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Morphological Characteristics and Yield Components of Rapeseed in Response to Different Nitrogen and Boron Levels

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Abstract: The experiment was conducted at the Horticulture Farm of Sher-e-Bangla Agricultural University, Bangladesh September 2011 to February 2012 to examine the response of nitrogen and boron on growth, yield attributes and yield of rapeseed cv. BARI Sarisha- 14. The experiment consisted four levels of nitrogen (N_0: 0, N_1: 60, N_2: 120 and N_3: 180 kg N/ha) and three levels of boron (B_0: 0, B_1: 1 and B_2: 2 kg/ha) using randomized complete block design (RCBD) with 3 replications. The maximum plant height, number of leaves, number of primary branches, length of inflorescence, number of siliquae, seed weight of 100 siliquae, seed yield plant^{-1}, seed yield ha^{-1} was found from N_2 (87.5 cm, 23.4 plant^{-1}, 6.7 plant^{-1}, 33.7 cm, 26.1 plant^{-1}, 10.7 g, 5.4 g, 1.5 t, respectively) for nitrogen levels; B_2 (83.7 cm, 22.7 4 plant^{-1}, 6.0 plant^{-1}, 33.4 cm, 25.4 plant^{-1}, 10.4 g, 5.2 g, 1.5 t, respectively) for boron levels and N_2B_2 (88.9 cm, 26.9 4 plant^{-1}, 7.4 plant^{-1}, 35.7 cm, 27.5 plant^{-1}, 11.9 g, 6.5 g, 1.8 t, respectively) for combinations. From growth and yield point of view, it is apparent that the combination of N_2P_2 was suitable for rapeseed cultivation.

Key words: Brassica campestris · Growth · Yield · N and B

INTRODUCTION

Rapeseed (*Brassica campestris* L.) is the major oilseed crop in Bangladesh. Nitrogen nutrition of this crop is important to its productivity; optimum requirement of this major nutrient is relatively high and has been shown to vary from soil to soil. Both growth and yield of rapeseed are enhanced significantly by doses of nitrogen fertilizer. Nitrogen supports the plant with rapid growth, increasing seed and fruit production and yield of mustard [1-5]. In addition, the deficiency of N causes stunted or slow growth, slender fibrous stems and the classic yellowing of the leaves which reduces the seed yield of crops including mustard [6]. Separately, excessive use of N increases the vegetative growth thus food production may be impaired and delayed maturity [7]. Boron is required by plants in small quantities that involve several physiological and biochemical processes in plants [8-11]. Seed set failure is a major reason for lower yield of Rabi crops and this problem can be attributed to B deficiency, as reported in mustard [12, 13]. Considering above point, current study has been undertaken to investigate the growth and yield of rapeseed variety BARI sarisha with different levels of nitrogen and boron.

MATERIALS AND METHODS

An experiment was carried out at Sher-e-Bangla Agricultural University Farm, Dhaka-1207, Bangladesh from September 2011 to February 2012 to study the response of nitrogen and boron on growth, yield and yield attributes of rapeseed cv. BARI Sarisha- 14. Seed was collected from the Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. Before sowing germination test was done in the laboratory and percentage of germination was over 95%.

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The recommended doses of TSP, MP, Gypsum and $ZnSO_4$ were added to the soil of experimental field along with different levels of Nitrogen (N) and Boron (B). However any N or B fertilizers were not applied to control plot. Experiment consisted four levels of nitrogen viz. N_0 = 0 kg N/ha, N_1 = 60 kg N/ha, N_2 = 120 kg N/ha, N_3 = 180 kg N/ha and three levels of boron viz. B_0 = 0 kg B/ha, B_1 = 1 kg B/ha and B_2 =2 kg B/ha using Randomized Complete Block Design (RCBD) with 3 replications. The unit plot area was 3 m x 1.5 m and distance between blocks was 1 m and plots were 0.5 m, while plant spacing was 30 cm X 5 cm. TSP (160 kg/ha), MP (110 kg/ha), Gypsum (160 kg/ha) and $ZnSO_4$ (7.5 kg/ha) were applied. Half of urea and total amount of all other fertilizers of each plot were applied and incorporated into soil during final land preparation. Rest of the urea was top dressed after 30 days of sowing (DAS). Sowing was done in rows 30 cm apart @ 8 kg/ha. As a preventive measure of aphid infestation, Malathion 57 EC @ 2 ml/L of water was applied twice first at 25 DAS and second at 50 DAS. The seeds were separated from the plants by beating the bundles with bamboo sticks on threshing floor. Seeds and stovers thus collected were dried in the sun for couple of days. Dried seeds and stovers of each plot was weighed and subsequently converted into yield kg/ha. Ten (10) plants from each plot were selected as random and were tagged for the data collection. The sample plants were uprooted prior to harvest and dried properly in the sun. The seed yield and stover yield per plot were recorded after cleaning and drying those properly in the sun. Data were collected on plant height (cm), leaves plant^{-1}, primary branches plant^{-1}, secondary branches plant^{-1}, length of main inflorescence (cm), siliquae on the main inflorescence, seed weight of 100 siliquae (g), yield (t/ha) and harvest index (%). Collected data were statistically analyzed using MSTAT-C computer package programme and difference between treatments was assessed by Least Significant Difference (LSD) test at 5% level of significance [14].

