J. Agrofor. Environ. 3 (2): 39-42, 2010 ISSN 1995-6983

Effect of nitrogen application on green leaf production and seed quality of BRRIdhan 30

M.A.I. Khan[1], M. Ahmed[2], N.C. Sutradhar[3], Z. Alam[4] and M.E. Haque[5]
[1]Controller of Examination Section, BAU, [2]Department of Agronomy, BAU,
[3]Padakhep Manabik Unnayan Kendra, [4]Establishment Section, BAU, Mymensingh and [5]Department of Agriculture Extension, Khamarbari, Dhaka

Abstract: An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh and Crop Physiology Departmental Laboratory, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during June, 2002 to April, 2003 to investigate the effect of nitrogen application on green leaf production and seed quality of BRRI dhan 30. The split plot experiment included three different nitrogen application levels viz. low level of nitrogen @ 20 kg ha^{-1} (N_1), standard level of nitrogen @ 40 kg ha^{-1} (N_2) and high level of nitrogen @ 60 kg ha^{-1} (N_3). The result revealed that yield and yield contributing characters decreased considerably by different levels of nitrogen application. Plant height at harvest, effective tillers hill^{-1}, seeds panicle^{-1}, seed yield, straw yield and harvest index were significantly highest obtained with the highest level of nitrogen (N_3). The shortest plant height and the lowest number of seed panicle^{-1} were produced with the lowest level of nitrogen (N_1). Weight of 1000 seeds, green and dry leaf production varied significantly but vigour index, protein content (%) was not significantly affected by different levels of nitrogen. The highest production of green leaves 4.22 t ha^{-1} and grain yield 4.04 t ha^{-1} was produced by the application of highest level of nitrogen @ 60 kg ha^{-1} (N_3).

Key words: Nitrogen application, green leaf, seed quality and BRRIdhan 30.

Introduction

Crop yield depends on many factors, such as, light, water and nutrient. Nitrogen fertilizer is the key input for rice production. An increase in yield by 70-80% may be obtained by the application of nitrogen fertilizer (IFC, 1982). The introduction of high yielding rice varieties greatly increased the prospect of getting higher yields but these cannot be achieved without balanced fertilizer application, especially nitrogen. Moreover, the soil of Bangladesh is not properly enriched with different nutrients required for the growth and development of the plants. Besides, along with other elements, nitrogen is being exhausted in many ways in the field. Hence, application of nitrogen is essential for the proper growth of crops including rice. But the most appropriate level of nitrogen fertilizer is a major concern affecting both economic viability of the crop production and the impact of agriculture on the environment. The standard level of nitrogen for rice crop may vary due to the changing system of agro-technology, for example, if some levels of a rice plants are clipped; a considerable quantity of nitrogen may be drained out along with the cut leaves. Afterwards, when regrowth starts, there might be some deficiency of nitrogen in the rice plants, which might not true in normal case. At vegetative stage, the leaf may be cut in order to use as animal feed and further allowed for regrowth and finally at maturity it could be harvested for seed. To overcome the scarcity of food cum forage crop like rice seems to be one of the most feasible and economically viable practices to serve the needs of human, cash income and animal feed, particularly for those has limited resources (Topark-Ngram *et al.*, 1988). If clipping has no effect on seed quality, it may become one of the most economical ways to use rice as multipurpose crop. But the success of rice cultivation as multipurpose crop is mostly dependent on clipping frequency without affecting seed quantity and quality. Therefore, it is important to determine the effect of clipping frequency on the way of multipurpose use of rice crop. In Bangladesh very scattered and sporadic attempts have been made in this regards. The present study was, therefore undertaken to determine the standard levels of nitrogen fertilizer on green leaf production, yield and yield contributing characters and quality of seeds of transplanted aman rice and to find out the possibility of using green leaves as animal fodder.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh and Crop Physiology Departmental Laboratory, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during June, 2002 to April, 2003 to investigate the effect of nitrogen application on green leaf production and seed quality of BRRI dhan 30. The split plot experiment included three different nitrogen application levels viz. low level of nitrogen @ 20 kg ha^{-1} (N_1), standard level of nitrogen @ 40 kg ha^{-1} (N_2) and high level of nitrogen @ 60 kg ha^{-1} (N_3). The experimental field was a medium high, well drained; silt loam soil belongs to the Sonatala soil series under Old Brahmaputra Floodplain (AEZ-9). The land was fertilized with 20, 35, 11 and 2.3 kg ha^{-1} in the form of triple super phosphate, muriate of potash, gypsum and zinc sulphate respectively (BRRI, 1999). Whole amount of all fertilizers excluding urea was applied at the time of final land preparation. Urea was equally top dressed at 15, 30 and 45 days after transplanting (DAT). Thirty days old seedlings were transplanted maintaining three seedlings hill^{-1} with 25x15cm spacing. Intercultural operations were applied when necessary. Five hills (excluding border hills) from each plot were randomly selected and tagged just after transplanting for measuring necessary data at 15 days intervals beginning from 30 DAT and continued up to 90 DAT. Before harvesting 5 prefix hills were uprooted and properly tagged for recording of necessary data. After harvesting, threshing and drying data of each plot were also recorded separately from crop of each plot. The recorded data were compiled, tabulated and adjusted the mean differences among the treatment as per Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

