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Effect of transplanting date and nitrogen fertilization on the yield of BRRI dhan29

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Abstract

BRRI dhan29, a high yielding inbred variety, was grown in *boro* season on five different dates of transplanting viz. 1 January, 10 January, 20 January, 30 January and 10 February under four levels of nitrogen i.e. 80, 100, 120 and 140 kg ha^{-1} at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh in 2005-2006 aimed at assessing the influence of dates of planting and nitrogen level on different crop characters and yields of grain and straw of rice. Grain yield of rice planted on 20 January was highest (4.99 t ha^{-1}) due to highest number of grains $panicle^{-1}$ (130.7) and 1000-grain weight. The lowest yield (3.77 t ha^{-1}) was obtained from 10 February and was at par with 1 January ones. Grain yield registered an increasing trend upto 120 kg N ha^{-1} (4.93 t ha^{-1}) but differed significantly form second highest (4.30 t ha^{-1}) yield obtained from 140 kg N ha^{-1}. The lowest grain yield (3.91 t ha^{-1}) was recorded from 80 kg N ha^{-1}. Straw yield was also found the highest (5.82 t ha^{-1}) from 120 kg N ha^{-1} The second highest nitrogen level (120 kg ha^{-1}) interacted favourably with 20 January plantation to give highest grain and straw yields (5.59 and 6.25 t ha^{-1}, respectively). Considering grain and straw yields and total growth duration transplanting on 20th January with 120 kg N ha^{-1} was found to appear more appropriate within the per view of the study area.

Keywords: Date of transplanting, Nitrogen, Growth duration, Yield attributes, Yield, Rice

Introduction

In Bangladesh, rice dominates over all other crops and covers 75% of the total cropped area and 92% peasants grow rice (Rekabdar, 2004). Fortunately, during recent past food autarky is oscillating near the vicinity of self sufficiency mainly due to increased volume of rice production around 25.18 million metric tones. In recent years, rice production have increased, due to emanation of noble varieties, use of chemical fertilizer and expansion of irrigated area. But as yet the yield is far below the world average, being only 2.33 tones ha^{-1} (BBS, 2003). *Boro* rice covers 3.74 million hectares producing 12.83 million tones of grain (BBS, 2004). Changes in climatic factors influence growth and yield components of rice. Usually, *boro* rice is planted from December to March (BRRI, 1984). Early transplanting prolongs crop duration, again delayed transplanting decreases the yield (BRRI, 1985).

Nitrogen plays a vital role in enhancing crop growth but it is a limiting nutrient and its deficiency is universal. To increase sustainable productivity and reduce adverse effect of N use, it is required to develop practices that minimize N loss, increase recovery of applied N by the crops. The present study was, therefore, undertaken to find out the optimum date of transplanting and determine the required dose of nitrogen (as urea) and their interaction effect on BRRI dhan29 during *boro* season.

Materials and Methods

A piece of research work was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh from November 2005 to May 2006 with a view to finding out the influence of date of transplanting and nitrogen level on the rice yield. The experimental treatments included (A) five dates of transplanting namely. 1 January (D_1), 10 January (D_2), 20 January (D_3), 30 January (D_4) and 10 February (D_5) and (B) four levels of nitrogen viz., 80 (N_1), 100 (N_2), 120 (N_3) and 140 (N_4) kg N ha^{-1} applied as urea. The experiment was laid out in a randomized complete block design with three replications. The

