Short communication

DETERMINATION OF OPTIMUM DOSE AND TIME OF FOLIAR APPLICATION OF BORON FOR INCREASING YIELD OF BRINJAL

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Abstract

A field experiment was carried out at Bangladesh Institute of Nuclear Agriculture (BINA) sub-station farm, Magura during Rabi season of 2020-21. The objective of the experiment was to determine the optimum dose and time of foliar application of Boron. The treatments were viz., 0.5g B L^{-1} .H_2O at vegetative stage, 1.0g B L^{-1}.H_2O at vegetative stage, 0.5g B L^{-1}.H_2O at vegetative stage + g B L^{-1}.H_2O at Fruiting stage, 1.0g B L^{-1}.H_2O at vegetative stage + 1.0 g B L^{-1}.H_2O at Fruiting stage, 1.5g B L^{-1}.H_2O at vegetative stage, 1.5g B L^{-1} L.H_2O at vegetative stage + 1.5g B L^{-1}. H_2O at Fruiting stage, 2.0g B L^{-1}.H_2O at vegetative stage, 2.0g B L^{-1}.H_2O at vegetative stage + 2.0g B L^{-1}.H_2O at Fruiting stage and control. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The Plot size of the experiment was 3m × 2m. Various parameters were influenced significantly by different concentrations of boron except for plant height. Maximum number of branches (5.07 $plant^{-1}$), number of fruits (25.67 $plant^{-1}$), fruit length (11.47 cm), single fruit weight (185.80g) and fruit yield 5.33 kg $plant^{-1}$ and 10.66 t ha^{-1}) were found from foliar application of boron with 1.0g B L^{-1}.H_2O at the vegetative stage and 1.0g B L^{-1}. H_2O at the fruiting stage while minimum from control. The study suggested that foliar application of boron with 1.0g B L^{-1}.H_2O at the vegetative stage and 1.0g B L^{-1}.H_2O at the fruiting stage could be recommended to get maximum yield of brinjal.

Key words: Brinjal, foliar boron, dose, time, yield

Brinjal (*Solanum melongena* L.) is considered to be the king of vegetables, also known as eggplants are the second most important solanaceous fruit crop in the genus *Solanum*. Eggplant is known as one of the ten sources of the world's healthiest food which is also described as the best species cultivated worldwide (Bliss and Elstein, 2004; Caguiat and Hautea, 2014). The brinjal is of much importance in the warm areas of far East, being grown extensively in India, Bangladesh, Pakistan, China, and the Philippines. Brinjal is an important solanaceous crop of tropics and sub-tropics. It is native to southern India and widely grown in America, Europe and Asia (Gotame *et al*., 2020). It is a perennial plant native to the Indian sub- continent and grown in many tropical and semi tropical regions as a popular vegetable all around the year. Brinjal has been a staple vegetable in many tropical countries since ancient times. It contains 124 IU of vitamins A, 12 mg of vitamin C, 18 mg of calcium and 47mg of phosphorus, 0.9mg of iron, 1.4g of protein, 4g of carbohydrates and 92.7g of moisture per 100g of edible portion. Apart from trios, it also has some medicinal properties (Chaudhary, 1996).

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Brinjal, or eggplant (*Solanum melongena* L.), is the second most important vegetable grown in Bangladesh, about 150,000 resource-poor farmers on 132,551 acres with a total production of 587,212 metric tons in 2021. Brinjal accounted for 9.01 and 8.71%, respectively, of all winter and summer vegetable production in 2021 (BBS, 2021).

Increasing land use intensity, introduction of modern varieties of crop, minimum and unbalanced use of fertilizer and no practice of leaving crop residues, and no addition of organic manure to soil have led to a marked depletion of nutrient reserve in Bangladesh soils. Consequently, along with N,P,K,S and some micronutrient (B and Mo) deficiencies have also been observed. Nutrients are the key factor for crop production. Balanced fertilizer is indispensable for the optimum yield of any crop. The micronutrient boron is important for carbohydrate metabolism and translocation. It is also responsible for cell wall development and RNA metabolism. Boron deficiency hampers flowering, fruit setting by retarding pollen germination and pollen tube development (Halfacre and Barden, 1979).

