EFFECT OF NITROGEN AND NUMBER OF SEEDLINGS PER HILL ON THE YIELD AND YIELD COMPONENTS OF T. AMAN RICE (BRRI Dhan 33)

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ABSTRACT

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The experiment was conducted at the Agronomy field Laboratory, Department of Agronomy, Hajee Mohammad Danesh Science and Technology University, Dinajpur during the period from July to December, 2007 to investigate the effect of nitrogen (N) and number of seedlings hill^{-1} on the yield and yield components of transplant aman rice cv. BRRI dhan 33. Five levels of N (viz. 40, 60, 80, 100 and 120 kg ha^{-1}) and four levels of seedlings hill^{-1} (viz. 1, 2, 3 and 4 seedlings hill^{-1}) were taken as treament combination. The application of N fertilizer significantly influenced the plant height, number of tillers, effective tillers, panicle length, grains panicle^{-1} and grain yield. The highest grain yield 4.27 t ha^{-1} was recorded with the N_4 (100 kg N ha^{-1}). Among four levels of seedlings, three seedlings hill^{-1} (S_3) was the best in respect of plant height, tillers hill^{-1}, effective tillers hill^{-1}, grains panicle^{-1} and grain yield (4.07 t ha^{-1}). The interaction effect of different doses of N and number of seedlings per hill was significant in all the parameters. The treatment combination N_4S_3 produced the highest 1000-grain weight followed by N_1S_1 and N_5S_1 and grain yield (4.90 t ha^{-1}), on the other hand the lowest grain yield 2.60 t ha^{-1} was recorded from N_1S_3.

Keywords: Nitrogen, Seedlings, Yield and Rice

INTRODUCTION

Rice is a vital food material for more than half the world's population. Among cereals rice is more nutritious and about 40% of world population consumes it as a major source of calorie (Banik, 1999). Bangladesh ranks third position in respect of growing area and fourth in production among the major rice growing countries (Huke and Huke, 1990). Here rice is cultivated in 10.71 million hectares having the average yield 1.79 t ha^{-1} with the production of 23.07milion metric tons (BBS, 2000). The yield of rice is very low in Bangladesh comparing to that of the other countries in the world. The reasons for such low yield are mainly associated with cultural technologies. Among the cultural technologies like plant population and N fertilizer are important ones.

Rice plants solely upon soil and applied source of N for maximum yield. N plays a key role in supporting plant activity and increasing the rice yield (BRRI, 1997 and Behera, 1998). Different varieties may have varying response to N-fertilizer depending on their agronomic traits. Many workers have reported a significant response of rice to N in different soils in Bangladesh (Islam *et al.,* 1990). Cultivation of T. aman rice is becoming popular due to its low cost of production and higher price.

The optimum seedlings per hill ensure the plants to grow in their both aerial and under ground parts through efficient utilization of solar radiation, water and nutrients (Miah *et al.,* 2004). When the planting densities exceed the optimum level, competition among plants becomes severe and consequently the plant growth slows down and the grain yield decreases. As the tiller production in T-aman rice is very low and most of them are low yielding. So, it is essential to determine suitable spacing for T. aman rice varieties to maximise their yield. So, it is necessary to improve its cultural practices like optimum doses of N and seedling per hill under Dinajpur-a famed area for growing T. amn rice.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Field Laboratory, Hajee Mohammad Danesh Science and Technology University, Dinajpur during July to December 2007. The site of the experiment was situated between $25^0$28′ to $25^0$47′ North latitude and $88^0$34′ to $88^0$47′ East longitudes at the elevation of 37.58 meter above the sea level. The experiment was laid out in a medium high land belonging to the AEZ-1 (Old Himalayan Piedmont Plain). The soil texture was sandy loam (sand, silt and clay are 62, 25 and 13 %, respectively) with a pH 5.1 and the organic matter content was around 1.20 percent. The characteristics of the soil were previously tested in the soil science department, HSTU, Dinajpur. The experiment consisted of five N levels viz. 40 kg ha^{-1} (N_1), 60 kg ha^{-1} (N_2), 80 kg ha^{-1} (N_3), 100 kg ha^{-1} (N_4) and 120 kg ha^{-1} (N_5) coupled with four seedlings hill^{-1} viz. one seedling (S_1), two seedlings (S_2), three seedlings (S_3) and four seedlings (S_4). The experiment was laid out in the randomized complete block design with three replications. The plot size was 5m