Pre-harvest observations; Plant height: The effect of different levels of nitrogen was found significant in respect of plant height in all the observations (Table 1). At

30 DAT, the tallest plant (39.08 cm) was recorded from the highest rate of nitrogen (N_3) and the shortest plant (35.90 cm) was recorded from the lowest rate of nitrogen (N_1) which was statistically identical to standard rate of nitrogen (N_2). At 45 DAT, the tallest plant (59.02 cm) was recorded from the highest rate of nitrogen (N_3) and the shortest plant (54.22 cm) was found in the lowest rate of nitrogen (N_1). The similar trend of plant height was also found at 60 DAT to 90 DAT respectively. The result showed that there was gradual decrease in the height of the plant with lower levels of nitrogen. Reddy *et al.* (1988) found similar results that plant height was significantly affected by increasing nitrogen application.

Number of tillers hill^{-1}: Significant different was observed in the production of tillers hill^{-1} in respect of different levels of nitrogen application. At 30 DAT, the highest number of tillers hill^{-1}(9.90) was observed from high rate of nitrogen (N_3) which was statistically similar to standard rate of nitrogen (N_2) and the lowest (8.13) from low rate of nitrogen(N_1). At 45 DAT, the highest number of tillers hill^{-1}(14.57) was obtained from (N_3) and the lowest (11.83) from (N_1). At 60, 75 and 90 DAT, numerically the highest number of tillers hill^{-1}(15.49) was recorded from the high rate of nitrogen (N_3) and the lowest from the low rate of nitrogen (N_1) (Table 1). Wagh and Throat (1988) also reported that increasing rate of nitrogen increased number of tillers hill^{-1}.

Number of green leaves hill^{-1}: Significant effect was observed on production of green leaves hill^{-1} at different levels of nitrogen (Table 2). At 30 DAT, the highest number of green leaves hill^{-1}(27.48) was recorded from high rate of nitrogen (N_3) which was statistically identical to standard rate of nitrogen (N_2) and the lowest (23.82) was recorded from low rate of nitrogen(N_1). At 45 DAT, the highest number of green leaves hill^{-1}(55.47) was produced from high rate of nitrogen (N_3) and the lowest (49.62) from the low rate of nitrogen (N_1). At 60, 75 and 90 DAT, numerically the highest and the lowest number of green leaves hill^{-1} were produced with high and low rate of nitrogen respectively. Reddy *et al.* (1985) observed a similar trend that leaves plant^{-1} was increased significantly with the increased nitrogen application.

Number of dead leaves hill^{-1}: Different levels of nitrogen influenced the rate of senescence of leaves which was reflected by the number of dead leaves^{-1} at all the sampling dates except 45 DAT. At 30 DAT, the maximum number of dead leaves hill^{-1}(2.77) was recorded from high rate of nitrogen (N_3) and the lowest (2.53) from low rate of nitrogen (N_1) but it was statistically similar to standard rate of nitrogen (N_2). Similar trend also found at 60 and 75 DAT. At 90 DAT, maximum number of dead leaves hill^{-1} (3.47) was obtained from low rate of nitrogen and minimum number of dead leaves hill^{-1} (3.27) was found from standard rate of nitrogen (Table 2).

Green leaf production: Green leaf production was significantly influenced by different levels of nitrogen. The highest (4.22 t ha^{-1}) green leaf production was recorded in high level of nitrogen and the lowest green leaf production (2.48 t ha^{-1}) was obtained from low level of nitrogen (Table 2). Reddy *et al.* (1985) observed a similar trend that leaves plant^{-1} was increased significantly with the increased nitrogen application.

