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Yield performance of some transplant *aman* rice varieties as influenced by different levels of nitrogen

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Abstract

The experiment was carried out during the period of June to November 2013 at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh with a view to examine the yield performance of some transplant *aman* rice varieties as influenced by different levels of nitrogen. The experiment consisted of four varieties viz. BRRI dhan49, BRRI dhan52, BRRI dhan56, BRRI dhan57 and four levels of N viz. 0, 46, 60 and 75 kg ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. Variety, levels of N and their interactions exerted significant influence on yield contributing characters and yield of transplant *aman* rice. Among the varieties, BRRI dhan52 produced the tallest plant (117.20 cm), highest number of effective tillers hill^{-1} (11.28), grains panicle^{-1} (121.5) and 1000-grain weight (23.65 g) whereas the lowest values of these parameters were produced by BRRI dhan57. Highest grain yield (5.69 t ha^{-1}) was obtained from BRRI dhan52 followed by BRRI dhan49 (5.15 t ha^{-1}) and the lowest one (4.25 t ha^{-1}) was obtained from BRRI dhan57. In case of N, the tallest plant (111.70 cm), highest number of total tillers hill^{-1} (12.34), grains panicle^{-1} (133.6), 1000-grain weight (24.55 g) and grain yield (5.64 t ha^{-1}) were obtained from 75 kg N ha^{-1} and the lowest values were obtained from control. BRRI dhan52 fertilized with 75 kg N ha^{-1} showed best performance with respect to all the parameters studied. The overall results suggest that BRRI dhan52 should be fertilized with 75 kg N ha^{-1} for getting higher yield under the agro-climatic condition of BAU.

Keywords: Variety, Nitrogen, Yield performance, Transplant *Aman* rice

Introduction

Rice is the most important food crop of the world and the staple food of more than 3 billion people of the world's population. Rice is grown in more than a hundred countries with a total harvested area of about 160 million hectares, producing more than 700 million tons every year (IRRI, 2013). Nitrogen is a key nutrient element which plays a vital role in vegetative growth, development of yield components and yield of rice (BRRI, 1990). Efficient fertilizer management gives higher yield of crop and reduces fertilizer cost (Hossain and Islam, 2006). Rice is grown in Bangladesh in three distinct rice growing seasons namely *Aus, Aman* and *Boro*. Among these seasons, *Aman* rice covers the area of 5.66 million hectares with a production of 13.3 million tons (AIS, 2012). But the yield of transplant *Aman* rice unit^{-1} area is much lower in our country as compared to other rice growing countries of the world. It is mainly due to selection of potential varieties and judicious application of fertilizers. Selection of potential variety, planting in appropriate method and application of optimum amount of nutrient elements can play an important role to increase the rice yield and national income. Nitrogen management is another important factor that influences the growth, development, yield and yield components of transplanted rice significantly. Balanced fertilization ensures the plant to grow properly with their aerial and underground parts and help to increase the dry matter of the plant. Application of less or more fertilizer than the optimum are not economic i.e., both of this situation give lower yield. So fertilizer application in right time in right dose and in right form has to be ensured. Nitrogen use efficiency for rice crop largely ranges between 25% and 35% and seldom exceeds 50% (Singh *et al*. 1999;, Thakur, 1999). Urea is an important source of nitrogen and has great impact for increasing the nitrogen use efficiency and yield of rice. It increases absorption rate, improves soil health and ultimately increases rice yield. It is known that the response of crops to nitrogen varies due to variety. A suitable combination of variety and level of nitrogen is necessary for better yield. Therefore, the present study was conducted to evaluate the yield performance of some transplant *aman* rice varieties as influenced by different levels of nitrogen.

Materials and Methods

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during June to November 2013 to study the yield performance of some transplant *aman* rice varieties as influenced by different levels of nitrogen. The experiment field was a medium high land having silty clay loam having pH 6.5. The experiment comprised four rice varieties viz. BRRI dhan49, BRRI dhan52, BRRI dhan56, BRRI dhan57 and four levels of N viz. 0, 46, 60 and 75 kg ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. The size of unit plot was 4.0 m $\times$ 2.5 m. Before raising seeds in the nursery, seeds were water soaked for 24 hours and then taken out of water and packed in the gunny bags for sprouting. The seeds sprouted after 72 hours.

