EFFECT OF DIFFERENT LEVEL OF NITROGEN ON GROWTH AND YIELD OF TRANSPLANT *AMAN* RICE cv BRRI dhan32

M. H. RAHMAN[1], M. H. ALI[2], M. M. ALI[3] and M. M. KHATUN[4]

[1]Scientific Officer, Hybrid Rice Project, [2]Principal Scientific Officer, Hybrid Rice Project, Bangladesh Rice Research Institute, Joydevpur, Gazipur-1703, [3]MS Student, Bangabandhu Sheikh Muzibur Rahman g icultural University, Gazipur-1706, [4]Scientific Officer, On Farm Research Division, Bangladesh Agricultural Research Institute, Rangpur, Bangladesh.

Accepted for publication: 15 December 2006

ABSTRACT

Rahman, M. H., Ali, M. H., Ali, M. M. and Khatun, M. M. 2007. *Effect of Different Level of Nitrogen on Growth and Yield of Transplant Aman Rice cv brri dhan32.* Int. J. Sustain. Crop Prod. 2(1): 28-34.

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during T. Aman season, 2002 to study the effect of different level of nitrogen on growth and yield of transplant *aman* rice. The experiment included four treatments viz. 0, 60, 80 and 100 kg N ha^{-1}. Nitrogen level significantly influenced growth and yield components. The highest number of effective tillers $hill^{-1}$ (9.20), maximum grains $panicle^{-1}$ (100.80) and highest grain yield (5.34 t ha^{-1}) were obtained with 80 kg N ha^{-1}. The highest straw yield (6.98 t ha^{-1}) was obtained at the highest nitrogen level (100 kg N ha^{-1}). The highest harvest index (44.50%) was observed at 80 kg N ha^{-1}. Results showed that 80 kg N ha^{-1} was optimum to produce maximum yield of transplant *aman* rice cv. BRRI dhan32.

Key words: Nitrogen, Growth, Yield and T. Aman rice

INTRODUCTION

Rice is the second most important crop next to wheat in terms of area in the world and about 40% of the World's population consumes rice as a major source of calorie (Banik 1999). Among the rice growing countries of the world, Bangladesh ranked third in respect of growing area and fourth in production (Huke and Huke 1999). The country produced 23.07 million metric tons rice in 10.71 million ha land, the food grain requirement of the country was 25 million metric tons (BBS, 2000).

Nitrogen is the key element in the production of rice and gives by far the largest response. It is also a fact that improper use of nitrogenous fertilizer, instead of giving yield advantage, may reduce the same. Again different varieties may have varying responses to N-fertilizer depending on their agronomic traits. Many workers have reported a significant response of rice to nitrogen in different soils in Bangladesh (Bhuiya *et al*. 1989, Hossain *et al.* 1989 and Islam *et al.* 1990).

For maximization of rice yield agronomic management is highly important. Among the management practices, soil fertilization, particularly nitrogen management is the most important. High yielding varieties are generally more adaptive to nitrogen application and they show increased yield with increasing nitrogen level up to a certain limit. Many workers at home and abroad investigated the response of nitrogen on rice growth for its successful production (Sarker and Ghatak 1988; Park 1987).

Therefore, the present study was undertaken to determine the suitable dose of nitrogen application for optimum growth and yield of transplant *aman* rice.

MATERIALS AND METHODS

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during T. A*man* season 2002. To determine the different level of nitrogen on the growth and yield of transplant *aman* rice plant height, tiller containing, data for Light Area Index (LAI) etc. were recorded on 30, 45, 60, 75 and 90 Days After Transplanting(DAT). The plot was ploughed well. Phosphorus, Potassium, Sulphur and Zinc fertilizer were applied as per recommendation of BRRI (1991). All the phosphatic, Potassic, Sulphur, Zinc and one third of Urea fertilizer were applied in each plot at the time of final land preparation and were mixed thoroughly with soil. The rest of the urea was top dressed in two equal splits. One at active tillering stage and the other at panicle initiation stage at 30 and 50 DAT respectively. The control plots received no nitrogen fertilizer. The experiment was conducted using randomized Complete Block Design (RCBD) with three replications. Thirty day old seedlings were transplanted on 22 July, 2002. The crop was harvested when 90% of the seeds became golden yellow in color. Grains were sun dried and moisture content of 14% was adjusted to estimate in grain yield.