Dry leaf production: The highest dry leaf production (0.52 t ha^{-1}) and the lowest (0.25 t ha^{-1}) with high level of nitrogen and low level of nitrogen, respectively. The results indicated that nitrogen level had profound effect on green leaf production as well as its dry weight (Table 2).

Table1. Effect of different levels of nitrogen on plant height (cm) and number of tillers hill^{-1} of transplant BRRIdhan30 at different days after transplanting (DAT)

Level of nitrogen (Kg N ha^{-1})	Plant height (cm)					Number of tillers hill^{-1}				
	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT
Low level (N_1)	35.90b	54.22c	69.63c	79.67b	97.88b	8.13b	11.83c	11.20b	10.92b	10.32b
Standard level (N_2)	36.68b	56.65b	71.48b	82.70ab	102.57a	9.30a	13.15b	12.10b	11.77ab	11.03ab
High level (N_3)	39.08a	59.02a	73.33a	83.60a	103.96a	9.90a	14.57a	13.38a	12.97a	11.92a
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sx	0.282	0.204	0.226	0.501	0.345	0.111	0.106	0.172	0.214	0.154
CV (%)	2.63	1.25	1.10	1.12	1.18	4.25	1.80	4.89	6.26	4.83

In a column, figures having similar letter (s) or without letter (s) do not differ significantly, whereas figures bearing dissimilar letter (s) differ significantly as per DMRT.

Table2. Effect of different levels of nitrogen on number of green leaves hill^{-1}, dead leaves hill^{-1}, green leaf and dry leaf production (t ha^{-1}) of transplant BRRIdhan 30 at different days after transplanting (DAT)

Level of nitrogen (Kg N ha^{-1})	Number of green leaves hill^{-1}					Number of dead leaves hill^{-1}					Green leaf production (t ha^{-1})	Dry leaf production (t ha^{-1})
	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT		
Low level (N_1)	23.82b	49.62c	48.13c	47.08c	45.57c	2.53a	3.59	3.46a	3.40a	3.24ab	2.48c	0.25c
Standard level (N_2)	25.95a	53.05b	51.47b	50.13b	49.16b	2.61a	3.68	3.51a	3.45a	3.21b	3.27b	0.41b
High level (N_3)	27.48a	55.47a	54.08a	52.90a	51.62a	2.77a	3.83	3.72a	3.67a	3.47a	4.22a	0.52a
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	NS	0.05	0.01	0.01	0.01	0.01
Sx	0.279	0.253	0.225	0.223	0.337	0.050	-	0.067	0.053	0.039	0.084	0.015
CV (%)	3.76	1.26	1.25	1.55	2.40	6.60	6.27	6.59	5.28	4.19	8.77	13.46

In a column, figures having similar letter (s) or without letter (s) do not differ significantly, whereas figures bearing dissimilar letter (s) differ significantly as per DMRT, NS= Not Significant

Post-harvest observations; Plant height: Significant variation in plant height was recorded due to nitrogen levels. The highest level of nitrogen produced the tallest plant (102.5 cm) and the lowest level of nitrogen produced the shortest plant (96.60 cm) which was identically followed by standard level of nitrogen. Similar results were also reported by Talukder (1973) who noted that plant height increased with increasing rate of urea as nitrogen (Table 3).

Number of effective tillers hill^{-1}: Nitrogen had a significant effect on number of effective tillers hill^{-1}. The highest number of effective tillers hill^{-1}(12.73) was produced by high rate of nitrogen and the lowest number of effective tillers hill^{-1}(10.13) was produced by the low rate of nitrogen (Table 3). Singh and Arya (1992) reported similar results; they stated that the increasing rate of nitrogen up to 130 kg/hac increased number of effective tillers hill^{-1}.

Number of non-effective tillers hill^{-1}: There was a significant effect of different levels of nitrogen on non-effective tillers hill^{-1}. It was observed that lowest rate of nitrogen produced the highest (2.81) number of non-effective tillers hill^{-1} and lowest number of non-effective tillers hill^{-1} was produced in high rate of nitrogen (2.37) and (2.59) was produced by standard rate of nitrogen that statistically similar to low and high rate of nitrogen (Table 3).

Panicle length: Although there was a great difference in panicle length, yet the effect recorded were not significant due to different levels of nitrogen. The longest panicle length (23.37 cm) was observed in high rate and the shortest (21.46 cm) was in low rate of nitrogen (Table 3).

