Effect of basal and foliar application of boron and zinc on yield attributes in *Solanum melongena* L.

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Summary: Field experiments were conducted during 1999–2000 and 2000–2001 to study the effect of basal application (BA) of zinc sulphate (5 and 10 mg kg^{-1} soil) or boric acid (1 and 2 mg kg^{-1} soil) alone or foliar applications (FA) of water or 1% $ZnSO_4$ or 1% $H_3\ BO_3$ or the combinations of both BA and FA of either $ZnSO_4$ or $H_3\ Bo_3$ on yield attributes (number of flowers and fruits/ plant, fruit weight, size and total yield). On the basis of the two-year data, it was found that all the treatments of BA as well as FA enhanced yield attributes but the combination of BA of 10 mg kg^{-1} soil $ZnSO_4$ and FA of 1% $H_3\ BO_3$ gave highest yield as compared to other treatments and control plants.

Key words: *Solanum melongena*, boron, zinc, yield

Introduction

Solanum melongena L. (Solanaceae) commonly known as brinjal or eggplant is an important vegetable crop. It is extensively grown in India as an annual and is very popular among people of all social strata for its fruits. It is also popular in other countries like Japan, Indonesia, the Philippines, China and Bulgaria and to some extent in other tropical countries of the African and American continents. Brinjal is an erect branching herb, two-three feet in height. The fruit is large, elongated or ovoid, whitish, violet or purple berry about the size of a coconut. The fruits are usually cut to slices and fried or boiled. The white coloured brinjal has medicinal value and is recommended for diabetic patients. The fruit of brinjal or eggplant contains 92.7% water, 1.2% protein, 0.02% fat, 0.54% ash and 5.5% carbohydrates and it is also a source of vitamin A and B with a low quantity of vitamin C as well.

The importance of nitrogen in enhancing the yield of eggplant is also well known *(Jones*, 1998). According to *Jones* fertilizing with N, P and K also increased the amount of vitamins A and C in the fruits. However, very little is known about the role of micronutients in relation to yield. The addition of micronutrients e.g. B, Mn, Cu and Zn can enhance the yield and sugar and vitamin C content in the fruits also *Szabolcsi* et al., 2004). On the other hand, the deficiency of micronutrients can be controlled either by correcting the pH or by adding small amounts of the appropriate chemicals to the soil *(Bennett*, 1993). Foliar applications may be the most convenient and appropriate method of correction. However, the impact of basal or/and foliar application of some micronutrients on yield attributes in eggplants is not well understood. In the light of above mentioned facts, the present experiment was conducted to study the effect of boron and zinc both by basal as well as foliar applications on yield in egg plants (*Solanum melongena* L.).

Material and method

Field experiments were conducted during the years 1999–2000 and 2000–2001 with *Solanum melongena* L. var. Pusa Kranti at the Experimental Research Farm of the School of Life Sciences, Dr. B.R. Ambedkar University, Agra. Brinjal seedlings were raised in the nursery during July-August in thoroughly ploughed and well manured land. After 20 days, the seedlings were transplanted into microplots of 5 m X 5 m with a the distance between rows of 100 cm and between plants of 50 cm. Thus, in each microplot there were fifty plants with five rows consisting of ten plants. The microplots were on sandy loam soil with pH 8.2, ECF 2.9 ds/m, salts 0.03%, organic carbon 0.16%, available N 80 kg/ha, P 60 kg/ha and K 40 kg/ha These microplots were separated by polythene lining up to 60 cm depth. Between two microplots, a band of half meter was left. At the time of transplanting, P 60 kg/ha and K 40 kg/ha was added, while N 20 kg/ha was applied twice, once after 20 days and again after 40 days after transplanting. In three microplots, zinc sulphate was added 20 days after transplanting, as basal dressing of 5 or 10 mg kg^{-1} soil, while six microplots did not receive this treatment. However, the plants in three of these microplots were sprayed with 1% $ZnSO_4$ and each plant receivied 100 ml solution, while the other three plots were left to serve as control. Similarly, 20 days after transplanting, in three microplots boric acid was added as basal dressing of 1.0 or 2.0 mg kg^{-1} soil, while nine microplots did not receive any boric acid. However, 20 days after transplanting, the plants in three of these microplots were sprayed with 1% boric acid with each plant receiving 100 ml solution. The plants, 20 days after transplanting in another three microplots, were sprayed on alternate days with 1% $ZnSO_4$ and 1% boric acid with each plant receiving 100 ml each of these solutions, while still three other microplots were left to serve as control. Thus, there were 48 microplots for three