LAI was measured by using the following formula:

$$LAI = \frac{\text{Sum of leaf area hill}^{-1} \text{ sampled hills}}{\text{Area of land covered by the sampled hills}} \text{ X } 100$$

Crop growth rate was measured using the following formula:

$$CGR = \frac{W_2 - W_1}{(T_2 - T_1)} \text{ g m}^{-2}\text{d}^{-1}$$

Where,

W_1= Dry matter production at the time T_1

W_2= Dry matter production at the time T_2

Relative growth rate was measured using the following formula:

$$RGR = \frac{1}{W} X \frac{dw}{d} = \frac{d}{dt\ (\log_e^{W})} \text{ g (g dry weight}^{-1}\text{day}^{-1}\text{)}$$

Where, W= The dry weight, $\frac{dw}{dt}$ = the change in the dry weight per unit time.

$$\text{Biological Yield} = \text{Grain yield} + \text{Straw yield}, \qquad \text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Straw yield}} \text{ X } 100$$

RESULTS AND DISCUSSION

Plant height

The highest plant height (121.40cm) was found with 100 kg N ha^{-1} at 90 DAT. The lowest (106.39cm) was obtained from control (0 kg N ha^{-1}) at all stages of crop growth. Higher dose of N increased plant height. It was observed that the use of increasing nitrogen level was found to increase in plant height (Fig.1). Similar trend of plant height due to different levels of nitrogen was obtained by Awan *et al*. (1984) and Oh *et al*. (1990)

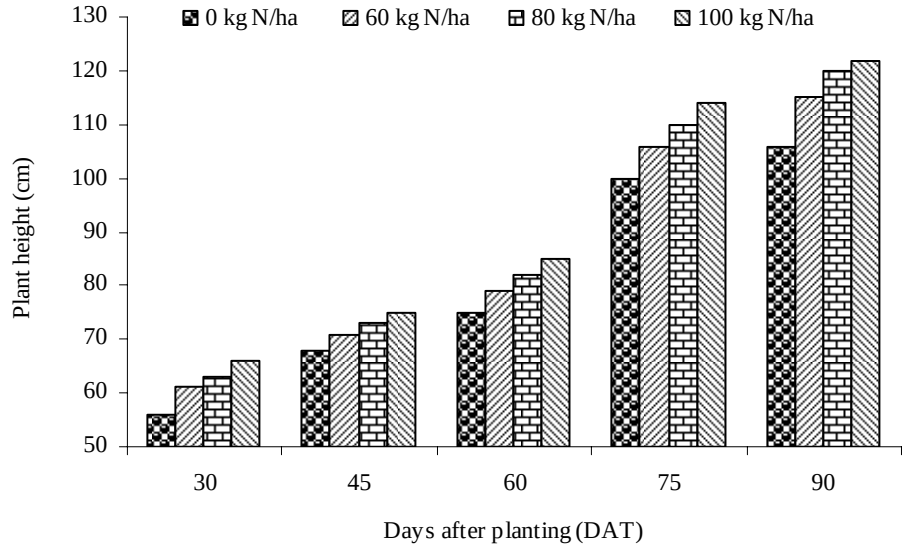

Fig.1 Effect of nitrogen level on plant height of transplant *aman* rice at different days after transplanting

Leaf area index (LAI)

The highest LAI value (4.46) was observed from 100 kg N ha^{-1} at 75 DAT (Table 1). The lowest LAI value was obtained from control (0 kg N ha^{-1}) at all sampling dates.

Table 1. Effect of nitrogen level on the leaf area index of transplant *aman* rice at different days after transplanting

Level of Nitrogen (kg ha-1)	Leaf area index of transplanting				
	30 Days	45 Days	60 Days	75 Days	90 Days
0	2.64	2.80	3.34	3.42	3.25
60	2.71	3.02	3.84	4.11	3.93
80	2.90	3.59	4.17	4.35	4.16
100	2.96	3.82	4.37	4.46	4.23

In the present experiment, a increasing trend LAI was found up to 75 DAT and decreased overall (90 DAT) LAI also increased with the increase of nitrogen levels. This might be due to the more vegetative growth in higher level of nitrogen application.

