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Effect of level of nitrogen and date of transplanting on the yield and yield attributes of transplant *aman* rice under SRI method

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Abstract

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from July to December 2003. The experiment consisted of two factors, four levels of nitrogen viz., (i) control (0 kg nitrogen ha^{-1}), (ii) 40 kg nitrogen ha^{-1} (50% of the BRRI recommended dose), (iii) 80 kg nitrogen ha^{-1} (100% of the BRRI recommended dose) and (iv) 120 kg nitrogen ha^{-1} (150% of the BRRI recommended dose) and four dates of transplanting viz., (i) 15 July, (ii) 30 July, (iii) 14 August and (iv) 29 August 2003. Nitrogen level had significant effect on plant height, total tillers $hill^{-1}$ and grain yield. The highest grain yield was recorded from the application of 80 kg nitrogen ha^{-1}(100% of the recommended dose). Date of transplanting had significant effect on all the yield and yield contributing characters of rice except straw yield and harvest index. The highest grain yield was recorded from 30 July transplanting. Eighty-kg nitrogen coupled with 30 July transplanting produced the highest grain yield of transplant *aman* rice cv. BRRI dhan31.

Keywords: Nitrogen level, Date of transplanting, SRI method

Introduction

Traditionally rice is transplanted with 2 to 3 seedlings $hill^{-1}$ and this practice needs more seeds. But, recently a new technique is evolved namely System of Rice Intensification (SRI) where one seedling is used to grow rice. The success of SRI is based on the synergistic development of both the tiller and root systems. SRI, a revolutionary approach to increase rice yield using less input, might be a suitable environment friendly option to raise income from rice field. Nitrogen is the key nutrient element, which plays a vital role on the yield of rice. Many workers have reported a significant response of rice to nitrogen in different soils of Bangladesh (Eaqub and Mian, 1981; Bhuiya *et al.*, 1989; Hussain *et al.*, 1989; Islam *et al.*, 1990). BRRI (1990) reported that nitrogen had a positive influence on the production of effective tillers. An increase in the yield of rice by 70-80% may be obtained by proper application of nitrogen fertilizer (IFC, 1982). Unfortunately the nitrogen reserve of Bangladesh soil is very low due to warm climate accompanied by centuries of cultivation of the same piece of land (Portech and Islam, 1984). Excess amount of N fertilizer encourages excessive vegetative growth resulting in lodging of plants, for this plant is susceptible to insect pests and diseases, which ultimately reduces yield. On the other hand, lower dose of nitrogen drastically reduces the yield. Efficient fertilizer management gave higher yield of crop and reduced fertilizer cost (Hossain and Islam, 1986). So, it is essential to find out optimum level of nitrogen application for efficient utilization of this element by the plant for better yield.

In general, vegetative development of *Indica* rice is more affected by time of transplanting than other type of rice (Langfield and Basinski, 1960). Time of transplanting has profound influence on the performance of different cultivars of photo and thermo-sensitive nature (Takahashi, *et al.*, 1967) and the time between July 15 and August 15 is the best for transplantation of high yielding cultivars of transplant *aman* rice specially photosensitive cultivars in Bangladesh (Islam, 1986). Better results are obtained from early transplanting than late transplanting (Alim *et al.*, 1993; Ishikura *et al.*, 1968;

Hedayetullah *et al.*, 1994). July transplanting in many places is not practicable, as the land remains occupied by such imported crops as jute and aus rice. In general, late transplanting always reduces yields irrespective of cultivars (BRRI, 1992). It is required to know the optimum time of transplanting for good performance. Therefore, satisfactory yield of rice cultivar might be obtained through appropriate combination of date of transplanting and level of nitrogen. The present study was therefore, undertaken to determine the optimum level of nitrogen and date of transplanting for the cultivation of *aman* rice.