For raising seedlings a piece of high land was selected. Sprouted seeds were sown in the nursery bed on 20 June 2013. Proper care was taken to raise seedlings in the nursery bed. Thirty days old seedlings were transplanted on 18 July 2013 in the main field with 3 seedlings hill^{-1} maintaining spacing at 25 cm × 15 cm. The experimental land was prepared by power tiller and cross ploughing with a country plough and leveled by laddering. Weeds and stubble of previous crop were removed from individual plots and finally plots were leveled properly. TSP, MoP, gypsum, and zinc sulphate were applied @ 600g, 480g,360g and 60g in each plot during the final land preparation. Urea was applied as per treatment in three equal splits at 15, 30 and 45 days after transplanting (DAT). Other intercultural operations were done as and when required. Four hills were randomly selected (excluding boarder hills and central 1m × 1m) prior to harvest to record the data on crop characters and yield contributing characters. The crop of individual plots was separately harvested at full maturity. Data on plant height, number of total and effective tillers hill^{-1}, panicle length, number of total spikelets panicle^{-1}, number of grains panicle^{-1}, and weight of 1000-grain were collected from five sample plants of each plot. The grain and straw yield for each plot were recorded after proper threshing, cleaning and drying in sun. The collected data were statistically analyzed and mean differences were compared by Duncan's New Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

Varietal performance

Yield contributing characters and yield of transplant *aman* rice were significantly influenced by variety (Table 1). BRRI dhan52 produced the tallest plant (117.20 cm) followed by BRRI dhan56 (111.6 cm) and BRRI dhan57 (106.9 cm) while the shortest one (101.30 cm) was recorded from BRRI dhan49. These differences are mostly due to the genetic variation among the varieties. These results are consistent to those of Om *et al.* (1998), Khisha (2002) and Rahman (2003) who recorded variable plant height among the varieties. The highest number of total tillers hill^{-1}(12.39) and effective tillers hill^{-1} (11.28) were found in BRRI dhan52 whereas the lowest values were counted in BRRI dhan57. The variation in number of tillers hill^{-1} as assessed might be due to varietal characters. Nuruzzaman *et al*. (2000) noticed that number of total tillers hill^{-1} differed among the varieties. BRRI dhan52 produced the highest number of total spikelets panicle^{-1} (155.20) and the lowest number of total spikelets panicle^{-1} (118.80) was obtained from BRRI dhan57. BRRI dhan52 produced the highest number of grains panicle^{-1} (121.5) and the heaviest gram (23.65 g) while the lowest number of grams and lighest grain (20.52 g) was obtained from BRRI dhan57. BRRI dhan52 gave the highest grain yield (5.69 t ha^{-1}), followed by BRRI dhan49 (5.15 t ha^{-1}) while the lowest grain yield (4.25 t ha^{-1}) was harvested from BRRI dhan57. Varietal differences regarding grain yield was reported elsewhere (Patel, 2000; Khisha, 2002; Tyeb *et al.* 2013 and Islam *et al.* 2014). Straw yield showed similar trend as like as grain yield. The grain and straw yield increasement of BRRI dhan52 over BRRI dhan57 were (33.88 %) and (18.2%) respectively. The highest harvest index (45.48 %) was recorded from BRRI dhan52 and the lowest one (42.77 %) was obtained from BRRI dhan57. Tyeb *et al*. (2013) reported that variety has significant influence on harvest index.

Table 1. Effect of variety on yield and yield attributes of transplant *aman* rice

Variety	Plant height (cm)	Total tillers hill^{-1} (No.)	Effective tillers hill^{-1} (No.)	Total spikelets panicle^{-1} (No.)	Grains panicle^{-1} (No.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Grain yield increasement over BRRI dhan57 (%)	Straw yield (t ha^{-1})	Straw yield increasement over BRRI dhan57 (%)	Harvest index (%)
BRRI dhan49	101.30d	11.19b	9.55b	127.50c	95.29c	22.90b	5.15b	21.17	6.53b	8.08	44.06b
BRRI dhan52	117.20a	12.39a	11.28a	155.20a	121.50a	23.65a	5.69a	33.88	6.73a	18.2	45.48a
BRRI dhan56	111.60b	9.53c	8.06c	147.70b	108.00b	21.50c	4.88c	14.82	6.15c	14.76	44.01b
BRRI dhan57	106.90c	8.94d	6.74d	118.80d	77.75d	20.52d	4.25d	-	5.69d	-	42.77c
Level of significance	**	**	**	**	**	**	**	-	**	-	**
CV (%)	5.01	3.95	4.66	6.23	8.42	3.10	4.45	-	1.91	-	2.44