Micronutrients play an important role in increasing yield of crops through their effects on the plant itself. Until 1980, farmers used only NPK-fertilizers but now they are applying S and Zn along with N,P,K addition of B, Mg, Mo, Cu or Ca is needed in some soils (Islam, 1992). Deficiencies of B and Mo on some soils and crops were found in some parts of Bangladesh (Jahiruddin *et al*., 1992). Application of phytohormones and micro-nutrients will not only enhance productivity, but will also increase the production and the efficiency of fertilizer use in brinjal crops (Kumar *et al*., 2016). A limited number of works had been done in this regard in Bangladesh. From this point of view, the present research was undertaken to find out the optimum dose of boron and time of application for brinjal fruit yield in Magura.

The field experiment was conducted at BINA sub-station farm, Magura during the rabi season of 2020-21. The soil of the experimental site was calcareous and slightly alkaline in reaction. The boron status of the analyzed soil presented Table 1. The weather data (Temperature, rainfall, relative humidity and sunshine hours) also presented in Fig. 1. Total nine treatments comprising one control and eight different doses of solubor boron vizs., T_1= 0.5g B $L^{-1}.H_2O$ at vegetative stage, T_2= 1.0g B $L^{-1}.H_2O$ at vegetative stage, T_3= 0.5g B $L^{-1}.H_2O$ at vegetative stage + g B $L^{-1}.H_2O$ at Fruiting stage, T_4= -1.0g B $L^{-1}.H_2O$ at vegetative stage + 1.0g B $L^{-1}.H_2O$ at Fruiting stage, T_5= 1.5g B $L^{-1}.H_2O$ at vegetative stage, T_6= -1.5g B L^{-1} L.H_2O at vegetative stage + 1.5g B $L^{-1}.H_2O$ at Fruiting stage, T_7= 2.0g B L^{-1}. H_2O at vegetative stage, T_8= 2.0g B $L^{-1}.H_2O$ at vegetative stage+2.0g B $L^{-1}.H_2O$ at Fruiting stage and T_9=control. The experiment was laid out in a Randomized Complete Block Design (RCBD) and the treatments were replicated in thrice randomly. The unit plot size was 3m × 2m where plant spacing was 75 cm × 60 cm. All management practices were done as and when necessary. Boron solution was sprayed on plant foliage using a hand sprayer and others fertilizers used as basal dose.

Table 1. Analytical result of Initial soil at the experimental area

Sample no.	Analytical result of soil sample
	B (mg/gm)
Initial soil	0.58
Interpretation	Low

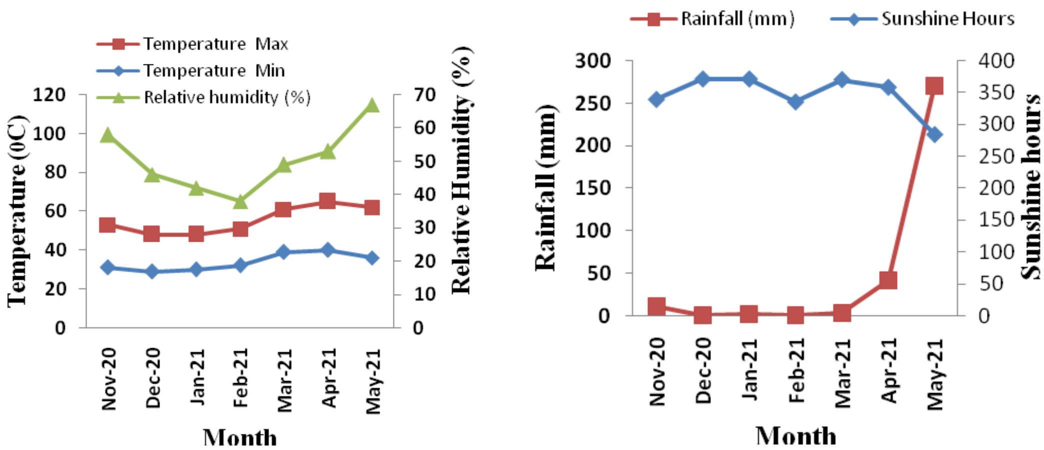

Figure. 1: Weather data during the experimental period

Data were collected on plant height, number of branches plants^{-1}, number of fruits plant^{-1}, fruit length, individual fruit weight, fruit yield/plant and fruit yield ha^{-1}. Data were reported as mean of five plants of each replication of a treatment. The data were analyzed using Statistix10 software and then mean comparison was done by using LSD at 5% level of significance.