Materials and Methods

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from July to December 2003. The soil belongs to Sonatola series of dark-grey floodplain soil type (AEZ-9). The texture is silt loam having non-calcareous soil with p^H 6.7. The soil is low in organic matter content and its general fertility level is low (UNDP and FAO, 1988). The study consisted of two factors, four levels of nitrogen viz., (i) control (0 kg nitrogen ha^{-1}), (ii) 40 kg nitrogen ha^{-1} (50% of the BRRI recommended dose), (iii) 80 kg nitrogen ha^{-1} (100% of the BRRI recommended dose) and (iv) 120 kg nitrogen ha^{-1} (150% of the BRRI recommended dose) and four dates of transplanting viz., (i) 15 July, (ii) 30 July, (iii) 14 August and (iv) 29 August 2003. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The size of unit plot was 4 m × 2.5 m and the number of total plots was 48. Healthy seeds of BRRI dhan31 selected by specific gravity method were used as planting material. Selected seeds were then soaked in water in bucket for 24 hours. After keeping thickly in gunny bags seeds started sprouting after 48 hours, and were sown after 72 hours. A piece of high land was selected and puddled with country plough, cleaned and leveled with ladder. Then the sprouted seeds were sown in the nursery beds on 1 July, 15 July, 30 July and 14 August, 2003. Seedlings were taken proper care of at the time of raising. Weeds were removed and irrigation was given in the seedling nursery as and when necessary. The main land was first opened with a power tiller. The land was then puddled thoroughly by ploughing and cross ploughing with a country plough and subsequently leveled by laddering. The field lay out was made on 13 July according to experimental specification immediately after final land preparation. Individual plots were cleared of weeds and stubble and finally leveled by a wooden plank. The land was thus ready for transplanting of rice seedlings. The experimental plots were fertilized with urea, triple super phosphate (TSP), muriate of potash (MP), gypsum and zinc sulphate. The urea was applied according to the experimental treatments. The rates of other fertilizers were 100 kg TSP, 70 kg MP, 60 kg gypsum and 10 kg zinc sulphate ha^{-1}. Except urea all the fertilizers were applied before final land preparation. Urea was applied in three equal splits at 15, 30 and 50 days after transplanting (DAT). Fifteen-day-old seedlings were uprooted from the nursery bed carefully. Uprooting was done carefully so that the seeds remained attached to the seedlings. Seedlings were transplanted according to the experimental treatment viz., on 15 July, 30 July, 14 August and 29 August 2003 in the plots. One seedling was transplanted in each hill maintaining a spacing of 30 cm × 30 cm. The seedlings were transplanted within 30 minutes after uprooting. The roots of the seedlings were kept on the surface of the soil. Seedlings in some hills died, and these were replaced by seedlings from the same source. The first weeding was done at 15 DAT. Before panicle initiation five weeding was done by hand pulling. Due to lack of natural rain during crop growth period irrigation was done weekly. When water stagnancy occurred due to heavy rainfall, drainage was maintained to avoid it. A few yellow stem borers were noticed in the second week of October which was controlled by using Dimecron 100 EC

@ 1.5l ha^{-1}. Individual plots were harvested at maturity at different dates ranging from 18 November to 10 December 2002. The crops were then separately threshed, their straws and grains were sun dried and weights were recorded. Yield was adjusted to 14% moisture content and recorded into t ha^{-1} basis. Data pertaining to yield and yield attributes were taken from randomly selected hills (10 hills $plot^{-1}$) harvested and collected from each plot. Data were collected on plant height, total tillers $hill^{-1}$, number of effective tillers $hill^{-1}$, panicle length, number of grains $panicle^{-1}$, number of sterile spikelets $panicle^{-1}$, 1000-grain weight, grain yield, straw yield and harvest index. Collected data were compiled and tabulated in proper form and were subjected to statistical analysis. Analysis of variance was done following the computer package MSTAT. The mean differences among the treatments were adjudged by Duncan's Multiple New Range Test (Gomez and Gomez, 1984).

Results and Discussion

Results of the present study regarding the influence of nitrogen level and date of transplanting on the yield and yield contributing characters of transplant *aman* rice (BRRI dhan31) have been presented and discussed in this chapter. The results have been presented in Table 1 through 3. From the Table 1 it is observed that nitrogen level had significant influence on plant height, total tillers $hill^{-1}$ and grain yield. Nitrogen level did not exert any significant influence on other yield and yield contributing characters of rice. The tallest plant (139.42 cm) was recorded from control treatment (0 kg nitrogen ha^{-1}) which was statically at par (139.28 cm) with 120 kg nitrogen ha^{-1}. The highest number of total tillers $hill^{-1}$ (22.12) was obtained from 120 kg nitrogen ha^{-1} and the lowest one (19.90) was recorded from control treatment. Nitrogen encouraged tiller production in rice and thus more tiller $hill^{-1}$ was found when nitrogen level was increased. These results were consistent with the result of Sharma and Mishra (1986). The highest number of effective tillers $hill^{-1}$ (16.08) was observed in 120 kg nitrogen ha^{-1} and the lowest one (14.93) in control treatment (0 kg nitrogen ha^{-1}). Apparently the longest panicle (26.06 cm) and the highest number (154.34) of grains $panicle^{-1}$ were produced by the application of 80 kg nitrogen ha^{-1}. The highest grain yield (5.03 t ha^{-1}) was recorded from 80 kg nitrogen ha^{-1}. This might be due to cumulative effect of longest panicle and highest number of grains $panicle^{-1}$. Similar trend was also reported by Haider *et al.* (1988) who mentioned that 100% of the recommended dose of nitrogen produced the highest grain yield. The lowest grain yield (3.09 t ha^{-1}) was recorded from control treatment (0 kg nitrogen ha^{-1}). Apparently the highest straw yield (7.48 t ha^{-1}) was produced from 120 kg nitrogen ha^{-1}. Harvest index did not differ significantly due to nitrogen level. However, the highest harvest index was obtained from the application of 80 kg nitrogen ha^{-1}