x 4m.The experimental field was ploughed and cross ploughed followed by laddering to obtain a desirable tilth. Fertilizers were applied to the plots at the rate of 100, 70, 60, and 10 kg ha^{-1} of triple super phosphate, muriate of potash, gypsum and zinc sulphate, respectively one day before transplanting. The N was applied in the form of urea as experimental specification (The whole amount of urea was top-dressed in three equal splits each at 15, 35 and 55 days after transplanting). The whole amount of triple super phosphate, muriate of potash, gypsum and zinc sulphate was applied at the time of final land preparation. Thirty days (30) old seedlings were uprooted carefully and transplanted on the well puddled experimental plots on July 26, 2007 using spacing 25 cm X15 cm as seedlings specification per hill. The intercultural operations like weeding, irrigation and plant protection measures were done as necessary. Five hills (excluding border hill) were randomly selected at maturity and uprooted from each unit plot prior to harvest for recording data on different plant characteristics. The crop was harvested when 90% of the grains became golden yellow. The grains were threshed, cleaned and sun dried to record grain yield $plot^{-1}$. The grain yield was adjusted to 12% moisture content. Straws were also sun-dried to record its yield $plot^{-1}$. Grain and straw yields were then converted to t ha^{-1}. The recorded data were analysed using the Analysis of Variance with the help of computer package MSTAT. The mean differences among the treatments were adjudged with Duncan's Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The result that the application of N fertilizer significantly influenced plant height, number of tillers, effective tillers, panicle length, grains $panicle^{-1}$, unfilled grains $panicle^{-1}$ and grain and straw yield. Number of seedlings $hill^{-1}$ had significant effect on plant height, tillers $hill^{-1}$, effective tillers $hill^{-1}$, unfilled grains $panicle^{-1}$, grains $panicle^{-1}$ and grain yield. The interaction of N and varieties showed significant effect in all yield contributing parameters and yield.

Effect of N

The plant height increased significantly with the increasing rate of N up to 100 kg ha^{-1} and thereafter declined (Table 1). The tallest plant (93.59 cm) was observed in N_4 (100 kg ha^{-1}N) and the shortest (87.18cm) was found in N_1 (40 kg ha^{-1} N). Sikder *et al.* (2006) stated that plant height increased significantly with the increasing rate of N. The highest tillers $hill^{-1}$ (9.25) was observed in N_4 and the lowest (6.25) was in N_1 which was statistically similar to N_2. Similar result was observed by Ni-Zhihua (1997). The effective tillers $hill^{-1}$ increased up to N_4 and thereafter decreased. The highest number of effective tillers $hill^{-1}$ (8.12) was obtained in N_4 and the lowest (5.87) was in N_1. Panicle length gradually increased with the application rate of N up to 100 kg ha^{-1} and then declined. Number of grain $panicle^{-1}$ increased with the increasing level of N up to 100 kg N ha^{-1} and there after declined and it was higher (111.1) at N_4 but statistically similar to N_5 and N_3. The similar trends were also reported Behera (1998). Filled grains $panicle^{-1}$ and weight of 1000-grain was not significantly influenced by N level as it mostly governed by genetic make up of the variety. Grain yield also increased with the increasing of N level up to N_5 and there after declined (Table 1). Increase in grain yield due to application of N level was mainly due to improvement in yield component i.e. no. of effective tillers, panicle length, grains $panicle^{-1}$ and 1000 grain weight. These results are in agreement with those obtained by Dwivedi (1997).

Table 1: Effect of different doses of N on yield and yield contributing characters of BRRI Dhan33

Treatments (N levels)	Plant height (cm)	Tillers $hill^{-1}$	Effective tillers $hill^{-1}$	Panicle length (cm)	Grains $panicle^{-1}$	Filled grains $panicle^{-1}$	Unfilled grains $panicle^{-1}$	1000-grain wt.	Grain yield ($kgha^{-1}$)	Straw yield (kg ha^{-1})
N_1	87.18b	6.62c	5.87b	20.43b	96.38d	84.50	16.13a	23.32	3.26c	8.21b
N_2	87.90ab	6.73c	6.00b	20.50b	105.60c	89.75	15.88b	23.16	3.70b	9.68ab
N_3	92.40ab	7.50b	6.75ab	20.66b	108.00ab	95.25	11.88c	23.25	4.12a	10.06ab
N_4	93.59a	9.25a	8.12a	22.59a	111.10a	99.38	10.63d	23.36	4.27a	12.00a
N_5	92.78ab	8.70ab	7.25ab	21.00ab	109.10ab	95.70	11.25c	23.16	4.18a	10.46ab
LSD (0.05)	5.61	1.65	1.53	1.71	16.95	NS	5.48	NS	0.76	2.59

In a colum, figures bearing same or no letter(s) do not differ significantly at 5% level of significance by Duncans Multiple Range Test
NS= Not significant