unit plot size was $10m^2$ (4.0 m × 2.5 m) and the spaces between blocks and plots were 1 m and 0.5 m, respectively. The land was fertilized with TSP, MP, Gypsum and zinc sulphate at the rate of 130, 120, 70 and 10 kg ha^{-1}, respectively. Urea was applied as per experimental specification. The entire amount of all the fertilizers, except urea were applied as basal dose while urea was top dressed in three equal splits at 15, 45 and 55 days after transplanting. Fortyfive day-old seedlings of BRRI dhan29 were transplanted at the rate of 3 seedlings $hill^{-1}$ with 25 cm spacing between lines and 15 cm spacing between hills. Different intercultural operations such as gap filling, weeding, water management and pest management were done properly in time. Five hills (excluding border line) from each plot were selected at random and tagged immediately after transplanting for measuring data on different plant characters and yield components. The plants of selected hills were uprooted from each unit plot prior to harvest for recording data on different crop characters. After sampling, the crop of whole plot were harvested when around 90% of the grains appeared golden yellow in colour. The data on different agronomic characters were collected from randomly selected hills in each plots, and for grain and straw yields, it was recorded from the whole plot. Data were analyzed considering the analysis of variance technique and mean differences were adjudged by Duncan's Multiple Range Test (DMRT).

Results and Discussion

Date of transplanting had significant effect on all yield components at harvest. The highest number of total tillers (14.33) was obtained from 10 January transplanting but the number of bearing tiller was maximum from 1 January planting and minimum from 10 February. 1 January planting produced minimum number of non-bearing tillers with a tendency of gradual increase upto 10 February. The longest panicle (23.82 cm), maximum number of total spikelets $panicle^{-1}$ and highest number of grains $panicle^{-1}$ were obtained from 20 January planting and this parameters showed decreasing trend with further delay in planting (Table 1). Higher number of sterile spikelets was produced from 1 January planting while fertility index was maximum from 10 February planting. In 10 January planted crops the panicle density was highest and very close to 20 January crops. The highest1000-grain weight was recorded from 1 January planted crops with the lowest from 10 February ones. 20 January plantation yielded significantly the highest grain (4.99 t ha^{-1}) (Table 1). The recorded highest yield was harvested due to cumulative effect of longest panicle, maximum number of grains $panicle^{-1}$, low sterility percentage and similar 1000- grain weight. Ali *et al.* (1995) opined that grain yield decreased with delay in planting date. Om *et al.* (1993) in India also concluded from an experiment that yields decreased with delay in transplanting. They further concluded that this was due to reduction in number of panicles $hill^{-1}$ and grains $panicle^{-1}$. The lowest grain yield (3.77 t ha^{-1}) was obtained from 10 February planting. The 20 January planting also yielded highest straw (5.82 t ha^{-1}) and was due to longest plant height, statistically identical number of total tillers. The lowest straw yield was recorded from 1 January planting.

Nitrogen level profoundly influenced plant height. Yield enhancing characters like number of total tillers, 1000-grain weight were also found to be increased with highest level of nitrogen (140 kg ha^{-1}) and the corresponding values for these characters were 16.01 and 20.69g, respectively (Table 2). Higher nitrogen level increased number of non-bearing tillers which ultimately lowered the effectivity index of tillers. The second highest level of nitrogen (120 kg ha^{-1}) produced the highest number of bearing tillers, maximum number of grains $panicle^{-1}$, and the highest percentage of fertility index. The minimum level of nitrogen (80 kg ha^{-1}) gave the shortest plant (78.05 cm) the lowest number of total tillers (10.96), the lowest number of bearing tillers (8.38) the shortest panicle (20.81 cm) the lowest number of grains $panicle^{-1}$ (108.0) and the lowest 1000-grain weight (20.57 g).

