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Effect of Row Arrangement and Nitrogen Level on the Yield and Yield Components of Transplant Aman Rice

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Abstract: The experiment was conducted to investigate the effect of row arrangement and nitrogen level on the yield and yield components of transplant aman rice (cv. BRRI dhan 32). The highest plant height at harvest, number of total tillers hill^{-1}, number of effective tillers hill^{-1} number of non bearing tillers hill^{-1}, grains panicle^{-1} and total spikelets panicle^{-1} were obtained in single row arrangement followed by double, triple and haphazard row system. The maximum grain and straw yield were obtained in double row arrangement. The highest number of effective tillers hill^{-1}, grains panicle^{-1} and grain yield were found where the crop was fertilized with 120 kg N ha^{-1}. These results were statistically identical when 60 and 90 kg N ha^{-1} were applied. So, cultivation of transplant aman rice (cv. BRRI Dhan 32) in double row arrangement appeared to be beneficial practice and fertilization with 60 kg N ha^{-1} was more economic in respect of grain yield.

Key words: Row arrangement, nitrogen level, yield, yield components, transplant aman rice, Bangladesh

Introduction

The horizontal expansion of the rice area in Bangladesh is not possible due to heavy population pressure. So, the only scope to increase the production of rice through vertical means. Proper management practices are the most effective means for maximizing yield of rice. Among the management practices, row arrangement and fertilizer application especially nitrogen fertilization are important. The yield of transplant aman rice are greatly affected by plant population. Row arrangement of transplant aman rice may have a remarkable influence on the yield and yield components of rice. Rice scientists reported that double row showed better performance over single and triple row (Anonymous, 1981; Hossain *et al*., 1990; Paul *et al*., 2002). Rice plants compete themselves severely for space, nutrients, air, water and other factors such as photosynthesis and respiration under densely planted condition. High plant population reduces the growth, development and ultimately the yield of rice. In a densely populated crop, the interspace competition between the plant is very high which causes mutual shading and lodging and thus favours the increased production of straw instead of grain. Nitrogen level is another important factor for rice production. Rice plants require more nutrients to produce appreciable good yield. Grain yield of rice increased significantly up to the application of 80 kg N ha^{-1} and thereafter declined (Hossain and Sharma, 1991) but Singh *et al*. (1997) reported that the grain yield increased with up to 60 kg N ha^{-1}. This study was therefore, undertaken to investigate the effect of row arrangement and nitrogen level on the yield and yield components of transplant aman rice.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, from June to November 1999. The land was medium high with silty loam texture having pH 6.25. A modern rice variety of transplant aman rice (cv. BRRI dhan 32) has been used as a test crop. The experiment consists of four row arrangements viz., single row (row spacing 25 cm), double row (row spacing 25-10-25 cm), triple row (row spacing 25-10-10-25 cm), haphazard row (farmers normal practice) and five levels of nitrogen viz., 0, 30, 60, 90 and 120 kg ha^{-1}. The experiment was laid out in a randomized complete block design. Area of each unit plot was 4.0 x 2.5 m^2. Thirty-five days old seedlings were uprooted from the seed bed and were transplanted on 1 August, 1999 with two seedlings hill^{-1}. The phosphatic, potassic, sulphur and zinc fertilizers were applied as basal dose in the experimental plot @ 100, 70, 60 and 10 kg ha^{-1} in the form of triple super phosphate, muriate of potash, gypsum and zinc sulphate respectively. Nitrogen in the form of urea was applied as per experimental specification. The entire amount of, triple super phosphate, muriate of potash, gypsum and zinc sulphate were broadcast and incorporated into the soil prior to final land preparation. Urea was top dressed in three equal splits on 10 days after transplanting (DAT), 25 and 45 DAT (panicle initiation stage). Weeding and irrigation was done whenever necessary.