Table 1 Effect of boron and zinc on yield in *Solanum melongena*

Treatment	Total no. of flowers/plant	Total no. of fruits/plant	Fruits set %	Single fruit weight (g)	Total yield (kg)
B0Zn0	118.1	62.54	53.5	95.5	
B0Zn5	127.6	76.20	60.3	100.2	7.62
B0Zn10	143.5	78.74	62.5	105.0	8.26
B0ZnFA	151.5	91.65	60.5	110.1	10.08
B1Zn0	137.5	80.71	58.7	98.3	7.90
B1Zn5	141.6	88.21	62.3	108.4	9.56
B1Zn10	149.2	102.79	68.9	115.6	11.88
B1ZnFA	178.7	125.44	70.2	116.8	14.65
B2Zn0	142.2	90.15	63.4	102.8	9.23
B2Zn5	150.8	105.25	69.8	121.6	12.78
B2Zn10	167.5	121.10	72.3	139.1	16.84
B2ZnFA	*180.6*	*134.18*	*74.3*	*141.8*	*18.92*
BFAZn0	146.3	98.45	67.3	120.8	11.89
BFAZn5	163.6	117.46	71.8	136.2	15.99
BFAZn10	190.6	145.99	76.6	139.1	19.06
BFAZnFA	187.6	137.13	73.1	142.2	20.73
CD at 5%	8.61	7.32	–	0.81	9.52

* Mean value of 150 plants

** Mean value of 100 fruits

replications in randomized block design for each treatment either with basal (BA) or foliar application (FA) of each micronutient or combination of BA and FA.

Data on number of flowers/plant, fruits/plant, fruit set, weight and total yield/plant were collected from variously treated and untreated (control) plants and were statistically analyzed by analysis of variance (ANOVA).

Results and discussion

Application of zinc either in basal or foliar form enhanced the parameters as compared to control plants. Foliar application of 1% $ZnSO_4$ gave the maximum yields and the plants receiving this treatment produced 151.5 flowers/plant, 91.65 fruits/plant with 60.5% fruit-set and the weight of a single fruit was 110.1 g with a total yield of 10.08 kg/plant as compared to control plants producing 118.1 flowers/plant and 62.54 fruits/plant with 53.5% fruit-set with 95.5 g weight of a single fruit and a total yield of 5.89 kg plant.

Basal or foliar application of boron alone also enhanced yield parameters compared to control plants and maximum increase was recorded in plants receiving foliar application of 1% boric acid. Such plants produced 146.3 flowers and 98.45 fruits/plant with 67.3% fruit-set and the average weight of a single fruit was 120.8 g with a total yield of 11.89 kg/plant. On the other hand, all the combinations of both basal and foliar applications of both B and Zn further enhanced various yield attributes. The plants receiving foliar application of 1% boric acid and basal application of zinc sulphate (10 mg kg^{-1}soil) exhibited significant increase in the yield attributes. Such plants produced 178.7 flowers and 125.44 fruits/plant, 70.2% fruit-set with 116.8 g single fruit weight and 14.65 kg total yield/plant. However, the best yield parameters were obtained by the basal application of $ZnSO_4$ of 10 mg kg^{-1} soil in combination with foliar application of 1% H_3BO_3. These plants produced 190.6 flowers and 145.99 fruits/plant with 76.6% fruit-set and 19.06 kg total yield/plant with 139.1 g average weight of a single fruit. The second best result was obtained by the foliar application of both micronutrients where each plant produced 187.6 flowers and 137.15 fruits/plant with 73.1% fruit-set and the average weight of a single fruit was 142.2 g and the total yield was 20.73 kg/plant.

Requirement of boron is much higher in reproductive growth than in vegetative growth *(Loomis & Durst,* 1991). Boron deficiency reduced not only the number of fruits per plant but also reduced the weight, diameter, reducing sugar content and acidity in fruits of tomato, when grown in liquid culture *(Lopez-Andreu* et al., 1988). On the other hand, the same authors reported on an increase in fruit weight and sugar accumulation in tomato fruits by boron application. According to *Coetzer* et al. (1990) pod length and pod number per plant in *Phaseolus vulgaris* and fruit weight in *Lycopersicon esculentum* increased with increasing concentration of boron. Foliar application of boron at the end of flowering has been reported to increase 100 seed weight in soybean *(Hemantaranjan,* 1997). Similarly, Zn fertilization is known to be useful on yield in *Vicia faba (Kranze* et al., 1989). According to *Sharma* et al. (1999), zinc should be applied to the soil at higher rates because of its slow reversion to plant in unavailable form and application of boron and zinc is known to enhance both seed yield and quality in radish. Perhaps because of this reason foliar application of 1% $ZnSO_4$ in the present investigation has enhanced yield with a considerable extent as compared to its basal application alone. Similarly, foliar application of 1% H_3BO_3 alone or in combination with both basal as well as foliar application of Zn also enhanced yield with a considerable extent and FA of 1% boron with BA of $ZnSO_4$ (10 mg kg^{-1} soil) resulted in maximum yield. *Hemantaranjan & Trivedi* (1999) and *Hemantaranjan* (2000 a, b) have made an attempt to study the individual and combined application(s) of B and Zn on growth, flowering and yield capacity of soybean. The combination(s) of B and Zn showed a synergistic effect on different physiological attributes, but higher concentrations of Zn with a lower concentration of boron were found to be the most suitable combination. The increase in yield by foliar applications may be largely due to the absorption of ions on a larger surface, i.e. leaves. These lead to an increase in photosynthetic rates and ultimately yield. *Bajapai & Chauhan* (2001) have recorded maximum fruits/plant, seeds/fruit, dry and fresh fruit weight and seed weight in okra (*Abelmoschus esculentus*) plants grown in soils with 10-mg/ kg zinc content.

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