The maximum grain yield (4.93 t ha^{-1}) was harvested from 120 kg N ha^{-1} and was followed by 140 kg N ha^{-1} and 100 kg N ha^{-1}. The lowest grain yield (3.91 t ha^{-1}) was recorded from the lowest level of nitrogen (80 kg ha^{-1}). Chopra and Chopra (2004) recorded increased grain yield at 120 kg N ha^{-1} and it was due to increase in yield attributes such as plant height, grains panicle^{-1} and 1000- grain weight. Gopal *et al.* (1999) reported that yield of rice increased upto 100 kg N ha^{-1} and then decreased with 140 kg N ha^{-1} regardless of split application. Straw yield was the highest (5.82 t ha^{-}) from 120 kg N ha^{-1}. The lowest straw yield (5.04 t ha^{-1}) was obtained from the lowest nitrogen level (80 kg N ha^{-1}) and was at par with 100 and 140 kg N ha^{-1}. The highest biological yield (10.83 t ha^{-1}) was recorded from 120 kg N ha^{-1} and the lowest (8.95 t ha^{-1}) was obtained from lowest level of nitrogen. The highest harvest index (45.50%) was calculated at 140 kg N ha^{-1} and was identically followed by 120 kg N ha^{-1}. The lowest harvest index (43.59%) was recorded from 80 kg N ha^{-1} and was at par with 100 kg N ha^{-1} (Table 2).

Table 1 Effect of date of transplanting on different crop characters of BRRI dhan29

Date	Plant height at harvest (cm)	No. of effective tillers hill^{-1}	Effectivity index of tillers (%)	Panicle length (cm)	No. of grains panicle^{-1}	Fertility index (%)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)	TGD (days)
1 January	80.35 c*	11.41a	79.31 a	21.80 b	119.9 c	85.36 bc	21.20 a	3.92 d	4.90 b	44.39 a	164a
10 January	86.17 ab	11.38a	79.93 a	22.27 b	125.8 b	86.77 b	21.01 a	4.16 c	5.13 b	44.78 a	160ab
20 January	86.96 a	10.05b	75.29 b	23.82 a	130.7 a	84.76 bc	20.96 a	4.99 a	5.82 a	44.97 a	156bc
30 January	84.88 b	9.62bc	75.78 b	22.62 b	124.6 b	82.82 c	20.10 b	4.76 b	5.66 a	45.66 a	154c
10 February	80.65 c	8.91c	74.28 b	22.27 b	114.8 d	89.78 a	19.85 b	3.77 d	5.05b	42.78 b	153c
Level of Significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
$s_{\bar{x}}$	0.607	0.300	0.790	0.270	1.600	0.95 8	0.243	0.068	0.079	0.412	1.508
CV (%)	2.51	10.14	3.56	4.15	4.50	3.87	4.09	5.46	5.20		3.32

*In a column, figures having similar letter(s) do not differ significantly whereas, dissimilar letters differ significantly as per DMRT

Table 2 Effect of nitrogen level on different crop characters of BRRI dhan29

Nitrogen level (kg ha^{-1})	Plant height at harvest (cm)	No. of effective tillers hill^{-1}	Effectivity index of tillers (%)	Panicle length (cm)	No. of grains panicle^{-1}	Fertility index (%)	1000- grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)	TGD (days)
80	78.05 d*	8.38c	76.56 b	20.81 d	108.0 d	88.33 a	20.57	3.91c	5.04 b	43.59 c	156.7a
100	83.12 c	10.47b	78.81 a	22.38 c	120.8 c	79.53 b	20.62	4.16 b	5.24 b	44.17 bc	158.1a
120	85.69 b	12.21a	76.74 b	23.15 b	136.5 a	88.54 a	20.61	4.93 a	5.82 a	44.80 ab	157.4a
140	88.36 a	10.03b	75.56 b	23.88 a	127.2 b	87.22 a	20.69	4.30 b	5.14 b	45.50 a	157.4a
Level of significance	0.01	0.01	0.05	0.01	0.01	0.01	NS	0.01	0.01	0.01	NS
$s_{\bar{x}}$	0.543	0.269	0.706	0.242	1.431	0.857	0.217	0.061	0.071	0.369	1.349
CV (%)	2.51	10.14	3.56	4.15	4.50	3.87	4.09	5.46	5.20	3.21	3.32

* In a column, figures having similar letter(s) do not differ significantly whereas, dissimilar letters differ significantly as per DMRT
NS = Not significant