Effect of different boron treatments on plant height

The data presented in Table 2 indicated that foliar application of boron had no significant effect on plant height. The maximum plant height of brinjal (68.94 cm) was found in the treatment T_2 (B 1.0 gm/L.H_2O at vegetative stage). On the contrary, the lowest values (61.13 cm) for plant height were recorded with the control treatment, which received no boron.

Effect of boron on number of branches plant^{-1}

The brinjal crop that supplied with foliar application of 1.0 B L^{-1}.H_2O at vegetative stage+1.0 B L^{-1}.H_2O at fruiting stage produced maximum number of branches (5.07 plant^{-1}) followed by 4.80 and 4.73 number of branches per plant at 1.0 B L^{-1}.H_2O at vegetative stage and 0.5 B L^{-1}.H_2O at vegetative stage+1.0 B L^{-1}.H_2O at fruiting stage respectively (Table 2). The minimum number of branches (3.80 plant^{1}) was recorded in control plots. Number of branches/plant increased by application of boron (Basavarajeswari *et al.*, 2008).

Table 2. Effects of different treatments of boron as foliar application on the growth and yield components of brinjal.

Treatments	Plant height (cm)	No. of branch plant^{-1}	No. of fruits plant^{-1}	Fruit length (cm)	Individual fruit weight (gm)	Fruit yield plant^{-1} (kg)	Fruit yield ha^{-1} (t ha^{-1})
T_1	63.40	4.27 c	23.67 ab	10.94 a	146.98 b	3.98 c	7.96 c
T_2	68.94	4.80 ab	24.93 ab	11.03 a	149.97 b	4.82 ab	9.63 ab
T_3	64.67	4.73 ab	22.50 abc	11.03 a	149.26 b	3.96 c	7.92 c
T_4	67.50	5.07 a	25.67 a	11.47 a	185.80 a	5.33 a	10.66 a
T_5	67.00	4.13 cd	19.73 cd	11.05 a	150.60 b	3.96 c	7.96 c
T_6	62.93	4.43 bc	19.37 cd	10.98 a	146.13 b	4.03 c	8.06 c
T_7	66.27	4.27 c	21.43 bc	11.33 a	175.00 a	4.74 b	9.49 b
T_8	68.07	4.07 cd	16.87 de	11.29 a	173.36 a	4.13 c	8.26 c
T_9	61.13	3.80 d	15.47 e	9.87 b	139.64 b	3.79 c	7.58 c
CV (%)	4.92	5.67	9.60	4.32	5.44	6.95	6.95
Lsd at 5% level	5.58	0.43	3.50	0.82	14.82	0.51	1.03

Note: T_1 = 0.5g B L^{-1} .H_2O at vegetative stage, T_2= 1.0g B L^{-1}.H_2O at vegetative stage, T_3= 0.5g B L^{-1}.H_2O at vegetative stage + g B L^{-1}.H_2O at Fruiting stage, T_4= -1.0g B L^{-1}.H_2O at vegetative stage + 1.0g B L^{-1}.H_2O at Fruiting stage, T_5= 1.5g B L^{-1}.H_2O at vegetative stage, T_6= -1.5g B L^{-1} L.H_2O at vegetative stage + 1.5g B L^{-1}. H_2O at Fruiting stage, T_7 = 2.0g B L^{-1}.H_2O at vegetative stage, T_8 = 2.0g B L^{-1}.H_2O at vegetative stage + 2.0g B L^{-1}.H_2O at Fruiting stage and T_9 = control

Effect of boron on number of fruits plant^{-1}

The data presented in the Table 2 suggested that the maximum fruits per plant (25.67) was found in the treatment T_4 (1.0 g B L^{-1}.H_2O at vegetative stage + 1.0 g B L^{-1}.H_2O at Fruiting stage) as compared to other treatments. On the other hand, minimum number of fruits per plant (15.47) was found at control. Increased number of fruits due to foliar spray of micronutrients like B might be attributed to enhanced photosynthetic activity, resulting in increased accumulation of carbohydrates which enhanced the vegetative growth and retention of flowers and fruits. Increased number of fruits in response to micronutrients (B, Zn and mixture) has been reported by Basavarajeshwari *et al*., 2008 and Davis *et al*., 2003 in different vegetable crops.

