 kg N ha^{-1} with 25 cm x 20 cm spacing followed by 100 kg N ha^{-1} with 20 cm x15 cm spacing (137.1) and the lowest one (131.2) was observed from the combination of the control with 20 cm x 20 cm spacing (Table 03). The interaction effect of different rates of nitrogen and plant spacing was not found significant in respect of 1000-gram weight. However, the 1000-grain weight ranged from 23.77 to 25.82 (Table 3). Grain yield was significantly influenced by the interaction between rate of nitrogen and plant spacing. The highest grain yield (4.7 t ha^{-1}) was found from 10 kg N ha^{-1} with 25 cm x 20 cm spacing followed by 140 kg N ha^{-1} with 25 cm x 15 cm spacing and the lowest one (3.60 t ha^{-1}) was obtained from control (0 kg N ha^{-1}) with 20 cm x 15 cm spacing (Table 03). Miah *et al.* (1990) previous study supported the results. From the results discussed above, it can be concluded that Transplant *aman rice* cv. BRRI dhan52 grown under 100 kg N ha^{-1} with 25 cm x 20 cm spacing emerged out as a promising practice in order to get the desired grain yield. Interaction of rate of nitrogen and plant spacing significantly influenced straw yield. The highest straw yield (6.25 t ha^{-1}) was recorded from 100 kg N ha^{-1} with 25 cm x 20 cm spacing and the lowest straw yield (4.25 t ha^{-1}) was obtained from control treatment (0 kg N ha^{-1}) and 20 cm x 15 cm spacing (Table 03). Interaction of rate of nitrogen and plant spacing significantly influenced the biological yield. The highest biological yield (10.99) t ha^{-1} was recorded from 100 kg N ha^{-1} with 25 cm x 20 cm spacing and the lowest biological yield (67.850 t ha^{-1}) was obtained from control treatment (0 kg N ha^{-1}) with 25 cm x 20 cm spacing (Table 03).

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Interactions of rate of nitrogen and plant spacing not significantly influenced the harvest index. Harvest index ranged from (42.17%) to (45.86%).

IV. Conclusion

The highest plant height, number of total and effective tillers hill^{-1} was observed in wider spacing, 25 cm × 20 cm with N 100 kg ha^{-1}. On the contrary, the lowest one was recorded in narrower spacing 20 cm × 15 cm with no nitrogen. Based on the experimental results, it may be concluded that 25 cm × 20 cm spacing with 100 kg N ha^{-1} would be the best regarding yield and yield attributes of BRRI dhan52 in *aman season.*

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VI. References

[1]. Anonymous, (2009). Monthly Statistical Bulletin of Bangladesh, June 2006. Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Govt. of the People's Republic of Bangladesh, Dhaka. p. 54.
[2]. BBS (Bangladesh Bureau of Statistics), (2011). Statistical Year Book of Bangladesh, August. Bangladesh Bur. of Stat. Stat. Div., Min. Plan., Govt. Peoples Repub., Bangladesh, Dhaka. p. 136-140.
[3]. BRRI (Bangladesh Rice Research Institute), (1999). Annual Report for 1998. Bangladesh Rice Res. Inst., Joydebpur, Gazipur. pp. 152-158.
[4]. BRRI (Bangladesh Rice Research Institute) (1990). Annual Internal Review Report 1989. Bangladesh Rice Res. Inst., Joydebpur, Gazipur. 11:1-19.
[5]. Chopra, N. K., and Chopra, N. (2004). Seed yield and quality of 'pusa 44'rice (*Oryza sativa*) as influenced by nitrogen fertilizer and row spacing. *India. J. Agril. Sci.* 74(3): 144-146.
[6]. Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedure for Agricultural Research. Intl. Rice Res. Inst., John Wiley and Sons. New York, Chickester, Brisbane, Toronto, Singapore. pp. 1-34.
[7]. Hamid. M. A. (1991). A Data Base on Agricultural and Food Grains in Bangladesh (1947-48 to 1989-90). Ayesha Akhtar, 606 North Shajahanpur, Dhaka, Bangladesh. pp. 30-35.
[8]. Kiron, G. M. (2003). Azker Bishaw. Primiar publication 77/F-1, East Rampura, Dhaka-1219. P. 150.
[9]. Miah, M. N. H, Karim, M. A, Rahman, M. S. and Islam, M. S. (1990). Performance of Nigersail mutants under different row spacing. *Bangladesh J. Training Dcv*. 3(2): 31-34.
[10]. Hossain, S. M. A. and Islam, M. S. (1986). Fertilizer management in Bangladesh., Adv. Agron. Res. in Joydebpur, Gazipur. pp. 48-54.
[11]. Idris, M. and Matin, M. A. (1990). Response of four exotic strains of Aman rice to urea. *Bangladesh J. Agril. Sci* .17(2): 271-275, pp. 87-91.
[12]. Sharma, M. L. and Mishra, V. R. (1986). Effect of fertilizer nitrogen and algal inoculation on rice corp. *Madras Agric. J*. 71(2): 155-159.
[13]. Lawal, M. I. and Lawal, A. B. (2002). Influence of nitrogen rate and placement methods on growth and yield of rice (*Oryza sativa* L.) at Kadawa. Nigerian J. 23(3): 403-441.
[14]. Singh, M. K., Thakur, R., Verma, U. N., Upasami, R. R. and Pal, S. K. (2000). Effect of planting time and nitrogen on production potential of Basmati rice (*Oryza sativa*) cultivars in Bihar Plateau. *Indian J. Agron*. 45(2): 303-303.
[15]. Sarker, M. A. I. (2001). Effect of row spacing and number of seedlings hill^{-1} on the performance of hybrid rice, Sonar Bangla-1, M.S. Thesis, Dept. Agron., Bangladesh Agril. Univ., Mymensingh. p. 52.