Total dry matter (TDM)

Total dry matter production was significantly influenced by different level of nitrogen DAT. The highest dry matter at 90 DAT was obtained (711.65 gm^{-1}) with 100 kg N ha^{-1} (Table 2). Total dry matter production increased due to nitrogen application at active tillering stage and panicle initiation stage.

Table 2. Effect of nitrogen level on the total dry matter production of transplant *aman* rice at different days after transplanting

Level of Nitrogen (kg ha-1)	Total dry matter production of transplant (gm-1)				
	30 Days	45 Days	60 Days	75 Days	90 Days
0	99.94	146.11	257.63	430.32	551.82
60	113.50	161.85	287.46	485.94	626.62
80	121.78	174.25	307.99	526.42	671.50
100	132.65	188.50	329.10	557.94	711.65

Crop growth rate (CGR)

The data revealed that the highest CGR (15.26 $gm^{-2}d^{-1}$) was produced when 100 kg N ha^{-1} was applied on DAT. The CGR values increased rapidly along with LAI up to 60-90 DAT and there after decreased markedly. CGR values increased with the increase in nitrogen level (Fig. 2). This result was in agreement with the findings of Thakur and Patel (1999).

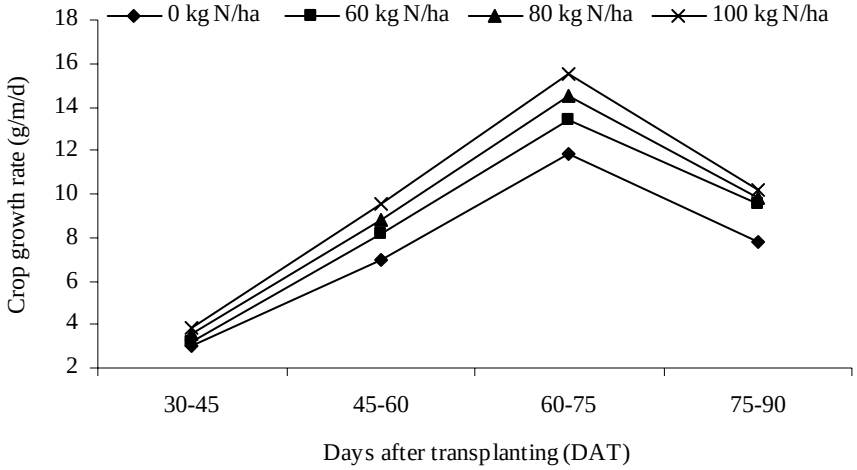

Fig. 2 Effect of nitrogen level on crop growth rate of transplant *aman* rice at different days after transplanting

Relative growth rate (RGR)

RGR was significantly influenced by nitrogen level at 30-45 DAT, 45-60 DAT and 75-90 DAT but insignificant at 60-75 DAT. The highest RGR (38.37 mg $g^{-1}d^{-1}$) at the early vegetative stage from 60 kg N ha^{-1} and trend similar in 80 kg ha^{-1} (38.11mg $g^{-1}d^{-1}$) at 45-60 DAT (Fig. 4).