RESULTS AND DISCUSSION

Plant Height: Different levels of N influenced the height of rapeseed plant significantly. The tallest plant was recorded with N_2 (87.46 cm) while shortest from N_0 (74.2 cm) at 60 DAS (Fig. 1a). These findings are in agreement with those of Singh *et al*. [15], Tripathi and Tripathi [16]. Similar findings were reported by Tomar *et al.* [17], Ali and Ullah [18], Shamsuddin *et al.* [19], Ali and Rahman [20]; Hassan and Rahman [21]. Plant height increased with increasing levels of boron up to higher level. The tallest plant was found from B_2 (83.7 cm), while the shortest from B_0 (80.5 cm) at 60 DAS (Fig. 1b). These results suggested that B has no contribution to elongation of the axis of the plant during growth period. These results are in agreement with the findings of Moniruzzaman *et al.* [22], who reported that B failed to increase plant height of broccoli. The combined use of N and B had significant effect on plant height. The tallest plant was found in N_2B_2 (88.9 cm), whereas the shortest from N_0B_0 (72.9 cm) at 60 DAS (Fig. 2). Plant height was increased significantly with successive increase in nitrogen up to 120 kg/ha [23]. The N increased plant height but B could not show any effect on plant height of rapeseed separately. All together these results indicated that plant height of rapeseed was increased with combined use of nitrogen and boron.

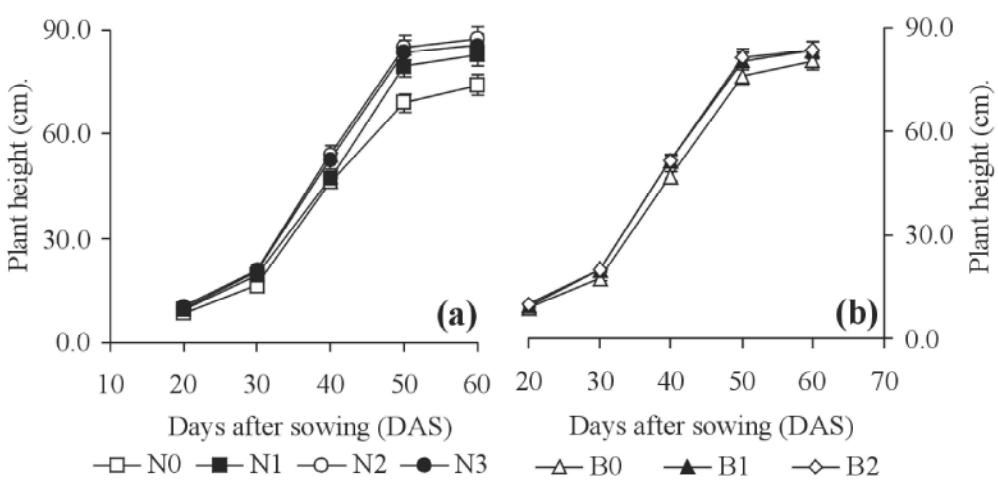

Fig 1: Plant height responses of rapeseed to different (a) N levels and (b) B levels at different DAS

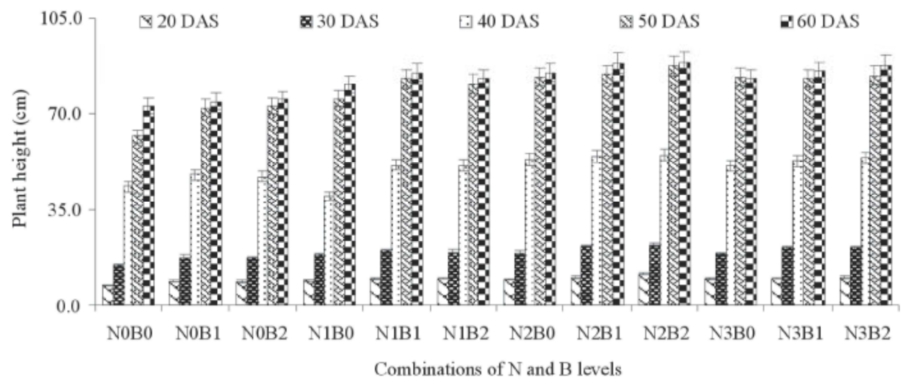

Fig 2: Interaction effect of N and B on the height of rapeseed plant at different days after sowing (DAS)
Here; N_0 = without nitrogen, N_1 = 60 kg N /ha, N_2 = 120 kg N/ha, N_3 = 180 kg N/ha, B_0= without boron, B_1= 1 kg B/ha, B_2= 2 kg B/ha