In a column, figures having dissimilar letters differ significantly as per Duncan's Multiple Range Test (DMRT).
** = Significant at 1% level of probability

Effect of level of nitrogen

Application of N significantly influenced the yield and yield attributes of transplant *aman* rice (Table 2). Plant height increased with the increasing rates of N. The tallest plant (111.70 cm) was recorded at 60 kg N ha^{-1} which was statistically identical to 75 kg N ha^{-1} and the shortest one (105.4 cm) was recorded from control (0 kg N ha^{-1}) treatment. The highest number of total tillers hill^{-1} (12.34) and effective tillers (11.27) were recorded from 75 kg N ha^{-1} and the lowest one (8.48) was recorded in control plots (0 kg N ha^{-1}). The highest number of total spikelets panicle^{-1} (158.10) and grains panicle^{-1} (133.60) were obtained at 75 kg N ha^{-1} followed by 60 kg N ha^{-1} and the lowest values of total spikelets panicle^{-1} (116.00) and grains panicle^{-1} (62.80) were recorded in control plots (0 kg N ha^{-1}). Nitrogen helps in proper filling of seeds which resulted higher number of grains panicle^{-1}. Mendhe *et al.,* (2002) reported that the number of grains panicle^{-1} increased significantly with increments in level of N which was also reported elsewhere (Salahuddin *et al*., 2009; Mendhe *et al.,* 2002). The heaviest grains (24.55 g) was obtained at 75 kg N ha^{-1} and the lighest grain (19.45) was recorded from control (0 kg N ha^{-1}). Baligar and Ganin (2001) reported that the weight of 1000-grain increased significantly with increasing N levels. The highest grain (5.64 t ha^{-1}) and straw (6.70 t ha^{-1}) yield and harvest index (45.63 %) were obtained when N was applied @ 75 kg ha^{-1} and the lowest from the control (0 kg N ha^{-1}) treatment. When N was applied @ 75 kg ha^{-1} it showed (31.77 %) higher grain and (15.92 %) higher straw yield over control treatment.

Table 2. Effects of different levels of N on yield and yield attributes of transplant *aman* rice

Level of N (kg ha^{-1})	Plant height (cm)	Total tillers hill^{-1} (No.)	Effective tillers hill^{-1} (No.)	Total spikelets panicle^{-1} (No.)	Grains panicle^{-1} (No.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Grain yield increasement over BRRI dhan57 (%)	Straw yield (t ha^{-1})	Straw yield increasement over BRRI dhan57 (%)	Harvest index (%)
0	105.40b	8.48d	6.61d	116.00d	62.80d	19.45d	4.28d	-	5.78d	-	42.38c
46	108.80ab	10.36c	8.68c	129.10c	88.37c	21.37c	4.69c	9.57	6.02c	4.15	43.75b
60	111.70a	11.37b	9.99b	146.10b	117.80b	23.20b	5.35b	25	6.39b	10.55	45.33a
75	111.10a	12.34a	11.27a	158.10a	133.60a	24.55a	5.64a	31.77	6.70a	15.92	45.63a
Level of significance	*	**	**	**	**	**	**	-	**	-	**
CV (%)	5.01	3.95	4.66	6.23	8.42	3.10	4.45	-	1.91	-	2.44

In a column, figures having dissimilar letters differ significantly as per Duncan's Multiple Range Test (DMRT).
** = Significant at 1% level of probability
* = Significant at 5% level of probability