Corresponding author emails: mahaquebina@gmail.com (Haque, M. A.) / maullah09@gmail.com (Ullah, M. A.)
eISSN: 2312-7945, Research paper

[16]. UNDP/FAO, (1988). Land resources appraisal of bangladesh for agricultural development report No. 2. Agro-ecological regions of Bangladesh. United Nations Development Program and Food and Agriculture Organization, pp: 212-221.
[17]. Verma, A. K., Pandey, N. and Tripathi, S. (2002). Effect of transplanting spacing and number of seedlings on productive tillers, spikelets sterility, grain yield and harvest index of hybrid rice. *Intl. Rice Res*. Notes 57: 1-51.

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Table 01. Mean effect of plant spacing on plant characters and yields of *Aman rice* BRRI Dhan52

Plant Spacing (cm)	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Panicle Length (cm)	Filled grains panicle^{-1} (no.)	Unfilled grains panicle^{-1} (no.)	Total grains panicle^{-1} (no.)	1000 grains Wt .(g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological Yield (t ha^{-1})	Harvest index (%)
25 x 20	108.30a	7.127a	5.29a	1.840c	24.63a	117.8a	16.94c	134.7a	24.88a	4.247a	5.448a	9.695a	43.83bc
25 x 15	104.40b	7.145a	4.99c	2.158a	22.78c	116.3c	17.68b	134.0c	24.68ab	4.004c	5.056c	9.059c	44.26ab
20 x 20	106.80a	7.161a	5.13b	2.028b	23.49b	117.2b	17.15c	134.3b	24.61ab	4.084b	5.317b	9.401b	43.46c
20 x 15	102.10c	6.737b	4.60d	2.13a	22.58c	116.0c	18.12a	134.1c	24.41b	3.917d	4.870d	8.787d	44.63a
Level of significance	**	**	**	**	**	**	**	**	*	**	**	**	**
CV (%)	*2.04*	*2.01*	*2.13*	*4.25*	*2.63*	*0.45*	*2.49*	*0.50*	*1.78*	*2.02*	*2.08*	*1.45*	*2.22*

In a column, the figures with similar letter(s) do not differ significantly whereas the figures with dissimilar letter(s) differ significantly (as per DMRT); ** = Significant at 1% level of probability, * = Significant at 5% level of probability

Table 02. Mean effect of different levels of N on plant characters and yields of *Aman* rice Var. BRRI dhan52

Nitrogen Level (kg ha^{-1})	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Panicle length (cm)	Filled grains panicle^{-1} (no.)	Unfilled grains panicle^{-1} (no.)	Total grains panicle^{-1} (no.)	1000 grain Wt.(g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
0	102.80d	6.82c	4.36e	2.46a	22.56d	113.5e	18.36a	131.90d	24.12c	3.70e	4.59e	8.285e	44.67a
40	104.20cd	6.89c	4.79d	2.10b	22.67cd	115.1d	17.97b	133.10c	24.47bc	3.89d	4.90d	8.792d	44.26a
80	104.90bc	7.10b	5.10c	2.0c	23.10bc	117.2c	17.49c	134.70b	24.55b	4.09c	5.15c	9.242c	44.28a
100	106.30b	7.15ab	5.45a	1.70e	25.18a	120.3a	16.68d	137.0a	25.33a	4.39a	5.85a	10.24a	42.88b
140	108.70a	7.25a	5.32b	1.93d	23.36b	118.0b	16.88d	134.90b	24.76b	4.24b	5.37b	9.619b	44.12a
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**	**
CV (%)	*2.04*	*2.01*	*2.13*	*4.25*	*2.63*	*0.45*	*2.49*	*0.50*	*1.78*	*2.02*	*2.08*	*1.45*	*2.22*

In a column, the figures with similar letter(s) do not differ significantly whereas the figures with dissimilar letter (s) differ significantly (as per DMRT); ** = Significant at 1% level of probability

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Table 03. Interaction effect of plant spacing and different nitrogen levels on plant characters and yields of *Aman rice* BRRI Dhan52