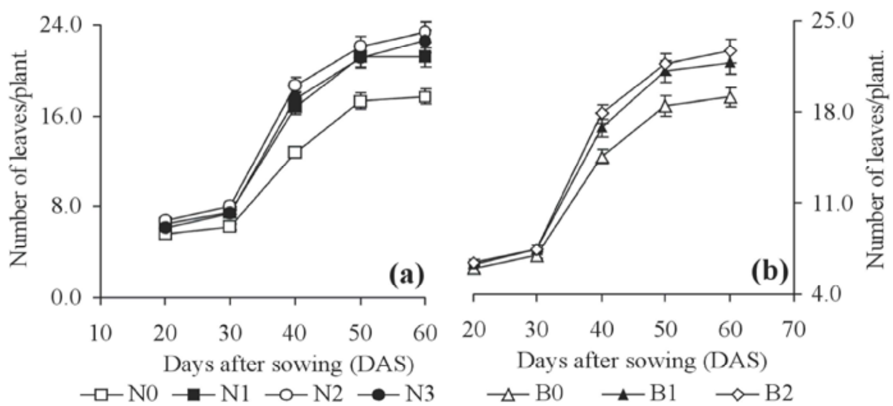

Fig 3: Responses of number of leaves of rapeseed to different (a) N levels and (b) B levels at different DAS

Number of Leaves: A good number of leaves indicated better growth and development of crop. It is also possibly related to the yield of rapeseed. The greater number of leaf, the greater the photosynthetic area which may result higher seed yield. The N showed significant variation in the number of leaves. The maximum numbers of leaves were found from N_2 (23.4/plant), while the minimum from N_0 (17.7/plant) at 60 DAS (Fig. 3a). These indicated that the number of leaves/plant was increased with increasing N levels; those are consistent with Patil *et al.* [24] findings. The highest number of leaves was found from B_2 (22.7/palnt) while lowest from B_0 (19.1/plant) at 60 DAS (Fig. 3b). So, B has important role on increasing number of rapeseed leaves. Significant variation in the number of leaves was found among the different combinations of the N and B levels. The maximum number of leaves was found from N_2B_2 (26.9/plant), while the minimum from N_0B_0 (17.7/plant) at 60 DAS (Fig. 4). These results indicated that the combined use of N along with B can increase leaf number as well as leaf area of rapeseed plant.

Number of Primary Branches: The maximum number of primary branches was found from N_2 (6.7/plant), while the minimum from N_0 (4.2/plant) at 60 DAS (Fig. 5a). N fertilizer application had no significant effect on number of primary branches per plant of rapeseed [25] and the highest number of branches/plant with 120 kg N ha^{-1} [26, 17, 18]. Altogether, it suggested that N involve in initiating primary branches by sprouting lateral buds of rapeseed plants. The highest number of branches was obtained from B_2 (6.0/plant) and lowest from B_0 (5.4/plant) at 60 DAS. It was observed that with the increase of B, number of branches per plant also increase a certain level. The interaction between N and B was found significant on number of primary branches. The maximum number of branches was found in N_2B_2 (7.4/plant), whereas the lowest in N_0B_0 (3.7/plant) at 60 DAS. Significant effect of nitrogen on number of primary branches/plant [27] and the result of this study suggested that N and B form together primary branches of rapeseed plants.

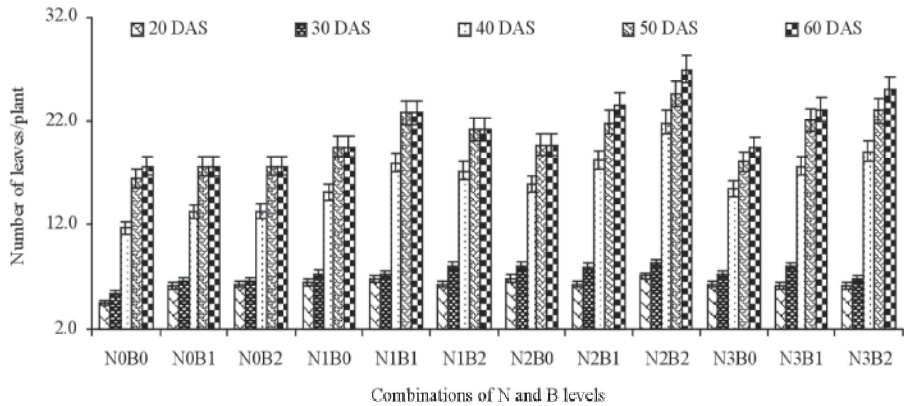

Fig 4: Interaction effect of N and B on number of leaves of rapeseed at different days after sowing (DAS)
Here; N_0 = without nitrogen, N_1 = 60 kg N /ha, N_2 = 120 kg N/ha, N_3 = 180 kg N/ha, B_0= without boron, B_1= 1 kg B/ha, B_2= 2 kg B/ha