Effect of seedlings $hill^{-1}$

It was evident that plant height influenced statistically by the number of seedlings $hill^{-1}$ and it was highest (91.60 cm) in S_1 and the lowest (88.00cm) was obtained in S_4 (Table 2). Similar results were found by Miah *et al.* (2004) and Inaba and Kitano (2005). The decreasing plant height with increase in the number of seedlings $hill^{-1}$ was due to the fact that interplant competition for space, light and nutrients which might acts for attaining lowest plant height. Tillers $hill^{-1}$ also significantly affected by number of seedlings $hill^{-1}$ and it was gradually increased

with the increasing seedlings hill^{-1}. The highest value was observed in S_4 and the lowest was in S_1. The effective tillers hill^{-1} increased up to S_3 (7.80) and thereafter decreased and statistically similar value was observed in S_2 and S_4. Panicle length was not influenced by the number of seedlings hill^{-1}. Number of grain panicle^{-1} increased with the increasing seedlings up to S_3 (110.7) and there after declined. Statistically poorest value (100.8) was recorded at S_1. The number of grains per panicle decreased with increasing seedling density was reported by Inaba and Kitano (2005). Filled grains panicle^{-1} and weight of 1000-grain was not significantly influenced by number of seedlings as it may be controlled by genetic make up of the studied variety. Grain yield also increased (4.07 t ha^{-1}) with the increasing of number of seedlings up to S_3 and it was identical to that of S_4 but the lowest was in S_1. Increasing seedling number per hill increased grain yield depending on the seedling age (Sanico *et al.*, 2002). Straw yield was not significantly influenced by the number of seedlings hill^{-1}.

Table 2: Effect of number on seedlings hill^{-1} on yield and yield contributing characters of BRRI Dhan33

Treatments (Seedlings hill^{-1})	Plant height (cm)	Tillers hill^{-1}	Effective tillers hill^{-1}	Panicle length (cm)	Grains panicle^{-1}	Filled grains panicle^{-1}	Unfilled grains panicle^{-1}	1000-grain wt.	Grain yield (kgha^{-1})	Straw yield (kg ha^{-1})
S_1	91.60a	6.30b	5.80b	20.16	100.80c	87.30	16.30a	23.35	3.50d	8.85
S_2	89.24ab	8.00ab	7.10ab	20.58	105.00b	88.70	12.50b	23.22	3.86c	9.96
S_3	88.33b	8.20ab	7.80a	21.30	110.70a	99.60	11.10c	23.22	4.07a	10.81
S_4	88.00b	9.00a	7.45ab	20.80	105.70b	91.00	12.70b	2319	3.98ab	10.71
LSD (0.05)	6.43	1.89	1.75	NS	19.43	NS	6.28	NS	087	NS

In a colum, figures bearing same or no letter(s) do not differ significantly at 5% level of significance by Duncans Multiple Range Test
NS= Not significant

Interaction effect

The interaction effect of different doses of N and number of seedlings per hill was significant in all the parameters (Table 3). The highest plant height (100.20 cm) was obtained in N_4S_3 which was statistically similar to N_4S_1 and the lowest value (82.01 cm) was obtained in N_2S_1 combination. Significant interaction effect was found in the number of tillers and the highest (12.00) and lowest (4.00) values were recorded in N_4S_3 and N_2S_1, respectively. Similar results were also observed in the effective tillers hill^{-1} and the highest (11.00) and lowest (3.50) values were recorded of the same combination. Interaction had effect on the length of panicle and maximum length of panicle was opined in N_4S_3 and the minimum was in N_5S_4 followed by N_4S_4. Number of spikelets panicle^{-1} and number of filled grains panicle^{-1} were significantly influenced by the interaction of nitrogen and number of seedling hill^{-1} and N_4S_3 and N_1S_3 produced the highest and the poorest values of those traits, respectively. Statistically the highest unfilled grain (25.0) was found in N_3S_1 followed by N_5S_1 the lowest (6.5) was in N_2S_2 similar to N_4S_4. N_4S_3 produced the highest 1000-grain weight (followed by N_1S_1 and N_5S_1) and grain yield (4.90 t ha^{-1}) on the other hand the lowest was in N_2S_4 and N_1S_3, respectively. These results were partially agreement of Paraye and Khandaker (1994). Straw yield was statistically highest in N_3S_1 followed by N_5S_4 and the lowest was in N_1S_2.