Five hills were randomly selected in each unit plot excluding border rows for recording plant characters and yield components. Harvesting was done on 10 November, 1999. The harvested crop was then threshed, cleaned and sun dried to record the grain yield plot^{-1} which was finally converted to t ha^{-1} at 14% moisture basis. The collected data were analyzed statistically and mean differences were adjudged with Duncan's multiple range test (Gomez and Gomez, 1983).

Results and Discussion

Vegetative characters are significantly ($P < 0.05$) influenced by row arrangement. The maximum plant height at harvest, number of non-bearing tillers hill^{-1} and number of total tillers hill^{-1} were found in single row arrangement but triple row arrangement showed lowest one (Table 1). Thompstone (1953) reported that wider space produced more tillers hill^{-1}. Tillering ability of individual plants is reduced due to increase in plant density, resulting in poor growth and development of plants (Yamada, 1961; Vachhani, 1961; Golingai and Mabbayed, 1969). The highest straw yield was found in double row arrangement but the lowest in triple row arrangement which was statistically identical with single and haphazard row arrangement.

Table 1: Effect of row arrangement on vegetative characters

Row arrangements	Plant height (cm)	Number of total tillers hill^{-1}	Number of non-bearing tillers hill^{-1}	Straw yield (t ha^{-1})
Single row	125.73a	10.3a	2.9a	6.16b
Double row	124.18ab	8.5c	1.9b	6.53a
Triple row	121.83b	6.7d	1.1c	6.13b
Haphazard row	125.50a	9.1b	1.9b	5.84b

Figures in a column having the same letter do not differ significantly at 5% level

Plant vegetative characters highly influenced by nitrogen level. Vegetative characters showed an increasing trend when the level of nitrogen increased (Table 2). The plant height hill^{-1}, number of non-bearing tillers hill^{-1}, number of total tillers hill^{-1} and straw yield were found when the crop was fertilized with 120 kg N ha^{-1} but the lowest one in control. These findings are agreement with Ram *et al*. (1984), Islam *et al*. (1988) and Khanda and Dixit (1996).

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Table 2: Effect of N level on vegetative characters

Nitrogen level (kg ha^{-1})	Plant height (cm)	Number of total tillers hill^{-1}	No. of non-bearing tillers hill^{-1}	Straw yield (t ha^{-1})
0	116.02c	7.2c	1.6b	5.07d
30	121.33b	8.6b	1.9ab	5.87c
60	126.76a	9.2ab	2.1a	6.32b
90	128.33a	8.8b	1.8ab	6.51b
120	129.13a	9.6a	2.3a	7.05a

Table 3: Effect of interaction between row arrangement and nitrogen level on vegetative characters

Row arrangements	Nitrogen level (kg ha^{-1})	Plant height (cm)	No. of total tillers hill^{-1}	No. of non-bearing tillers hill^{-1}	Straw yield (t ha^{-1})
Single row	0	119.7	8.6	2.4bc	5.33gh
	30	122.0	9.8	2.2bc	5.85e-h
	60	127.8	10.2	2.6bc	6.27b-f
	90	129.2	10.8	2.7b	6.45b-e
	120	129.8	12.5	4.1a	6.88bc
Double row	0	112.2	6.9	1.2e-g	5.50f-h
	30	122.1	8.6	2.0b-e	5.97c-h
	60	126.4	8.8	2.1b-d	6.03c-g
	90	129.0	8.6	1.8c-g	7.00b
	120	131.1	9.5	2.1bc	7.13a
Triple row	0	113.6	5.4	1.0g	5.10hi
	30	119.4	6.7	1.3d-g	5.90d-h
	60	124.3	7.4	1.3d-g	6.60b-e
	90	125.8	7.0	1.1fg	6.22b-g
	120	125.9	6.6	1.3e-g	6.82b-d
Haphazard row	0	118.5	7.8	1.8c-g	4.33i
	30	121.7	9.1	2.3cd	5.77e-h
	60	128.4	10.4	2.5bc	6.37b-f
	90	129.3	8.7	1.3d-g	6.36b-f
	120	129.6	9.7	1.8c-f	6.38b-f