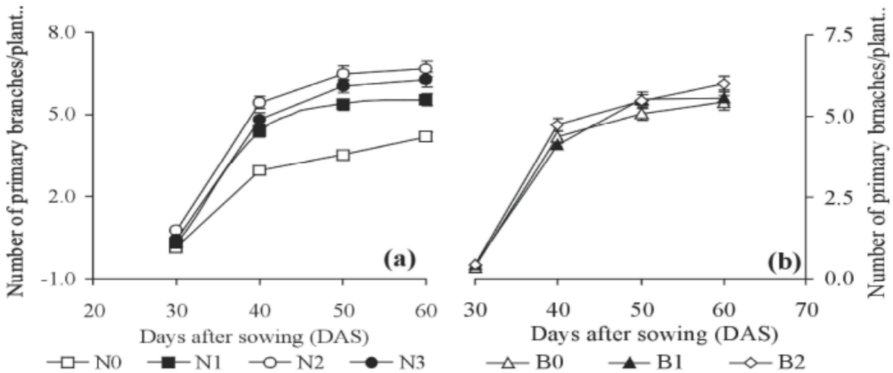

Fig 5: Responses of number of primary branches of rapeseed to different (a) N levels and (b) B levels at different DAS

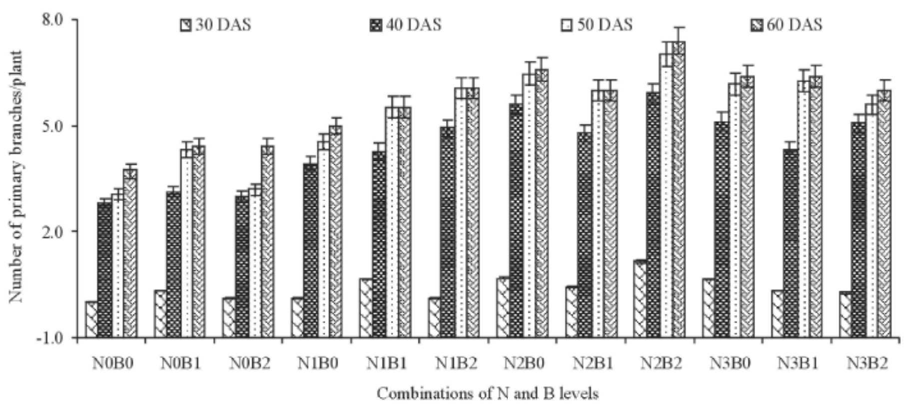

Fig 6: Interaction effect of N and B on number of primary branches of rapeseed at different days after sowing (DAS)
Here; N_0 = without nitrogen, N_1 = 60 kg N /ha, N_2 = 120 kg N/ha, N_3 = 180 kg N/ha, B_0= without boron, B_1= 1 kg B/ha, B_2= 2 kg B/ha

Length of Inflorescence: The longest inflorescence was found from N_2 (33.7 cm) which was statistically identical with N1 (33.3 cm), while the shortest from N_0 (30.9 cm) at 80 DAS (Fig. 7a). There was no significant difference among the B treatments in the length of inflorescence. However, the longest inflorescence was found from B_2 (33.4 cm) followed by B_1 (32.7 cm), whereas the shortest from B_0 (31.1 cm) at 80 DAS (Fig. 7b). The longest inflorescence was found from N_2B_2 (35.7 cm), whereas the shortest from N_0B_0 (30.0 cm) at 80 DAS (Fig. 8).

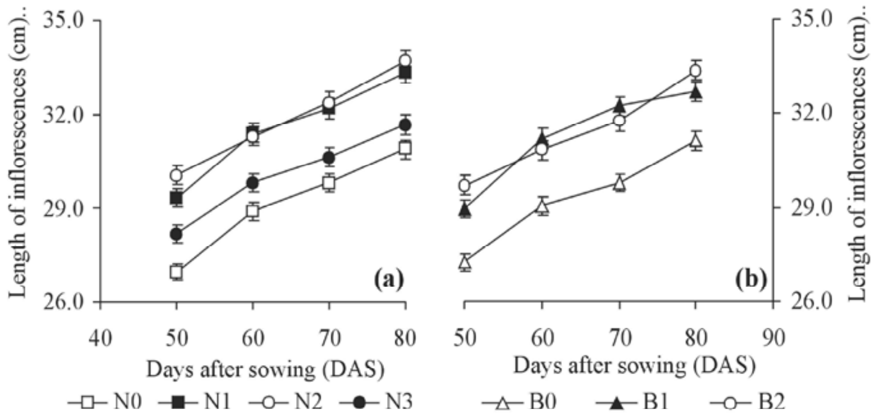

Fig 7: Responses of length of inflorescences of rapeseed to different (a) N levels and (b) B levels at different DAS