Effect of foliar spray of boron on fruit length

Longest fruit (11.47cm) was found from T_4 (1.0g B L^{-1}.H_2O at vegetative stage + 1.0g B L^{-1}.H_2O at Fruiting stage) while shortest fruit (9.87 cm) was found from T_9 (Table 2). It was supported that length of fruit significantly increased by zinc and boron (Wojcik and Wojcik, 2003) application by improving cell size or cell number (Khayyat *et al*., 2007).

Effect of foliar spray of boron on individual fruit weight

Fruit weight varied significantly among the treatments. Maximum individual fruit weight 185.80g produced from the treatment T_4 which was 175.00g followed by the treatment T_7 (Table 2). Foliar application of B and Zn increase fruit weight (Sindhu *et al.,* 1999). Boron plays a key role on accumulation of photosynthates that has correlation with fruit weight (Shukha, 2011). Zinc and boron improve fruit growth by synthesizing tryptophan and auxin (Wojcik and Wojcik, 2003).

Effect of foliar spray of boron on fruit yield

Fruit yield of brinjal showed a significant variation among the treatments. Maximum yield was found from the treatment T_4 (10.66 t ha^{-1}) while minimum was obtained from the control (7.58 t ha^{-1}) (Table 2). Foliar application of Zinc and boron significantly increases the yield of different crops (Singram and Prabhu, 2001; Mustafa *et al.*, 1999; Ashoori *et al*., 2013).

Correlation among the yield contributing traits

Correlation among the studied traits were represented in Figure 2. Among the yield contributing traits high significant positive correlation was found between fruit yield $plant^{-1}$ and fruit yield ha^{-1}. Other traits were not significantly correlated.

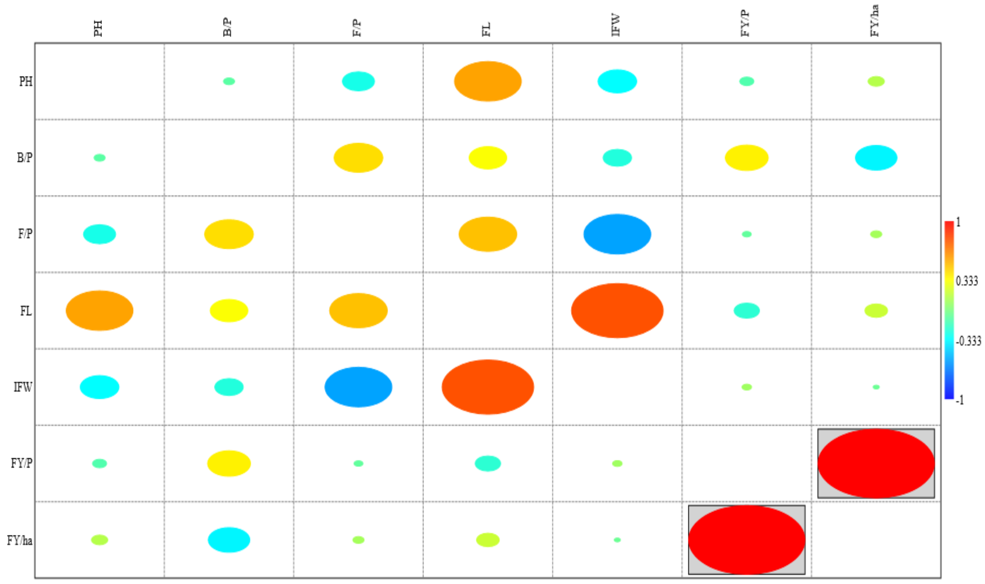

Fig. 2. Correlation among the studied traits. Color scale showed the magnitude of correlation. Boxed trait indicated the significance of correlation at 5% level of significance.

Based on findings it can be concluded that foliar application of boron enhanced most of the plant growth parameters and yield of brinjal. So, foliar application of boron 1.0g $L^{-1}.H_2O$ at vegetative stage and 1.0g $L^{-1}.H_2O$ at fruiting stage might be increased yield potentiality of brinjal. However, the findings suggested for further research with these doses of foliar spray of boron at different locations of Bangladesh for the validation of the present results.