Table3. Effect of different levels of nitrogen on yield and yield contributing characters of transplant BRRIdhan 30

Level of nitrogen (Kg N ha^{-1})	Plant height (cm)	Effective tillers hill^{-1}	Non effective tillers hill^{-1}	Panicle length (cm)	Seeds panicle^{-1}	Sterile spikelets panicle^{-1}	Weight of 1000-seeds (gm)	Biological yield (t ha^{-1})	Harvest index (%)
Low level (N_1)	96.60b	10.13c	2.81a	21.46c	101.39c	36.75ad	21.18b	8.17c	38.98
Standard level (N_2)	100.84a	11.44b	2.59ab	22.43b	103.32b	34.71b	22.18a	8.85b	41.01
High level (N_3)	102.5a	12.73a	2.37b	23.37a	104.47a	33.72b	22.67a	9.66a	41.20
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	NS
Sx	0.394	0.114	0.057	0.142	0.180	0.194	0.152	0.105	-
CV (%)	1.37	3.45	7.73	2.21	0.61	1.92	2.40	4.09	6.50

In a column, figures having similar letter (s) or without letter (s) do not differ significantly, whereas figures bearing dissimilar letter (s) differ significantly as per DMRT, NS= Not Significant

Number of seeds panicle^{-1}: There was a significant effect of different levels of nitrogen on the number of seeds panicle^{-1}. It was observed (Table 3) that the highest rate of nitrogen produced the highest number of seeds panicle^{-1}(104.47) that was followed by standard rate of nitrogen. The lowest number of seeds panicle^{-1}(101.39) was produced by the lowest rate of nitrogen. The vegetative growth of the plant was increased by the application of high rate of nitrogen. Carbohydrate assimilation was increased due to the maximum photosynthesis from maximum vegetative growth of the plant. As a result, the number of seeds panicle^{-1}was highest due to the high rate of nitrogen.

Number of sterile spikelets panicle^{-1}: Number of sterile spikelets panicle^{-1} varied significantly due to nitrogen. Number of sterile spikelets panicle^{-1} were 36.75, 34.71 and 33.72 panicle^{-1} for the highest rate, standard rate and the lowest rate of nitrogen application respectively (Table 3). The highest number of sterile spikelets panicle^{-1} was produced by the highest rate of nitrogen (N_3) which was statistically similar to standard rate of nitrogen application (N_2).

Weight of 1000-seeds: There was a significant effect of different levels of nitrogen on weight of 1000-seeds. The highest weight of 1000-seeds (22.67 gm) was produced with high rate of nitrogen (N_3) which was statistically similar to standard rate of nitrogen application (N_2) (22.18 gm) and the lowest (21.18 gm) was produced by low rate of nitrogen (N_1).

Table 4. Effect of different levels of nitrogen on the seed and straw yield in BRRIdhan 3o at harvest

Level of nitrogen (Kg N ha^{-1})	Seed yield (t ha^{-1})	Straw yield (t ha^{-1})
Low level (N_1)	3.19c	4.98b
Standard level (N_2)	3.64b	5.22ab
High level (N_3)	4.04a	5.63a
Level of significance	0.01	0.05
$S\bar{x}$	0.047	0.091
CV (%)	4.56	6.00

In a column, figures having similar letter (s) or without letter (s) do not differ significantly, whereas figures bearing dissimilar letter (s) differ significantly as per DMRT. NS= Not Significant

Seed yield: Significant variations were found in seed yield for nitrogen application (Table 4). The highest seed yield (4.04 t ha^{-1}) was obtained from the highest rate of nitrogen (N_3) and the lowest seed yield (3.19 t ha^{-1}) was obtained from the lowest rate of nitrogen (N_1). Similar results were reported by Idris and Matin (1990) where seed yield increased with an increase in nitrogen application up to maximum 120 kg ha^{-1}.

Straw yield: Straw yield varied significantly due to nitrogen. The highest straw yield was observed (5.63 t ha^{-1}) from the highest rate of nitrogen that was statistically similar to standard rate of nitrogen. Standard and lower rate of nitrogen produced 5.22 and 4.98 t straw ha^{-1} respectively which was statistically similar (Table 4).

Biological yield: Different level of nitrogen showed a significant influence on biological yield (Table 3). The highest biological yield (9.66 t ha^{-1}) was recorded on no high rate of nitrogen (N_3) and the lowest biological yield (8.17 t ha^{-1}) on low rate of nitrogen (N_1).