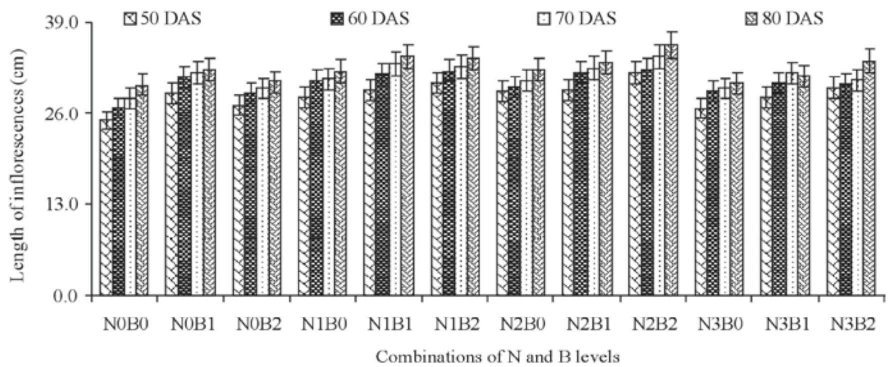

Fig 8: Interaction effect of N and B on length of inflorescences of rapeseed at different days after sowing (DAS)

Here; N_0 = without nitrogen, N_1 = 60 kg N /ha, N_2 = 120 kg N/ha, N_3 = 180 kg N/ha, B_0 = without boron, B_1 = 1 kg B/ha, B_2 = 2 kg B/ha

Number of Siliquae: Number of siliquae plant^{-1} is one of the most important yield contributing characters in rapeseed. N levels, B levels and their combinations showed significant variation in number of siliquae plant^{-1}. The maximum number of siliquae was found from N_2 (26.1 plant^{-1}), while N_0 produced the minimum number of siliquae (22.2 plant^{-1}) (Table 1). Similar result also obtained by Shukla *et al.* [2, 28], Shing *et al.* [15] on rapeseed. The maximum number of siliquae was produced in B_2 (25.4 plant^{-1}), while the minimum in B_0 (22.8 plant^{-1}) (Table 2). These results are in conformity with those obtained by Islam and Sharker [29]; Dutta and Uddin [30]; Dutta *et al.* [31], who have observed increased number of siliquae plant^{-1} of rapeseed by increasing rate of B. The maximum number of siliquae was found in N_2B_2 (27.5 plant^{-1}), whereas the minimum from N_0B_0 (20.6 plant^{-1}) (Table 3).

Seed Weight of 100 Siliquae: N levels, B levels and their combinations showed significant variation in the seed weight of 100 siliquae. The maximum seed weight of 100 siliquae was found from N_2 (10.7 g) which was statistically similar with N_1 and N_3, whereas the minimum from N_0 (8.2 g) (Table 1). The maximum seed weight of 100 siliquae was found in B_2 (10.4g) which was statistically identical with B_1, while the minimum was produced in B_0 (9.0 g) (Table 2). The maximum seed weight of 100 siliquae was found in N_2B_2 (11.9 g) whereas minimum from N_0B_0 (6.8 g) (Table 3). These results indicated that the combined use of N and B has strong role on increasing the seed weight of 100 siliquae other than N and B along.

Seed Yield: N levels, B levels and their combinations showed significant variation in seed yield plant^{-1}. The maximum seed yield was found from N_2 (5.4 g plant^{-1} and 1.5 tha^{-1}) which was statistically similar with N_1 and N_3, whereas the minimum from N_0 (3.1 g plant^{-1} and 1.0 tha^{-1}) (Table 1). Seed yield was increased with increasing rates of N fertilizer up to 120 kg/ha and then declined. Higher seed weight plant^{-1} was also obtained with the same N rate as reported by Singh *et al.* [32],

Table 1: The effect of N on yield contributing character and yield of rapeseed [X]

N levels [Y]	Siliquae $plant^{-1}$		Seed weight of 100 siliquae (g)		Seed yield (g $plant^{-1}$)		Seed yield (t/ha)		Harvest index (%)	
N_0	22.2	b	8.2	b	3.1	b	1.0	b	48.7	b
N_1	23.5	ab	10.5	a	4.3	a	1.2	ab	50.8	b
N_2	26.1	a	10.7	a	5.4	a	1.5	a	55.2	a
N_3	24.7	ab	9.9	a	4.8	a	1.4	ab	52.6	ab
$LSD_{(0.05)}$	3.3		1.1		1.1		0.4		4.0	
CV (%)	8.9		14.3		10.1		11.7		8.1	

[X] In a column means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability
[Y] N_0 = without nitrogen, N_1 = 60 kg N /ha, N_2 = 120 kg N/ha, N_3 = 180 kg N/ha, B_0= without boron, B_1= 1 kg B/ha, B_2= 2 kg B/ha