Date of transplanting had significant effect on all the yield and yield contributing characters of rice except straw yield and harvest index (Table 2). The tallest plant (149.38 cm) was obtained from 15 July transplanting and the shortest one (126.47 cm) was obtained from 29 August transplanting. This result is in agreement with that of Mejos and Pava (1980) who reported that plant height reduced with late transplanting. The highest number of total tillers (28.95) and effective tillers (18.05) $hill^{-1}$ was recorded from 30 July transplanting. The longest panicle (26.38 cm) was recorded from 14 August transplanting which was statistically similar with 15 July transplanting and 30 July transplanting. The highest number (168.21) of grains $panicle^{-1}$ was obtained due to transplanting on 30 July and it was followed by 14 August transplanting which was statistically at par with 30 August transplanting. Fifteen July transplanting produced the highest number of sterile spikelets $panicle^{-1}$ (34.56) which was statistically similar with 14 August (31.65) and 29 August (30.07) transplanting. The heaviest 1000-

grain was obtained in 30 July transplanting and it was statistically identical with 15 July transplanting. The highest grain yield (4.92 t ha^{-1}) was recorded by the transplanting of 30 July and the lowest grain yield (3.63 t ha^{-1}) was obtained from 15 July transplanting of rice. The highest grain yield was obtained due to cumulative effect of longer panicle, highest number of grains $panicle^{-1}$ and heaviest 1000-grain weight. Similar result was also reported by Rahman (2003). Apparently the highest straw yield (8.58 t ha^{-1}) was obtained from 30 July transplanting and the lowest one (6.02 t ha^{-1}) was obtained from 29 August transplanting.

Table 1. Effect of level of nitrogen on the yield and yield attributes of transplant *aman* rice under SRI method

Nitrogen level	Plant height (cm)	Total tillers $hill^{-1}$ (no.)	Effective tillers $hill^{-1}$ (no.)	Panicle length (cm)	Grains $panicle^{-1}$ (no.)	Sterile spikelets $panicle^{-1}$ (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
N_0	139.42a	19.90b	14.93	25.39	136.34	30.40	23.83	3.09c	6.69	31.60
N_1	135.10b	21.52ab	15.57	25.29	146.83	32.27	23.26	4.35b	6.62	39.65
N_2	135.35b	20.10b	14.73	26.06	154.34	28.55	23.15	5.03a	7.15	41.29
N_3	139.28a	22.12a	16.08	25.79	147.25	29.49	23.88	4.55b	7.48	37.82
Sx	1.166	0.596	-	-	-	-	-	0.074	-	-
Level of Significance	0.05	0.05	NS	NS	NS	NS	NS	0.01	NS	NS

In a column, figures having common letter(s) do not differ significantly as per DMRT
NS = Not significant
N_0 = 0 kg nitrogen ha^{-1}, N_1 = 40 kg nitrogen ha^{-1}, N_2 = 80 kg nitrogen ha^{-1} and N_3 = 120 kg nitrogen ha^{-1}

Table 2. Effect of date of transplanting on the yield and yield attributes of transplant *aman* rice under SRI method

Date of transplanting	Plant height (cm)	Total tillers $hill^{-1}$ (no.)	Effective tillers $hill^{-1}$ (no.)	Panicle length (cm)	Grains $panicle^{-1}$ (no.)	Sterile spikelets $panicle^{-1}$ (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
D_1	149.38a	19.89b	15.87b	25.92a	131.62c	34.56a	24.08a	3.63c	6.19	36.97
D_2	141.03b	28.95a	18.05a	25.61a	168.21a	24.42b	24.68a	4.92a	8.58	36.44
D_3	132.27c	17.55c	14.38bc	26.38a	147.12b	31.65a	22.69b	4.21b	7.15	37.06
D_4	126.47d	17.16c	13.02c	24.62b	137.81bc	30.07ab	22.68b	4.27b	6.02	41.50
Sx	1.166	0.596	0.483	0.244	2.669	2.272	0.315	0.074	-	-
Level of Significance	0.01	0.01	0.01	0.01	0.05	0.05	0.01	0.01	NS	NS

In a column, figures having common letter(s) do not differ significantly as per DMRT.
NS = Not significant
D_1 = 15 July transplanting, D_2 = 30 July transplanting, D_3 = 14 August transplanting and D_4 = 29 August transplanting