Harvest index: Harvest index was not significantly affected by different level of nitrogen (Table 3). However, the highest harvest index (41.20%) was observed in high rate of nitrogen (N_3) and the lowest (38.98%) was observed in low rate of nitrogen (N_1).

Seed quality observations; Germination percentage: Germination percentage was significantly affected by different levels of nitrogen. The highest germination percentage 90.78% was found in the highest rate on nitrogen (N_3) and the lowest 89.57% was found in lowest rate of nitrogen (Table 5).

Vigour index: Different levels of nitrogen had no significant effect on vigour index. The highest vigour index 29.36% was found in the standard rate of nitrogen (N_2) and the lowest 28.59% in the highest rate of nitrogen (Table 5).

Seed protein content percentage: Protein content percentage of seed was not significantly affected by different levels of nitrogen. Result revealed that protein content was maximum (7.76%) in standard rate of nitrogen (N_2) and the minimum (7.58%) was recorded in high rate of nitrogen (N_3) (Table 5).

Table 5. Effect of different levels of nitrogen on the germination percentage, vigour index and protein content percentage in BRRIdhan 30

Level of nitrogen (Kg N ha^{-1})	Germination (%)	Vigour index	Protein content (%)
Low level (N_1)	89.57a	28.73	7.69
Standard level (N_2)	90.51a	29.36	7.76
High level (N_3)	90.78a	28.59	7.58
Level of significance	0.05	NS	NS
$S\bar{x}$	0.315	-	-
CV (%)	1.21	6.80	3.18

In a column, figures having similar letter (s) or without letter (s) do not differ significantly, whereas figures bearing dissimilar letter (s) differ significantly as per DMRT. NS= Not Significant.

From the experiment, it may be concluded that during aman season when entire fields of Bangladesh is covered by transplant aman rice as well as severe crisis for want of green leaf and straw prevail for our livestock, it is possible to obtain 4.22 t ha^{-1} green leaf and grain yield 4.04 t ha^{-1} and also better seed quality from transplanted aman rice cv. BRRI dhan 30 from the application of nitrogen @ 60 kg ha^{-1}.

References

BRRI (Bangladesh Rice Research Institute). 1999. Adhunik Dhaner Chash (in bangoli), 9th Edn. Pub. No. 5, Bangladesh Rice Research Inst., Joydebpur, Gazipur. p. 21-27.

Gomez, K.A. and Gomez, A.A. 1984. Duncan's Multiple Range Test. Statistical Procedures for Agricultural Research. 2nd Edi., A Willey-Interscience Publication, John and Sons, New York. Pp. 202-215.

Idris, M. and Matin, M.A. 1990. Response of four exotic strains of aman rice to urea. Bangladesh J. Agril. Sci. 17(2): 271-275.

IFC (International Fertilizer Correspondent). 1982. FAO/FAIC working partly on the economics of fertilizer use. 23(1):7-10.

Reddy, J.V., Singh, J.N. and Verma, A.K. 1985. Effect of time of nitrogen application on growth and yield of rice (*Oryza sativa* L.). Agric. Sci. Digest. India. 5:83-85.

Reddy, M.D., Panda, M.M., Ghosh, B.C. and Reddy, B.B. 1988. Effect of nitrogen fertilizer on yield and nitrogen concentration in grain straw yield of rice under semi deep water condition. J. Agric. Sci. United Kingdom. 110(1):53-59.

Singh, R.V. and Ayra, M.P.S. 1992. Effect of enriched farmyard manure and fertility level on yield of Japanese barnyard millet under rainfed condition. Indian J. Agron. 38(2): 223-226.

Talukder, M.N.I. 1973. Effect of nitrogen on the yield and other characteristics of 3 varieties of rice (IR-8-288-3, IRRATOM 24 and IRRATOM 38). M Sc Thesis, Dept. of Soil Sci., Bangladesh Agric. Univ., Mymensingh. pp. 31-33.

Topark-Ngram, A., Armada, E.C., Tengco, P.L. and Carangal, V.P. 1988. Food + Forage inter cropping under upland condition. Proceeding of the Crop-Animal workshop. 15-19, August, 1988. Serdang, Malaysia.

Wagh, R.G. and Throat, S.T. 1988. Response of Rice (*Oryza sativa* L.) variety R24 to different types of coastal soils. J. Indian Soc. Coastal Agril. Res. 43(1):33, 1990.