Table 2: The effect of B on yield contributing character and yield of rapeseed [X]

B levels [Y]	Siliquae $plant^{-1}$		Seed weight of 1 00 siliquae (g)		Seed yield (g $plant^{-1}$)		Seed yield (t/ha)		Harvest index (%)	
B_0	22.8	b	9.0	b	3.6	b	1.0	b	50.6	b
B_1	24.2	ab	10.1	a	4.5	ab	1.3	ab	51.9	ab
B_2	25.4	a	10.4	a	5.2	a	1.5	a	53.0	a
$LSD_{(0.05)}$	2.1		1.0		1.5		0.1		2.2	
CV (%)	8.9		14.3		10.1		11.7		8.1	

[X] In a column means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability
[Y] N_0 = without nitrogen, N_1 = 60 kg N /ha, N_2 = 120 kg N/ha, N_3 = 180 kg N/ha, B_0= without boron, B_1= 1 kg B/ha, B_2= 2 kg B/ha

Table 3: Interaction effect of N and B on yield contributing characters, yield and harvest index of rapeseed [X]

N and B combinations [Y]	Siliquae $plant^{-1}$		Seed weight of 100 siliquae (g)		Seed yield (g $plant^{-1}$)		Seed yield (t/ha)		Harvest Index (%)	
N_0B_0	20.6	d	6.8	c	2.0	d	0.9	f	46.3	b
N_0B_1	22.8	bcd	8.6	bc	3.5	cd	1.0	f	49.5	ab
N_0B_2	23.3	abcd	9.3	abc	3.9	c	1.1	ef	50.4	ab
N_1B_0	20.8	cd	10.8	ab	3.6	cd	1.0	f	51.3	ab
N_1B_1	24.8	abc	11.0	ab	4.7	bc	1.3	cde	50.6	ab
N_1B_2	24.9	abc	9.6	ab	4.7	bc	1.4	bcd	50.3	ab
N_2B_0	26.5	ab	9.4	abc	4.8	abc	1.2	def	53.3	ab
N_2B_1	24.3	abcd	10.7	ab	4.9	abc	1.5	abc	54.9	a
N_2B_2	27.5	a	11.9	a	6.5	a	1.8	a	57.5	a
N_3B_0	23.3	bcd	8.8	bc	3.8	c	1.0	ef	51.6	ab
N_3B_1	24.7	abc	10.2	ab	4.9	abc	1.5	bcd	52.6	ab
N_3B_2	26.0	ab	10.7	ab	5.7	ab	1.6	ab	53.7	ab
$LSD_{(0.05)}$	3.6		2.4		1.5		0.3		7.0	
CV (%)	8.9	f	14.3	b	10.1		11.7		8.1	

[X] In a column means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability
[Y] N_0 = without nitrogen, N_1 = 60 kg N /ha, N_2 = 120 kg N/ha, N_3 = 180 kg N/ha, B_0= without boron, B_1= 1 kg B/ha, B_2= 2 kg B/ha

Tateja *et al.* [33]. Further increase in N level beyond 120 kg/ha could not improve the seed yield. These results are consistent with the N-induced increase of growth parameters (Fig. 1a, 3a, 5a and 7a) along with number of siliquae $plant^{-1}$, seed weight of 100 siliquae and seed weight $plant^{-1}$ (Table 1). The higher seed yield/ha was also obtained with the same N rate reported by Sing and Prasad [34], Singh *et al*. [15], Shukla *et al*. [2, 28]. Therefore, N can enhance the seed yield (t/ha) of rapeseed variety BARI sarisha 14. The maximum seed yield was found in B_2 (5.2 g $plant^{-1}$ and 1.5 tha^{-1}), while the minimum from B_0 (3.6 g $plant^{-1}$ and 1.0 tha^{-1}) (Table 2). Similarly, Islam and Sarkar [29] reported that application of B increased significantly number of siliquae $plant^{-1}$, number of seeds $siliqua^{-1}$ and seed weight of rapeseed. This result showed that the yield of mustard increased gradually with the higher doses of B fertilizer. Sakal *et al.* [35], Sinha *et al.* [36], Banuels *et al.* [37] obtained a similar result by applying 1 to 2 kg B/ha. Malewar *et al.* [38] found that seed yield significantly increased with each levels of B. Interestingly, this result is consistent with the B-induced increase of growth parameters (Fig. 1b, 3b, 5b and 7b) along with number of siliquae $plant^{-1}$, seed weight of 100 siliquae and seed weight $plant^{-1}$ (Table 2).

Therefore, higher dose of B can increase seed yield of rapeseed. Maximum seed weight was found in N_2B_2 (6.5 g plant^{-1} and 1.8 tha^{-1}) whereas minimum from N_0B_0 (2.0 g plant^{-1} and 0.9 tha^{-1}) (Table 3).