Table 3: Interaction effect of number on seedlings hill^{-1} on yield and yield contributing characters of BRRI Dhan33

Treatments (N X Seedlings hill^{-1})	Plant height (cm)	Tillers hill^{-1}	Effective tillers hill^{-1}	Panicle length (cm)	Grains panicle^{-1}	Filled grains panicle^{-1}	Unfilled grains panicle^{-1}	1000-grain wt.	Grain yield (kgha^{-1})	Straw yield (kg ha^{-1})
N_1S_1	91.60 b-f	6.50 e	6.50 d-f	20.04 c-e	100.5 c-f	89.50 b-f	11.00 d-i	23.50 a	3.45 ef	8.80 d-g
N_1S_2	89.24 c-g	7.00 e	6.5 d-f	20.53 c-e	95.50 d-f	87.00 c-f	8.50 hi	23.25 d-f	3.50 d-f	9.05 c-g
N_1S_3	88.33 d-h	6.50 e	5.0 g	20.31 c-e	28.50 g	64.00 g	14.50 b-e	23.29 c-e	2.60 h	6.50 h
N_1S_4	93.90 bc	6.50 e	6.0 e-g	20.82 c-e	111.0 bc	97.50 bc	13.50 b-g	23.25 d-f	3.50 d-f	8.50 e-h
N_2S_1	82.021 i	4.00 f	3.5 h	20.55 c-e	108.0 b-d	96.50 b-d	11.50 c-h	23.25 d-f	4.25 a-c	7.50 f-h
N_2S_2	85.70 gi	6.50 e	6.0 e-g	21.19 cd	112.0 bc	105.5 ab	6.50 i	23.25 d-f	3.62 c-f	9.98 b-e
N_2S_3	87.20 fh	6.5 e	6.0 e-g	20.15 c-e	112.5 bc	97.00 bc	15.50 b-d	23.13 e-g	4.50 ab	11.25 bc
N_2S_4	91.00 b-f	9.5 bc	8.0 bc	20.10 c-e	107.5 b-d	98.50 bc	9.00 g-i	23.00 g	4.37 ab	10.00 b-e
N_3S_1	84.00 h	7.50 d	6.0 e-g	29.95 b	117.5 ab	92.50 b-e	25.00 a	23.15 d-g	4.60 ab	16.75 a
N_3S_2	85.00 gh	6.50 e	6.5 d-f	19.86 c-e	98.0 c-f	81.50 c-f	16.50 b	23.10 fg	4.05 b-e	9.00 c-g
N_3S_3	87.40 eh	7.50 d	6.5 d-f	21.28 c	102.0 c-f	91.50 b-e	10.50 e-i	23.30 b-d	3.30 fg	10.25 b-e
N_3S_4	95.20 b	8.50 cd	8.0 bc	20.53 c-e	88.50 fg	79.00 e-g	11.50 c-h	23.10 fg	4.55 ab	12.00 b
N_4S_1	99.60 a	6.50 e	5.0 fg	20.90 c-e	91.50 e-g	97.50 d-g	12.00 b-h	23.02 g	2.80 gh	11.00 b-d
N_4S_2	85.40 gh	9.50 bc	9.0 b	21.32 c	94.00 d-f	73.00 fg	16.00 bc	23.02 g	3.50 d-f	7.00 gh
N_4S_3	100.20 a	12.00 a	11.0 a	26.27 a	127.0 a	115.50 a	9.50 e-i	23.51 a	4.90 a	10.25 b-e
N_4S_4	67.15 c-g	9.00 c	7.0 cd	19.70 de	102.0 c-f	94.50 b-e	7.50 hi	23.42 a-c	4.50 ab	12.00 b
N_5S_1	91.80 b-f	7.00 e	7.5 cd	21.37 c	107.5 b-d	85.50 c-f	22.00 a	23.49 a	4.12 b-d	9.5 c-f
N_5S_2	92.80 b-d	10.50 b	7.5 cd	19.99 ce	104.5 b-e	79.50 b-f	15.00 b-e	23.46 ab	4.62 ab	9.25 c-g
N_5S_3	92.20 b-e	1 0.50 b	8.0 bc	21.24 c	104.5 b-e	92.00 b-e	13.50 b-g	23.10 fg	4.00 b-e	15.80 a
N_5S_4	92.80 b-d	8.50 cd	6.0 e-g	19.61 e	106.0 b-e	92.00 b-e	14.00 b-f	23.30 cd	3.45 ef	7.30 f-h
LSD (0.05)	4.403	1.297	1.199	1.343	13.30	15.20	4.301	0.1494	0.597	2.036

In a colum, figures bearing same or no letter(s) do not differ significantly at 5% level of significance by Duncans Multiple Range Test
NS= Not significant

CONCLUSION

The experimental results revealed that the modern rice variety statistically influenced by the used nitrogen treatments which was previously reported by different researchers. The result further point out that 100 kg ha^{-1} nitrogen produced the highest grain yield (4.27 t ha^{-1}). It was also confirmed that three seedlings hill^{-1} performed the best result than other treatments in the study.

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