Table 4: Effect of row arrangement and nitrogen level on reproductive characters, yield and yield components

Treatments	No. of effective tillers hill^{-1}	Panicle length (cm)	No. of grains Panicle^{-1}	Sterile spikelet Panicle^{-1}	Total spikelet Panicle^{-1}	Wt. of 1000 grains	Grain yield (t ha^{-1})	Biological yield(t ha^{-1})	Harvest Index(%)
Row arrangements									
Single row	7.6a	23.60	121.16a	25.9b	147.1a	21.78	4.42b	10.58b	41.85b
Double row	6.7b	24.50	117.12a	25.1b	142.2bc	21.68	5.24a	11.78a	44.81a
Triple row	5.3c	23.49	108.84c	29.5a	138.4c	21.16	4.00c	10.23c	39.64c
Haphazard row	7.2ab	23.87	116.29b	29.39a	145.6ab	21.76	4.23b	10.03c	42.21b
Nitrogen level (kg ha^{-1})									
0	5.5b	22.85	111.6c	21.80c	113.5d	21.37	4.07c	9.13d	44.54a
30	6.7a	24.65	113.7bc	24.58c	138.2c	21.76	4.45b	10.32c	42.97ab
60	7.0a	23.75	116.2ab	28.34b	144.5b	21.84	4.57ab	10.88b	42.00bc
90	7.1a	24.45	118.21a	29.66b	147.8b	21.52	4.58ab	11.08b	41.19bc
120	7.2a	23.60	119.45a	33.18a	152.6a	21.50	4.70a	11.75a	39.93c

Figures in a column having the same letter(s) do not differ significantly at 5% level

Number of non bearing tillers hill^{-1} and straw yield were varied due to interaction between row arrangement and nitrogen level (Table 3). The highest number of non bearing tillers hill^{-1} was found in single row system when the crop was treated with 120 kg N ha^{-1} followed by single row with 90 kg N ha^{-1} but the lowest one was recorded in triple row with control. Maximum straw yield was obtained from double arrangement when 120 kg N ha^{-1} was applied, but minimum straw yield was found in haphazard row with control.

Reproductive characters, yield and yield components were varied significantly ($P < 0.05$) by row arrangement. The highest number of effective tillers hill^{-1}, number of grains panicle^{-1}, number of total spikelets panicle^{-1} found in single row but the lowest one was in triple row arrangement (Table 4). The highest number of sterile spikelets panicle^{-1} was recorded in triple row which was statistically similar in haphazard row but the lowest sterile spikelets panicle^{-1} was found in double row arrangement.

The maximum grain yield was obtained in double row arrangement followed by single, triple and haphazard row system (Table 4). Reduction in the production of effective tillers hill^{-1} might have resulted in decreased grain yield. Although the higher number of effective tillers hill^{-1} was found in single row arrangement but in double row system total number of effective tillers per unit area might be high compare to single row for relatively wider spacing which was probably reasons of higher yield. Findings of the study that double row arrangement produced the highest grain yield are in agreement with this findings of many authors (Singh and Singh, 1980; Hossain *et al.*,1990; Paul *et al.*, 2002). The highest biological yield and harvest index were also found in double row arrangement followed by single, triple and haphazard row arrangement. In double row highest grain yield and straw yield were influenced higher the biological yield and harvest index.

Nitrogenous fertilizer also influenced on crop reproductive characters, yield and yield components. The highest number of effective tillers hill^{-1}, number of grains panicle^{-1} and grain yield were found when the crop was fertilized with 120 kg N ha^{-1} which was statistically identical when 60 and 90 kg N ha^{-1} applied (Table 4). Similar results were reported by Rahman *et al.* (1985), Pattel *et al.* (1987) and Kumar *et al.* (1996). But the sterile spikelets panicle^{-1}, total spikelets panicle^{-1} and biological yield showed a increasing trend when N level was increased and the highest one was found when 120 kg N ha^{-1} was applied. These findings were agreed with Ghosh *et al.* (1991). The highest biological yield was found when 120 kg N ha^{-1} was applied but lowest one in control. On the other hand the highest harvest index was obtained when the crop was not fertilized with nitrogen.