Harvest Index: N levels, B levels and their combinations had significant effect on the harvest index of mustard. The maximum harvest index was found from N_2 (55.2 %), while the minimum from N_0 (48.7 %) (Table 1). Shrivastava *et al.* [39] found a similar result in their experiment. The highest harvest index was obtained from B_2 (53.0 %), while the minimum from B_0 (50.6 %) (Table 2). The highest harvest index was obtained from N_2B_2 (57.5 %), whereas the lowest from N_0B_0 (46.3 %) (Table 3).

CONCLUSION

Growth and seed yield contributing parameters of rapeseed are related with N and B application. Combined use of 120 kg N/ha and 2 kg B/ha along with recommended doses of other fertilizer would be beneficial to increase the seed yield of rapeseed variety BARI sarisha 14 under the climatic condition of Sher-e-Bangla Agricultural University, Dhaka.

REFERENCES

1. Sinha, S., R.L. Nayak and B. Mitra, 2003. Effect of different levels of nitrogen on the growth of rapeseed under irrigated and rainfed conditions. Env. Ecol., 21(4): 741-743.
2. Shukla, R.K., A. Kumar, B.S. Mahapatra, B. Kandpal, A. Kumar and B. Kandpal, 2002 a. Integrated nutrient management practices in relation to morphological and physiological determinants of seed yield in Indian mustard (Brassica juncea). Indian J. Agric. Sci., 72(11): 670-672.
3. Meena, B.S., G.L. Sarma. and R.P. Sharma, 2002. Effect of nitrogen, irrigation and interculture on yield attributes and yield of mustard (Brassica juncea L. Czern and Coss). Res. Crops, 3(1): 37-39.
4. Zhao, F.J., P.J.A. Withers, E.J. Evans, S.E. Monaghan, P.R. Shewry and S.P. Mogarth, 1997. Nitrogen nutrition and important factor for the quality of wheat and rapeseed. Soil Sci. Plant Nutr., 43: 1137-1142.
5. Allen, E.J. and D.G. Morgan, 2009. A quantitative analysis of the effects of nitrogen on the growth, development and yield of oilseed rape. J. Agric. Sci., 78: 315-324.
6. Ozer, H., 2003. Sowing date and nitrogen rates effect on growth, yield and yield components of two summer rapeseed cultivars. European J. Agron., 19(3): 453-463.
7. Singh, K., B.P. Singh, A.L. Bhola and T.P. Yadava, 1972. Effect of sowing F time and nitrogen application on varieties of Indian mustard (Brassica juncea) under irrigated conditions in Haryana. Indian J. Agric. Sci., 42(7): 601-603.
8. Marschner, H., 1995. Mineral Nutrition of Higher Plants, 2nd Edition, pp: 379-396. Academic press, San Diego.
9. Gupta, U.C., 1993. Sources of boron. In: Gupta UC, (Ed.) Boron and its Role in Crop Production 87-104. CRP Press, Florida, USA.
10. Katyal, J.C. and B. Singh, 1983. Availability of boron in the soil and its uptake by rice as influenced by soil moisture regimes. Oryza, 29: 384-387.
11. Marcus-Wyner, L. and D.W. Rains, 1982. Nutritional disorders of cotton plants. Communication in Soil Science and Plant Analysis, 13: 685-736.
12. Rahman, A., M.I. Ali and M. Jahiruddin, 1993. Response of two mustard varieties to added sulphur and boron in Old Bralimaputra Flood Plain Soil. Bangladesh J. Nucl. Agric., 9: 25-28.
13. Islam, M.R., T.M. Riasat and M. Jahiruddin, 1997. Direct and residual of S, Zn and B on yield and nutrient uptake in a rice- mustard cropping system. J. Indian Soc. Soil Sci., 45: 126-129.
14. Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. 2nd edn. John Wiley and Sons. New York: 680.
15. Singh, O.K., Kedar Prasad and K. Prasad, 2003. Effect of row spacings, nitrogen levels and basis of N application on yield attributes and yield of mustard. Crop Research Hisar. C. S. Azad University of Agriculture & Technology, Kanpur, India, 25(3): 427-430.
16. Tripathi, A.K. and H.N. Tripathi, 2003. Influence of nitrogen levels on growth, yield and quality of Indian mustard. Farm-Science-Journal. C.S. Azad University of Agriculture & Technology, Kanpur, India, 12(1): 7 1-72.
17. Tomer, R.K.S. and R. Mishra, 1991. Influence of sowing dates and nitrogen on the yield of mustard (Brassica juncea). J. Oilseed Res., 8: 210-214.
18. Ali, M.H. and M.J. Ullah, 1995. Effect of different levels and methods of nitrogen application on growth and yield of rapeseed (Brassica campestris L.) Ann. Bangladesh Agric., 5(2): 115-120.