Spacing x Rate of N	Plant height (cm)	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Total tillers hill^{-1} (no.)	Panicle length (cm)	Filled grains panicle^{-1} (no.)	Unfilled grains panicle^{-1} (no.)	Total grains panicle^{-1} (no.)	Weight of 1000 grains (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
S_1N_0	105.5	4.69 efg	2.20 c	6.88 d-g	22.86 d	114.4 f	17.23 d-h	131.7 gh	24.40	3.85 hi	4.85 hi	8.71 kl	44.25
S_1N_1	106.4	4.96 cd	1.93 ef	6.89 d-g	23.06 d	115.6 e	17.30 d-h	132.9 d-g	24.62	4.03 fg	5.21 ef	9.24 hi	43.58
S_1N_2	107.4	5.40 b	1.73 gh	7.13 a-d	24.55 c	118.5 c	17.23 d-h	135.8 bc	24.74	4.22 bcd	5.42 d	9.64 def	43.83
S_1N_3	112.6	5.73 a	1.67 h	7.40 a	27.94 a	120.9 a	16.33 i	137.2 a	25.82	4.74 a	6.25 a	10.99 a	43.15
S_1N_4	109.4	5.67 a	1.67 h	7.33 ab	24.75 c	119.6 b	16.63 g-i	136.2 abc	24.80	4.37 b	5.50 d	9.87 cd	44.32
S_2N_0	102.4	4.33 i	2.73 a	7.06 b-e	22.40 d	113.2 g	19.04 ab	132.3 fgh	24.40	3.67 j	4.42 kl	8.08 n	45.38
S_2N_1	103.4	4.80 def	2.13 cd	6.93 d-g	22.45 d	114.8 ef	18.31 bc	133.1 def	24.44	3.87 hi	4.70 ij	8.57 l	45.15
S_2N_2	103.7	5.0 c	2.13 cd	7.13 a-d	22.57 d	116.6 d	17.53 c-f	134.1 d	24.51	4.06 efg	5.08 fg	9.14 hi	44.42
S_2N_3	108.4	5.47 b	1.73 h	7.20 a-c	23.42 d	119.9 b	16.58 ghi	136.5 abc	25.34	4.25 bcd	5.75 c	10.00 c	42.50
S_2N_4	104.0	5.33 b	2.07 cde	7.40 a	23.06 d	117.0 d	16.95 e-i	134.0 d	24.73	4.17 c-f	5.33 de	9.50 fg	43.86
S_3N_0	102.9	4.40 hi	2.47 b	6.87 d-g	22.71 d	113.4 g	17.78 cde	131.2 h	23.92	3.67 j	4.82 hi	8.49 lm	43.21
S_3N_1	106.0	4.87 cde	2.13 cd	7.0 c-f	22.77 d	115.3 ef	17.40 d-g	132.7 efg	24.46	3.92 gh	5.11 fg	9.03 ij	43.37
S_3N_2	106.9	5.33 b	2.0 def	7.33 ab	22.83 d	118.0 c	17.36 d-g	135.3 c	24.55	4.16 c-f	5.17 ef	9.33 gh	44.59
S_3N_3	109.7	5.67 a	1.67 h	7.33 a	26.09 b	120.5 ab	16.50 hi	137.0 ab	25.35	4.36 b	5.98 b	10.34 b	45.94
S_3N_4	108.2	5.40 b	1.87 fg	7.27 ab	23.07 d	118.7 c	16.70 f-i	135.4 c	24.78	4.31 bc	5.50 d	9.81 cde	43.94
S_4N_0	100.3	4.03 j	2.43 b	6.46 h	22.25 d	112.9 g	19.40 a	132.3 fgh	23.77	3.60 j	4.25 l	7.85 o	42.17
S_4N_1	101.3	4.53 gh	2.20 c	6.73 fg	22.39 d	114.7 ef	18.86 ab	133.6 de	24.34	3.74 ij	4.58 jk	8.32 m	44.95
S_4N_2	101.5	4.67 fg	2.16 c	6.83 e-g	22.45 d	115.6 e	17.82 cd	133.4 def	24.41	3.92 gh	4.93 gh	8.85 jk	44.28
S_4N_3	104.1	4.93 cd	1.73 gh	6.66 gh	23.28 d	119.8 b	17.30 d-h	137.1 a	24.81	4.20 cde	5.42 d	9.62 ef	43.69
S_4N_4	103.5	4.87 cde	2.13 cd	7.0 c-f	22.55 d	116.9 d	17.23 d-h	134.1 d	24.71	4.12 def	5.17 ef	9.29 gh	44.35
Level of significance	*NS*	**	**	*	**	**	*	**	*NS*	**	**	**	*NS*
CV(%)	*2.04*	*2.13*	*4.25*	*2.01*	*2.63*	*0.45*	*2.49*	*0.50*	*1.78*	*2.02*	*2.08*	*1.45*	*2.22*

In a column, the figures with similar letter (s) do not differ significantly whereas the figures with dissimilar letter (s) differ significantly (as per DMRT)
N_0 = 0 kg N ha^{-1}, N_1 = 40 kg N ha^{-1}, N_2 = 80 kg N ha^{-1}, N_3 = 100 kg N ha^{-1}, N_4 = 140 kg N ha^{-1};
S_1 = 25 cm x 20 cm, S_2 = 25 cm x 15 cm, S_3 = 20 cm x 20 cm, S_4 = 20 cm x 15 cm
** = Significant at 1% level of probability; * = Significant at 5% level of probability, NS = Not significant

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