From the results it can be concluded that BRRI Dhan 32 should preferably be transplanted in double row arrangement and nitrogenous fertilizer should be used 60 kg N ha^{-1} to harvest a appreciable good yield.

References

Anonymous, 1981. Bangladesh Rice Research Institute. Annual Report for 1976-77. BRRI Pub. No. 39. Joydebpur, Gazipur, Bangladesh, pp: 2-42.

Ghosh, B.C., C.V. Raghavaian and M.K. Jana, 1991. Effect of seed level and nitrogen on growth and yield of direct sown rice *(Oryza sativa* L.) under intermadiate deep water condition. Indian J. Agron., 36: 227-228.

Golingai, S.A. and B.B. Mabbayad, 1969. Plant arrangement and spacing study on C4-63 and IR-8 (68) rice varieties. Phil. Agric., 52: 556-577.

Gomez, K.A. and A.A. Gomez, 1983. Statistical Procedure for Agricultural Research. Second Ed. Int. Rice Res. Inst., P.O. Box. 993, Manila, Philippines, pp: 139-153, 204-207.

Hossain, S.M.A., M.U. Salam and M.S. Islam, 1990. Effect of alternate row spacing on rice yield in relation to rice–fish culture. Intern. J. Trop. Agric., 6: 9-11.

Hossain, S.M. and U.C. Sharma, 1991. Response of rice to nitrogen fertilizer in acidic soil of Nagaland. Indian J. Agric. Sci., 61: 660-664.

Islam, A.F. M.S., A.R.M. Solaiman, M.I. Ali and M.R. Haider, 1988. Response of rice nutrients to N, P, S and Zn fertilizers. Bangladesh J. Nucl. Agric., 4: 47-54.

Khanda, C.M. and L. Dixit, 1996. Effect of zinc and nitrogen fertilization on yield and nutrient uptake of summer rice (*Oryza sativa*). Indian J. Agron., 41: 368-372.

Kumar, D.A. Swarup and V. Kumar, 1996. Influence of level and methods of N application on the yield and nutrient uptake of rice in a sodic soil. J. Indian Soc. Sci., 44: 259-263.

Pattel, Z.G., C.L. Pattel, A.G. Niar and R.B. Pattel, 1987. Nitrogen management in summer paddy. Gujarat. Agric. Univ. Res. J., 12: 1-3.

Paul, S.K., M.A.R. Sarkar and M. Ahmed, 2002. Effect of row arrangement and tiller separation on the yield and yield components of transplant aman rice. Pak. J. Agron., 1: 9-11.

Rahman, M.S., A.J. Miahand and M.A. Mansur, 1985. Agronomic performance of rice nutrients with varying N fertilizer doses and plant spacing. Bangladesh J. Nucl. Agric., 1: 59-64.

Ram, G.B., S. Joshi and V.S. Trimutry, 1984. Effect of nitrogen level and application time on direct sown rice. Intl. Rice Res. Newl., 9: 2.

Singh, M.L. and B.B. Singh, 1980. Response of deep water rice to nitrogen and its application. Indian J. Agron., 25: 536-537.

Singh, M.V., H.N. Tripathi and H.P. Tripathi, 1997. Effect of nitrogen and planting date on yield and quality of scented rice. Indian J. Agron., 42: 602-606.

Thompstone, 1953. Effect of Spacing on the yield component of rice. Agric. J. India., 10: 26-53.

Vachhani, M.V., 1961. Influence of spacing on plant characters and yield of transplant rice. Rice News Lett., 9:15-16.

Yamada, N., 1961. On relationship between yield and spacing in rice. Agric. Hort., 36: 13-18.