Interaction effect of variety and level of nitrogen

Interaction of variety and level of N showed significant influence on crop characters, yield contributing characters and yield of transplant *aman* rice (Table 3). BRRI dhan52 fertilized with 75 kg N ha^{-1} produced the highest number of total tillers hill^{-1} (14.03) and the lowest one (7.09) was obtained in the interaction of BRRI dhan57 and control (0 kg N ha^{-1}). The highest number of effective tillers hill^{-1} (13.05) was counted in the treatment combination of BRRI dhan52 fertilized with 75 kg N ha^{-1}. The lowest one (5.15) was produced by the interaction between BRRI dhan57 and control (0 kg N ha^{-1}). Interaction between BRRI dhan52 and 75 kg N ha^{-1} was found to be the best in respect of total spikelets panicle^{-1} (190.9) and number of grains panicle^{-1} (171.4). The lowest number of total spikelets panicle^{-1} (99.90) and grains panicle^{-1} (50.94) were obtained from the interaction between BRRI dhan49 and control (0 kg N ha^{-1}) which was statistically identical (56.50) with the interaction of BRRI dhan57 and control. The highest 1000-grain weight (27.39 g) was obtained from BRRI dhan52 fertilized with 75 kg N ha^{-1}. The lowest 1000-grain weight (17.99 g) was obtained from the interaction of BRRI dhan57 with control (0 kg N ha^{-1}) which was statistically identical (18.62) by the interaction between BRRI dhan56 and control (0 kg N ha^{-1}) and the interaction between BRRI dhan57 and 46 kg N ha^{-1} (19.00). The highest grain (6.6 t ha^{-1}) and straw yield (7.51 t ha^{-1}) were recorded in the treatment combination of BRRI dhan52 and 75 kg N ha^{-1} followed by BRRI dhan56 fertilized with 75 kg N ha^{-1}. The lowest grain (3.52 t ha^{-1}) and straw (5.08 t ha^{-1}) yield were found in the treatment combination of BRRI dhan57 and control (0 kg N ha^{-1}) treatment.

Table 3. Interaction effect of variety and level of N on yield and yield attributes of transplant *aman* rice

Interaction (Variety × level of nitrogen)	Total tillers hill^{-1} (No.)	Effective tillers hill^{-1} (No.)	Total spikelets panicle^{-1} (No.)	Grains panicle^{-1} (No.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
$V_1 \times N_0$	8.45hi	6.73ij	108.40gh	50.94i	20.80g	4.71fg	6.32ef
$V_1 \times N_1$	10.35ef	8.77fg	116.00fg	66.44gh	22.69de	5.08ef	6.50de
$V_1 \times N_2$	11.52c	10.35d	122.40efg	91.14ef	23.64bcd	5.32cde	6.60cd
$V_1 \times N_3$	13.25b	12.17b	128.40ef	102.50def	24.48b	5.49bcd	6.69bcd
$V_2 \times N_0$	10.33ef	8.33g	124.70ef	73.17g	20.39g	4.94efg	6.22f
$V_2 \times N_1$	12.78b	11.07c	130.90ef	91.24f	22.61de	5.25de	6.38ef
$V_2 \times N_2$	13.18b	11.67bc	174.00b	150.10b	24.19bc	5.72bc	6.78bc
$V_2 \times N_3$	14.03a	13.05a	190.90a	171.40a	27.39a	6.60a	7.51a
$V_3 \times N_0$	8.04i	6.21j	130.90ef	70.61gh	18.62h	3.95h	5.51h
$V_3 \times N_1$	9.02gh	7.29hi	148.70cd	107.90d	21.19fg	4.27h	5.65gh
$V_3 \times N_2$	10.13f	8.61fg	152.80c	123.50c	22.86de	5.54bcd	6.60cd
$V_3 \times N_3$	10.95cde	9.75de	158.40c	130.00c	23.32bcde	5.73b	6.84b
$V_4 \times N_0$	7.09j	5.15k	99.90h	56.50hi	17.99h	3.52i	5.08i
$V_4 \times N_1$	9.293g	7.59h	120.70efg	87.90f	19.00h	4.16h	5.53h
$V_4 \times N_2$	10.66def	9.31ef	135.00de	106.40de	22.10ef	4.64g	5.59gh
$V_4 \times N_3$	11.14cd	10.11d	154.50c	130.40c	22.99cde	4.71fg	5.76g
Level of significance	**	**	**	**	**	**	**
CV (%)	3.95	4.66	6.23	8.42	3.10	3.77	3.50

In a column, figures having dissimilar letters differ significantly as per Duncan's Multiple Range Test (DMRT)
** = Significant at 1% level of probability * = Significant at 5% level of probability
V_1 = BRRI dhan49, V_2 = BRRI dhan52, V_3 = BRRI dhan56, V_4 = BRRI dhan57
N_0 = Control (0 kg N ha^{-1}), N_1 = 46 kg N ha^{-1}, N_2 = 60 kg N ha^{-1} and N_3 = 75 kg N ha^{-1}

From the result of this experiment, it can be concluded that, the performance of BRRI dhan52 was the best among the tested varieties. Crop fertilized with 75 kg N ha^{-1} showed the best performance among the other nitrogen levels. BRRI dhan52 fertilized with 75 kg N ha^{-1} appeared at the promising combination for transplant *aman* rice cultivation in terms of grain yield.

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