Interaction effect of level of nitrogen and date of transplanting had significant influence on plant height, panicle length, grains $panicle^{-1}$, 1000-grain weight and grain yield (Table 3). The longest plant (151.00 cm) was obtained by the application of 120 kg nitrogen ha^{-1} × 15 July transplanting which was statistically identical with 120 kg nitrogen ha^{-1} × 30 July transplanting, 0 kg nitrogen ha^{-1} coupled with 15 July transplanting, 40 kg nitrogen ha^{-1} × 15 July transplanting and 80 kg nitrogen ha^{-1} coupled with 15 July transplanting. The longest panicle (27.21 cm) was recorded by the application of 80 kg nitrogen ha^{-1} × 14 August transplanting which was statically at par with 120 kg nitrogen ha^{-1} × 14 August transplanting, and 0 kg nitrogen ha^{-1} × 15 July transplanting. The highest number of grains $panicle^{-1}$ (194.41) was recorded from 40 kg nitrogen ha^{-1} × 29 August transplanting and the lowest

number of grains panicle^{-1} (122.33) was recorded by the application of 120 kg nitrogen ha^{-1} × 30 July transplanting which was statistically at par with the application of 40 kg nitrogen ha^{-1} coupled with 15 July transplanting. The heaviest 1000- grain (25.94 g) was obtained from the application of 40 kg nitrogen ha^{-1} × 30 July transplanting and the lowest one (21.45 g) was recorded from the application of 80 kg nitrogen ha^{-1} × 14 July transplanting. The highest grain yield (6.25 t ha^{-1}) was recorded from the application of 80 kg nitrogen ha^{-1} coupled with 30 July transplanting. From the results of the study it may be concluded that 80 kg nitrogen ha^{-1} × 30 July transplanting may be used for better yield of T *aman* rice (BRRI dhan31) under the system of rice intensification.

Table 3. Effect of level of nitrogen and date of transplanting on the yield and yield attributes of transplant *aman* rice under SRI method

Nitrogen level	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Panicle length (cm)	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
N_0D_1	149.53ab	18.67	15.67	26.42abc	140.03def	39.36	24.71abc	3.09c	5.91	34.33
N_0D_2	138.47c	28.00	17.60	23.69f	128.32ef	24.18	24.14abcd	3.05c	8.25	26.99
N_0D_3	132.20cd	17.13	14.80	26.13abcd	132.52ef	26.73	22.87bcd	3.06c	7.50	28.98
N_0D_4	137.48c	15.77	11.67	25.32bcde	144.51de	31.33	23.61abcd	3.17c	5.08	38.42
N_1D_1	148.80ab	21.07	17.20	26.02abcd	123.95f	34.00	22.83bcd	3.38c	5.50	38.06
N_1D_2	136.87c	30.07	17.53	24.30ef	132.16ef	29.88	25.94a	4.47b	7.75	36.58
N_1D_3	132.73cd	16.80	14.00	25.25bcde	136.81def	31.11	22.59cd	4.66b	6.83	40.56
N_1D_4	122.00e	18.13	13.53	25.56bcde	194.41a	34.08	21.68d	4.92b	6.42	43.39
N_2D_1	148.20ab	18.27	13.67	26.28abcd	140.17def	28.17	24.97abc	4.63b	6.43	41.86
N_2D_2	140.13bc	27.33	17.67	24.74def	151.35cd	20.65	23.17abcd	6.25a	8.92	41.20
N_2D_3	130.60cde	18.27	14.20	27.21a	154.24cd	33.69	21.45d	4.75b	7.25	39.58
N_2D_4	122.47e	16.53	13.40	26.03abcd	171.59b	31.15	23.03bcd	4.50b	6.00	42.86
N_3D_1	151.0a	21.87	16.93	24.95cdef	122.33f	36.19	23.81abcd	3.41c	6.92	33.01
N_3D_2	148.67ab	30.40	19.40	25.73abcde	139.41def	22.97	25.47ab	5.92a	9.42	38.59
N_3D_3	13.353cd	18.00	14.53	26.91ab	164.92bc	35.07	23.85abcd	4.38b	7.00	38.48
N_3D_4	123.93de	18.20	13.47	25.53bcde	162.33bc	23.73	22.38cd	4.50b	6.58	40.06
Sx	2.331	-	-	0.489	5.337	-	0.629	0.147	-	-
Level of Significance	0.01	NS	NS	0.05	0.05	NS	0.01	0.01	NS	NS

In a column, figures having common letter(s) do not differ significantly as per DMRT
NS = Not significant
N_0 = 0 kg nitrogen ha^{-1}, N_1 = 40 kg nitrogen ha^{-1}, N_2 = 80 kg nitrogen ha^{-1} and N_3 = 120 kg nitrogen ha^{-1}
D_1 = 15 July transplanting, D_2 = 30 July transplanting, D_3 = 14 August transplanting and D_4 = 29 August transplanting

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