The interacting effect of date of planting and nitrogen level was found to exert significant influence on yield attributes except 1000-grain weight. The tallest plant (91.68 cm) was produced from 20 January crop grown with 140 kg N ha^{-1} and was statistically at par with 10 January planted crop with 140 kg N ha^{-1} (Table 3). The highest number of total tillers (18.33)

was produced from 10 January planted crops supplied with 140 kg N ha^{-1}. On the contrary, highest number of bearing tiller 14.00 was available from 10 January plantation with 120 kg N ha^{-1} was followed by 1 January × 120 kg N ha^{-1} and the minimum with 10 February and lowest nitrogen level. Bearing tiller number appeared to be maximum with 120 kg N irrespective of time of planting. Length of panicle was maximum (24.98 cm) in case of 20 January planting and 140 kg N ha^{-1} and closely followed by 120 and 100 kg N ha^{-1} of the same date. The highest number of spikelets $panicle^{-1}$ 165.6 and number of grains $panicle^{-1}$ 145.9 was obtained from 20 January × 120 kg N ha^{-1}. Both total number of spikelet $panicle^{-1}$ and number of grains $panicle^{-1}$ were found the lowest with the lowest level of nitrogen regardless of planting time. Harvested grain yield was maximum (5.59 t ha^{-1}) in case of 20 January planted crops and 120 kg N ha^{-1} and was statistically at par with that of 30 January planted crops and 120 kg N ha^{-1}. Grain yield was found to be reduced gradually when nitrogen level was lowered up to 80 kg N ha^{-1}. Straw yield and biological yield was the highest (6.25 t ha^{-1} and 12.24 t ha^{-1}, respectively) in 20 January and 120 kg N ha^{-1} and lowest in 1 January plantation with minimum nitrogen. The highest harvest index (47.11%) was calculated from 20 January and 140 kg N ha^{-1} which was very closed to 30 January and 120 kg N ha^{-1}, and the lowest one from 10 February and 80 kg N ha^{-1}. TGD ranged from 153 to 164 days due to interaction effect between date of planting and nitrogen level but did not differ significantly (Table 3). Maximum growth duration in case of 1 January planted crop might be due to relatively low temperature and minimum sunshine hours prevailed during early stages of growth which might have lengthened the vegetative phase and ultimately increasing total growth duration.

Table 3. Effect of interaction of date of transplanting and nitrogen level on different crop characters of BRRI dhan29