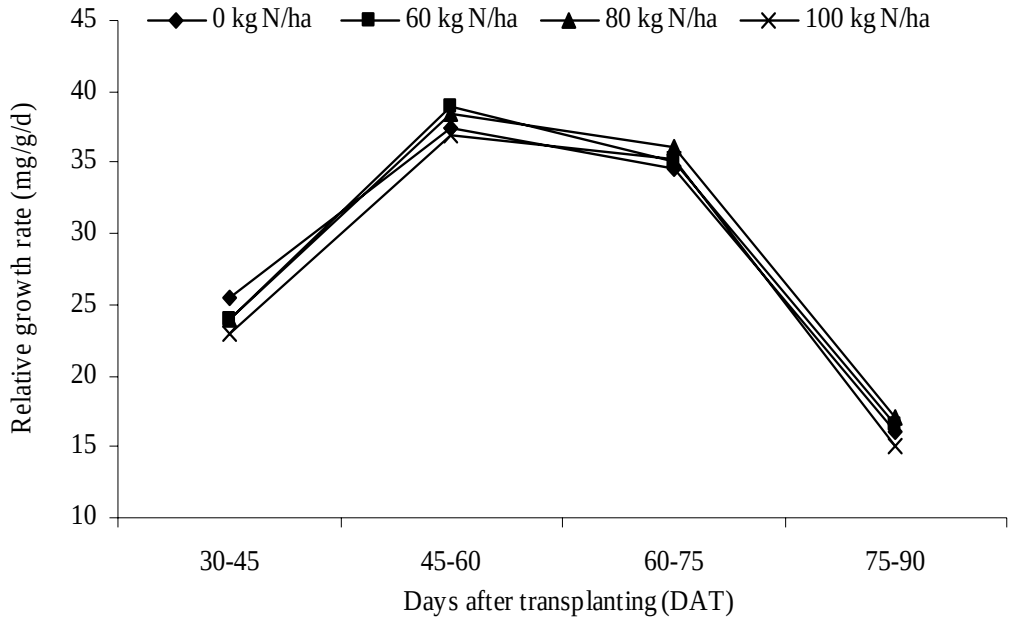

Fig. 3. Effect of nitrogen level on relative growth rate of transplant *aman* rice at different days after transplanting

Total number of tillers hill^{-1}

The maximum number of total tillers $hill^{-1}$ was produced at 100 kg N ha^{-1} (17.26) and the minimum number of total tillers $hill^{-1}$ (13.89) was produced at control at 60 DAT. However, a general trend was observed that the number of total tillers $hill^{-1}$ increased with the increased level nitrogen.

Table 2. Effect of nitrogen level on the plant characters, reproductive characters, yield and yield components of transplant aman rice at harvest.

Level of Nitrogen (kg ha^{-1})	Tillers $hill^{-1}$	Effective tillers $hill^{-1}$	Panicle Length (cm)	Spikelets $panicle^{-1}$	Grains $panicle^{-1}$	Sterile spikelets $panicle^{-1}$	1000-grain weight (g)	Harvest index (%)
0	13.89	6.76	19.00	104.09	93.66	10.43	20.87	42.65
60	14.78	7.97	19.34	107.40	98.05	9.34	21.45	43.29
80	16.31	9.02	20.24	110.90	100.80	10.10	21.97	44.50
100	17.26	8.74	19.81	110.96	99.31	11.65	21.94	42.32

Number of effective tillers hill^{-1}

The highest number of effective tillers $hill^{-1}$ (9.2) was produced with 80 kg N ha^{-1} which was statistically similar to 100 kg N ha^{-1} (8.74). The lowest number of effective tillers $hill^{-1}$ (6.76) was obtained from control (0 kg N ha^{-1}) (Table 2). Adequacy of nitrogen at 80 kg N ha^{-1} probably favoured the proper cellular activities during panicle formation and development, which led to increase number of effective tillers $hill^{-1}$.

Panicle length

The plant received no additional nitrogen fertilizer produced shortest panicle. The longest panicle (20.24cm) was found from 80 kg N ha^{-1} which was statistically similar to 100 kg N ha^{-1} (19.81cm) and the shortest panicle (19.00cm) was recorded from control (Table 2).

Number of total spikelets panicle^{-1}

The highest number of total spikelets $panicle^{-1}$(110.96) was observed at100 kg N ha^{-1} which was statistically similar to 80 kg N ha^{-1} (110.90) and the lowest number of total spikelets $panicle^{-1}$(104.09) was found when the crop was not fertilized with nitrogen (Table 2). Ghosh *et al*. (1991) found that increased level of N increased the number of total spikelets $panicle^{-1}$.