19. Shamsuddin, A.M., M.A. Islam and S.M. Asaduzzaman, 1987. Effect of nitrogen on yield and yield contributing characters of mustard at different levels. Bangladesh J. Agric. Sci., 14(2): 165-167.
20. Ali, M.H. and A.M. Rahman, 1986. Response of nitrogen in TS-72 (Kalynia) cultivar of Brassica campestris. Bangladesh J. Agric., 11(3): 85-86.
21. Hassan, A.A. and A. Rahman, 1987. Effect of various combinations of water supplies and nitrogen rates on growth and yield of mustard. Thai. J. Agric. Sci., 20: 17-35.
22. Moniruzzaman, M.S., M.L. Rahman, M.G. Kibria, M.A. Rahman and M.M. Hossain, 2007. Effect of boron and nitrogen on yield and hollow stem of broccoli. Journal of. Soil and Nature, 1(3): 24-29.
23. Singh, D., K.K. Jain and S.K. Sharma, 2004. Quality and nutrient uptake in mustard as influenced by levels of nitrogen and sulphur. J. of Maharashtra Agricultural Universities, 29(1): 87-88.
24. Patil, B.N., K.C. Lakkineni and S.C. Bhargava, 1997. Ontogenic changes in growth and assimilate distribution as influenced by nitrogen supply in rapeseed. J. Agron. Crop Sci., 178(1): 15-21.
25. Mondol, M.R.A. and M.A. Gaffer, 1983. Effect of different levels of nitrogen and phosphates on yield and yield contributing characters of mustard. Bangladesh J. Agric. Res., 8(1): 37-93.
26. Tomar, R.K.S., S.C. Chouraria, J.S. Raghu and V.B. Sing, 1996. Growth, yield and net returns of mustard under different levels of nitrogen and sulphur application on clay loam soils. J. Oilseed Res., 10(1): 13-17.
27. Murtuza, M.G. and N.K. Paul, 1989. The effect of nitrogen fertilizer on seed yield in three rape seed (Brassica campestris L.) cultivars. Bangladesh J. Agron., 14(2): 163-168.
28. Shukla, R.K., A. Kumar, B.S. Mahapatra, K. Basanth, A. Kumar and B. Kandpal, 2002 b. Response of promising varieties of rapeseed (Brassica napus) to nitrogen and phosphorus fertilizer on the Tarai region of Uttaranchal. Ann. Agril. Res., 23(4): 630-633.
29. Islam, M.B. and M.A.Z. Sarker, 1993. Effect of different level of boron on the yield of mustard. Research Report 1992-93. OFRD, BARI, Rangpur.
30. Dutta, R.K. and M. Uddin, 1983. A study on the growth and physiology of mustard in relation to boron supply. In Proc. Of the 8th Bangladesh Sci. Conf Dhaka, Bangladesh. Bangladesh Assoc. Advan. Sci., pp: 101.
31. Dutta, R.K., M. Uddin and L. Rahman, 1984. Productivity of mungbean, rice and mustard in relation to boron in Brahmaputra Floodplain soils. Bangladesh J. Soil Sci., 20: 77-83.
32. Singh, R.P., Y. Singh and Y. Singh, 1998. Performance of rainfed Indian mustard (Brassica juncea) varieties at varying levels of nitrogen. Indian J. Agron., 43(4): 709-712.
33. Tateja, S.S., R. Lakpale and R.S. Tripathi, 1996. Effect of date of sowing, nitrogen levels and nitrogen splitting on mustard (Brassica juncea). Adv.Plant Sci., 9(1): 167-168.
34. Singh, G.K. and K. Prosad, 2003. Studies on the effect of raw spacing and nitrogen doses on the yield and profit from Indian mustard. Progress. Agric., 3(1/2): 146-147.
35. Sakal, R., A.P. Singh, R.B. Sinha and N.S. Bhogal, 1991. Relative susceptibility of some important varieties of sesamum and mustard to boron deficiency in calcareous soil. Fertilizer News. Rajendra Agricultural University, Pusa 848125, Bihar, India., 36(3): 43-49.
36. Sinha, B., A.P. Singh, R. Sakal and N.S. Bhogal, 1991. Response of some field crops to boron application in calcareous soils. J. Indian Soil Sci., 39(1): 118-122.
37. Banuels, G.S., D.W. Meek and G.J. Hoffman, 1990. The influence of Selenium, salinity and boron on selenium uptake in wild mustard. Plant and soil, 127(2): 201-206.
38. Malewar, G.U., S.D. Kate, S.L. Waikar and S. Ismail, 2001. Interaction effects of zinc and boron on yield, nutrient uptake and quality of mustard. Journal of the Indian Society of Soil Science. Marathwada Agricultural University, Parbhani, Maharashtra, India, 49(4): 763-765.
39. Shrivastava, O.K., S.S. Tomar and G.S. Tomar, 1988. Effect of nitrogen and irrigation schedule on the harvest index of mustard. Research and Development Report, 5: 1-2.