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References

Ashoori, M., Lolaei, A., Zamani, S. & Mobasheri, S. 2013. Effect of N and Zn on quantity and quality characters of grapevine (*Vitisvinifera)*. Int. J. Agri. Crop Sci., 5(3), 207-211.

BBS (Bangladesh Bureau of Statistics) .2021. Statistical Year Book of Bangladesh. Planning Division. Ministry of planning. Government of the People's Republic of Bangladesh. Dhaka. pp. 281-337.

Basavarajeswari, C.P., Hosamni, R.M., Ajjappalavara, P.S., Naik, B.H., Smitha, R.P. & Ukkund. 2008. Effect of foliar application of micronutrients on growth, yield components of Tomato (*Lycopersiconesculentum* Mill). Karnataka J. Agri. Sci., 21(3), 428-430.

Bliss, R.M., & Elstein, D. 2004. Scientists get under egg plants skin. ARS magazine, January, 52 (1).

Caguiat, X.G.I., & Hautea D.M. 2014. Genetic diversity analysis of egg plant (*Solanummelongena* L.) and related wild species in the Philippines using morphological and SSR markers. Sabrao Journal of Breeding and Genetics, 46(2), 183-201.

Chaudhary, P.K., and Saraf, R.K. 1996. Influence of growth regulators and insecticides on growth & yield of brinjal (*Solanummelongen*a L.). Orissa Journal of Horticulture,20 (2), 42- 47.

Davis, J.M., Sanders, D.C., Nelson, P.V., Lengnick, L. & Sperry, W.J. 2003. Boron improves growth, yield, quality and nutrients contents of tomato. J. Am. Soc. Hort. Sci., 128(3), 441-446.

Gotame, T.P., Poudel, S., Lal Shrestha, S., & Shrestha, J. 2020. Evaluation of Yield and Yield Components of Eggplant (*Solanummelongena* L.) Genotypes in the Terai Region of Nepal. International Journal of Environment, 9(2), 67-80.

https://doi.org/10.3126/ije.v9i2.32517

Halfacre, R.G. and Barden, J.A. 1979. In: Horticulture. McGraw Hill Book Co.USA.

Islam, A. 1992. Review of soil fertility Research in BD. In: Proceedings of the Inter-congress conference of commission IV of ISSS on Improving Soil Management for Intensive Cropping in the Tropics and Subtropics. pp: 1-18.

Jahiruddin, M., Hoque, M.S., Haque, A.K.M.M. and Roy, P.K. 1992. Influence of boron, copper and molybdenum of grain formation in wheat. Crop Res., 5: 35-42.

Khayyat, M., Tafazoli, E., Eshghi, S. & Rajaee, S. 2007. Effect of Nitrogen, Boron, Potassium and Zinc Sprays on Yield and Fruit Quality of Date Palm. American-Eurasian Journal Agriculture & Environ. Sciences, 2(3), 289-296.

Kumar, N.M., Pandav, A.K., & Bhat, M.A. 2016. Growth and yield of solanaceous vegetables in response to application of micronutrients: A Review. International Journal of Innovative Science, Engineering & Technology, 3(2), 611-626.

Mustafa, E.A.M., El-shamma, M.S. & Hagass, L.F. 1999. Correction of boron deficiency in grape vines of Bez El-Anze cultivar. American-Euransian J. Agric. & Enviro. Sci., 1(3), 301- 305.

Sindhu, P.C., Ahlawat, V.P. & Nain, A.S. 1999. Effect on yield and fruit quality of grapes (Vitisvinifera L.) cv. Perlette. Haryana J. Hort. Sci., 28(2), 19-21.

Singram, P. & Prabhu, P.C. 2001. Effect of zinc and boron on growth and quality of grapes cv. Muscat. Madras Agriculture Journal, 88(4-6), 233-236.

Shukha, A.K. 2011. Effect of foliar application of calcium and boron on growth, productivity and quality of Indian gooseberry (Emblicaofficinalis). Indian J. Agric. Sci., 81(7), 628-632.

Wojcik, P. & Wojcik, M. 2003. Effects of boron fertilization on conference pear tree vigor, nutrition, and fruit yield and storability. Plant and soil, 256, 413-421.