Number of grains panicle^{-1}

The highest number of grains $panicle^{-1}$ (100.80) was obtained from 80 kg N ha^{-1} which was statistically similar to 100 kg N ha^{-1} (99.31) and 60 kg N ha^{-1} (98.05). The lowest number of grains $panicle^{-1}$(93.66) was obtained from control (Table 2). The highest nitrogen level 100 kg N ha^{-1} produced lower number of grains $panicle^{-1}$ than 80 kg N ha^{-1}. Adequate supply of nitrogen contributed to grain formation which probably increased number of grains $panicle^{-1}$ with increasing nitrogen level.

Number of sterile spikelets panicle^{-1}

The maximum number of sterile spikelets $panicle^{-1}$ (11.65) was recorded with 100 kg N ha^{-1} which was statistically different with 80 kg N ha^{-1} (10.10). The minimum number of sterile spikelets $panicle^{-1}$(9.34) was produced at 60 kg N ha^{-1}.The results show that number of sterile spikelets $panicle^{-1}$ gradually increased with increased level of nitrogen (Table 2). The medium nitrogen level 60 kg N ha^{-1} produced the minimum sterile $panicle^{-1}$(9.34). Munda (1989) also agreed to this view.

Weight of 1000-grains

The maximum weight of 1000-grains (21.97 g) was obtained from 80 kg N ha^{-1} but was statistically similar to 100 kg N ha^{-1} (21.94 g) and the minimum (20.87 g) from control (0 kg N ha^{-1}) (Table 2). It is a genetical character and genetically fixed by an individual variety.

Harvest index

The experiment results show that the highest harvest index (44.50%) was obtained from 80 kg N ha^{-1} which was statistically similar to 60 kg N ha^{-1} (43.29%). The lowest harvest index (42.32%) was found in 100 kg N ha^{-1} which was statistically similar to control (42.65%) (Table 2). With increment of nitrogen fertilizer from 80 kg N ha^{-1} grain yield was increased but further increase in nitrogen level produced higher straw yield which ultimately gave the lower harvest index.

Grain yield

The highest grain yield (5.34 t ha^{-1}) was obtained from 80 kg N ha^{-1} which was statistically similar to 100 kg N ha^{-1} (5.12 t ha^{-1}) and the lowest one (4.11 t ha^{-1}) was obtained from control. The application of nitrogen up to 80 kg N ha^{-1} registered an increased grain yield. But, further increment of nitrogen level had no positive influence on grain yield. Increase in grain yield due to application of nitrogen was mainly due to improvement of yield contributing characters like number of effective tillers $hill^{-1}$, panicle length and number of grains $panicle^{-1}$ (Fig. 4).

Straw yield

The straw yield (6.98 t ha^{-1}) was obtained from 100 kg N ha^{-1}. The lowest straw yield (5.52 t ha^{-1}) was produced in control treatment. Nitrogen influenced vegetative growth in terms of plant height and number of tiller $hill^{-1}$ which resulted in increase straw yield (Fig. 4). Similar trend of straw yield was also reported by Srivastava *et al*. (1987), Kanda and Dixit (1996).

Biological yield

The highest biological yield (12.10 t ha^{-1}) was produced by 100 kg N ha^{-1} which was statistically similar to that produced by 80 kg N ha^{-1} (11.98 t ha^{-1}). The lowest biological yield (9.63 t ha^{-1}) was produced by control. Nitrogen level positively influenced grain yield and straw yield that is turn increased biological yield (Fig. 4).

The experiment showed that nitrogen level had significant effect on all growth parameters. Nitrogen level significantly influenced growth and yield components except RGR. Based on the results might be concluded that the transplant *aman* rice (cv. BRRI dhan32) grown under 80 kg N ha^{-1} showed better performance.