Treatment combination (Date x Nitrogen)	Plant height at harvest (cm)	No. of effective tillers $hill^{-1}$	Effectivity index of tillers (%)	Panicle length (cm)	No. of grains $panicle^{-1}$	Fertility index (%)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)	TGD (days)
D_1N_1	75.75 h*	7.53 ijk	82.46 abc	20.20 gh	113.6 g	85.45 bcd	20.76	3.51 jk	4.71 g	42.70 def	164
D_1N_2	76.47 h	11.50 cdef	77.26 cdef	21.84 cdefg	120.9 efg	85.49 bcd	21.28	3.70 ijk	4.80 fg	43.52 cdef	164
D_1N_3	83.84 defg	13.46 ab	81.54 abcd	22.08 cdef	128.4 cde	86.01 bcd	21.13	4.55 def	5.35 cde	45.95 abc	164
D_1N_4	85.34 cdef	13.13 abc	75.96 efg	23.06 bcd	116.6 fg	84.49 cd	21.62	3.95 ghij	4.75 fg	45.40 abcd	164
D_2N_1	83.96 defg	9.86 fgh	85.98 a	21.22 efg	113.9 g	89.83 bcd	20.87	3.79 hijk	4.80 fg	44.12 bcdef	160
D_2N_2	83.60 efg	9.73 fgh	78.53 bcde	21.32 defg	126.3 def	85.87 bcd	20.94	3.89 ghijk	5.00 efg	43.75 cdef	160
D_2N_3	87.43 bcde	14.00 a	78.85 bcde	22.90 bcde	136.9 abc	86.39 bcd	21.22	5.00 bc	6.00 ab	45.45 abcd	160
D_2N_4	89.70 ab	11.93 bcde	76.37 defg	23.64 abc	126.1 def	84.99 bcd	20.99	3.99 ghi	4.72 fg	45.80 abc	160
D_3N_1	81.56 fg	9.80 fgh	67.62 h	22.54 bcdef	117.3 fg	87.91 bcd	21.20	4.50 ef	5.52 bcd	44.91 abcde	156
D_3N_2	85.86 bcde	11.06 defg	83.02 ab	23.46 abc	113.8 g	74.99 e	20.98	4.90 bcde	5.90 ab	45.37 abcd	156
D_3N_3	88.76 abc	12.33 abcd	74.11 efg	24.30 ab	145.9 a	88.09 bcd	20.71	5.59 a	6.25 a	42.47 ef	156
D_3N_4	91.68 a	7.01 jk	76.41 defg	24.98 a	145.7 a	88.19 bcd	20.94	4.98 bcd	5.59 bcd	47.11 a	156
D_4N_1	76.13 h	8.46 hij	74.20 efg	19.09 h	94.18 h	90.95 bc	20.14	4.25 fg	5.25 def	44.73 abcde	154ss
D_4N_2	89.03 abc	10.06 efgh	77.46 cdef	23.32 abc	123.0 bcd	64.88 f	20.01	4.72 cde	5.59 bcd	45.78 abc	154
D_4N_3	86.54 bcde	10.93 defg	77.41 cdef	22.94 ab	139.6 ab	83.91 d	20.20	5.29 ab	6.00 ab	46.85 ab	154
D_4N_4	87.83 abcd	9.040 ghi	74.05 efg	24.14 ab	132.7 bcd	91.53 b	20.05	4.80 cde	5.80 abc	45.28 abcd	154
D_5N_1	72.85 h	6.260 k	72.54 fg	21.02 fg	100.7 h	87.51 bcd	19.87	3.49 k	4.92 efg	41.49 f	153
D_5N_2	80.65 g	10.00 efgh	77.77 cdef	21.98 cdef	111.4 g	86.43 bcd	19.87	3.61 ijk	4.90 efg	42.42 ef	153
D_5N_3	81.88 fg	10.33 efgh	71.80 gh	22.54 bcdef	131.8 bcd	98.29 a	19.81	4.21 fgh	5.52 bcd	43.26 cdef	153
D_5N_4	87.24 bcde	9.060 ghi	75.00 efg	23.56 abc	115.2 g	86.88 bcd	19.83	3.80 hijk	4.85 efg	43.93 cdef	153
Level of significant	0.01	0.01	0.01	0.05	0.01	0.01	NS	0.01	0.05	0.05	NS
$S\bar{x}$	1.216	0.601	1.580	0.540	3.200	1.91	0.486	0.136	0.159	0.825	3.017
CV (%)	2.51	10.14	3.56	4.15	4.50	3.87	4.09	5.46	5.20	3.21	3.32

* In a column, figures having similar letter(s) do not differ significantly whereas, dissimilar letters differ significantly as per DMRT

NS = Not significant

D_1 = 1 January
D_2 = 10 January
D_3 = 20 January
D_4 = 30 January
D_5 = 10 February

N_1 = 80 kg ha^{-1}
N_2 = 100 kg ha^{-1}
N_3 = 120 kg ha^{-1}
N_4 = 140 kg ha^{-1}

Conclusion

Keeping in view the limitations of present piece of research the undermentioned suggestions are put forward. BRRI dhan29, a high yield potential *boro* rice variety, may be planted 20 January for harnessing higher grain and straw yields, the second best time appears to be around 30 January. For the variety in question 120 kg N ha^{-1} may be used for a good harvest of grain and straw. The second choice may be 100 kg N ha^{-1} from economic view point. In order to arrive at a conclusive remarks further studies are indispensable to find out real time of planting and crop need based nitrogen requirement.

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