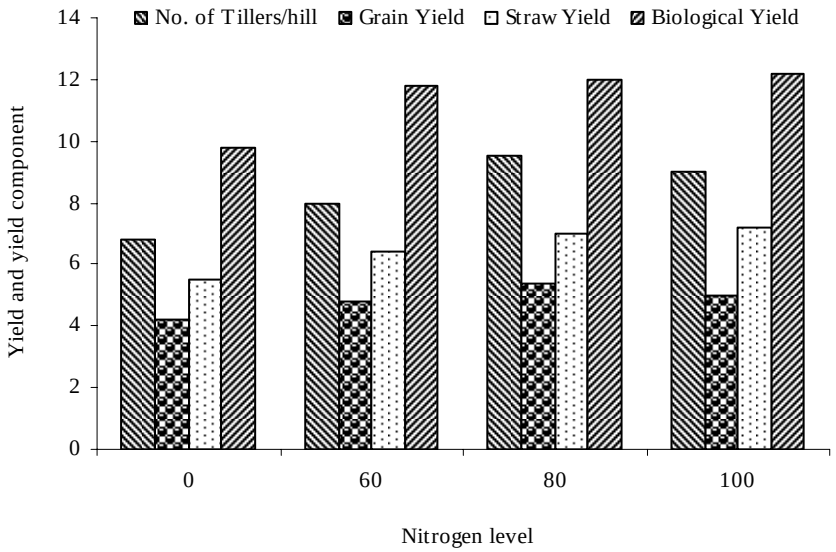

Fig. 4. Effect of nitrogen level on yield and yield component of transplant *aman* rice at harvest

REFFERENCES

Awan, I.U.; H.K. Ahmed, and S.U.D. Gandapur,. 1984. Effect of different nitrogen applications on rice grain yield. Intl. Rice Res. Newsl., 9 (6): 26.

Banik, P. 1999. Cold Injury Problems in Boro Rice. In Proc. of the Workshop on Modern Rice Cultivation in Bangladesh. Bangladesh Rice Res. Inst. Joydebpur, Gazipur, Bangladesh. 14-16 February. P.37.

BBS, 2000. The Year Book of Agricultural Statistics of Bangladesh. Stat. Div. Ministry. Plan., Govt. Peoples Rep. Bangladesh. Dhaka pp.123-127.

Bhuiya, M.S.U., S.M.A. Hossain and S.K.G Kabir. 1989.Nitrogen Fertilizer in rice cv. BR10 after green manuring. Bangladesh J. Agril. Sci., 16 (1): 87-92.

BRRI, 1991. Adhonik Dhan Chas (in Bangla). Bangladesh Rice Research Institute, BRRI Pub. 5: 26.

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

Hossain, A.; R. Islam and N.A. Miah. 1989. Response of rice of sulphur and zinc fertilizer. Bangladesh J. Agril. Sci., 16 (1): 131-134.

Huke R.E. and E.H. Huke, 1999. Rice: Then and Now. Intl. Rice Res. Inst.Los Banos, Laguna, Philippines. P. 108.

Islam, M.R., M.S. Hoque and Z.H. Bhaiya. 1990. Effect of nitrogen and sulphur fertilizer on yield response and nitrogen and sulphur composition of rice. Bangladesh J. Agril. Sci., 17 (2): 299-302.

Kanda 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 (3): 368-372.

Munda, G.C. 1989. Effect of nitrogen and phosphorus on rice growth and yield under upland condition of Japan Annals of Agril. Res. 14 (4): 415-419.

Oh, Y.B., J.K. Ahr, R.K. Park, and S.H. Park. 1990. Effect of nitrogen application method on the growth and grain yield of rice plant. Rice. 32 (1):16-20.

Park, S.T. 1987. Biological yield and harvest index relation to major cultivation methods in rice plant. Effect of nitrogen application on biological yield and harvest index. Research Reports of the Rural Development Administration, Crops. Kore a Republic. 29 (2): 92-106.

Sarker, R.K. and S. Ghatak.1988. Growth analysis and agronomic appraisal of Indian rape under nitrogen application. Ind. J. Agron. 32 (i): 63-69.

Srivastava, S.R.; J.R. Singh and B.R. Chandrawanshi. 1987. Nitrogen management for increasing N efficiency in transplanted rice. Intl. Rice Res. Newsl. 12: 4-51.

Thakur, D.S. and S.R. Patel. 1999. Growth and sink potential of rice as influenced by the split application of potassium with FYM in inceptisols of eastern centeral India J. of potassium Res. Madhya Pradesh, India. Pp. 73-77.