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Influence of foliar application of boron and zinc on growth, yield and bulb quality of onion (*Allium cepa* L.)

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ABSTRACT

A study was conducted at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal during rabi season (November- April) of 2010 and 2011. The main aim of the experiment was to enhance the production of onion through assessing the effect of different levels of boron and zinc. The experiment consisting of 4 levels of boron (0, 0.1, 0.2 and 0.5 %) and 4 levels of zinc (0, 0.1, 0.2 and 0.5 %) were applied as foliar spraying. Application of 0.5% boron significantly increased the growth (plant height, 63.93cm and number of leaf per plant, 7.25), yield (30.74 t ha^{-1}) and quality (Total soluble solids, 13.45^{o}B and pyruvic acid 5.94 µmol.g^{-1}) of onion. Among various levels of zinc 0.5% exhibited the best growth (plant height, 67.25cm and number of leaf per plant, 7.75), yield (33.34 t ha^{-1}) and quality (Total soluble solids, 14.57 ^{0}B and pyruvic acid, 5.86 µmolg^{-1}) attributes of onion.

Keywords*:* Boron, foliar application, onion, zinc.

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops and is widely grown in almost all over the world (Mishra *et al.*, 2013). Onion has its own distinctive flavour and is used in soups, different dishes, salads, sandwiches and is also cooked alone as a vegetable. Its pungency is due to the presence of *Allyl propyl disulphide,* a volatile oil (Malik, 1994). Itcontains carbohydrates, protein, vitamin A, thiamine, riboflavin, niacin and ascorbic acid.

India ranks next to China, accounting for 26.8 percent of world area and 19.9 percent of onion production. The area and production of onion in India is about 1.064 million hectares and15.1 million tonnes of bulb, respectively, with an average yield of 14.2 t ha^{-1} (NHB, 2011). The yield is very low as compared to the world average yield of 19.1 t ha^{-1}. Intensive cropping, imbalanced fertilization and minimal usage of micro nutrients and limited application of organic manures have resulted in the depletion of soil fertility in India. Boron and zincare the most important micro-nutrients and are essential for cell division, nitrogen and carbohydrate metabolism and water relation in plant growth (Brady, 1990). Application of boron can increase bulb size and yield of onion (Smriti *et al*.,2002). Response of onion to zinc application has also been reported (Lal and Maurya, 1981). Mishra *et al*., (1990) have shown that application of $ZnSO_4$ (0.5%) and $FeSO_4$ (1.0%) as foliar spray recorded significantly higher plant height and other growth parameters as compared to other treatments in onion. However, information on the use of micro nutrient in combination with inorganic fertilizers for onion is scanty in India. Therefore, an attempt was made to study the Influence of foliar application of boron and zinc on growth, yield and bulb quality of onion.

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MATERIALS AND METHODS

The study was undertaken at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal (23.5°N latitude, 89°E longitude having an average altitude of 9.75m from the sea level)on onion cultivar Sukhsagar during rabi season (November-April) of 2010 and 2011. The crop was planted (spacing of 15 cm × 10 cm), fertilized and irrigated as per the recommended practices. Before fertilizer application, random soil samples were taken fromthe experimental site and were analyzed. The analysis revealed that thefield contained 0.04%N; 22.61 kg ha^{-1}P; 183.21 kg ha^{-1}K; 0.25 ppm boron and 0.43 ppm Zinc; 0.35% Organic carbon with a pH level of 6.8.

The experiment was laid out in a randomized block design with four replications. The treatments included 4 levels of boron (0, 0.1, 0.2 and 0.5%) and 4 levels of zinc (0, 0.1, 0.2 and 0.5%). The source of micro nutrient for boron and zinc were boric acid and zinc sulphate, respectively. Onion plants were sprayed three times with micro nutrients at monthly intervals starting from30 days after transplanting. Ten plants were selected from each plot as a unit for all observations on growth and yield. Based on the net plot yield, yield per hectare was calculated and expressed in tonnes per hectare. Total soluble solids (TSS) were determined by using hand held

refractometer, and pyruvic acid content of onion bulb was estimated by using standard method given byYov *et al*., (1995).Statistical analysis was done using standard procedure given by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Data presented in Table 1, revealed that foliar application of boron and zincsignificantly improve vegetative growth, yield and quality of onion. Application of 0.5% boron significantly increases the plant height (63.93 cm) over control. No significant differences were detected on the number of leaves per plant. However maximum number of leaves (7.25) was produce under treatment 0.1% boron application. The result is in conformity with that of Dake *et al.,* (2011), who reported improvement in growth, yield and quality of onion cv. Baswant 780 with application of boron. Application of boron caused highly significant variation in terms of bulb diameter, neck thickness, individual bulb weight, marketable and total yield. The maximum bulb diameter (4.84 cm), neck thickness (1.39 cm), highest bulb weight (57.14 gm) was produced by the treatment 0.5% boron and that had lead to significantly highest marketable (25.89 $t.h^{-1}$) and total yield (30.74 $t.h^{-1}$) of onion (table 1). The results on the effects of boronon the yield and yield attributes of onion plants agreed with the results obtained by Smriti *et al.,* 2002. Dry matter content in bulb also significantly increases with the application of boron. These results are in close conformity with the findings of Meena and Singh, 1998. Foliar application of different boronlevels significantly affected quality parameters of onion in terms of total soluble solid (TSS) and pyruvic acid content.This results conformity with those of Sliman *et al*., (1999) and El-Shafie and El-Gamaily (2002).

Table 1: Effect of boron and zinc on growth, yield and quality of onion. (Pooled of two years).

Treatments	Plant height (cm)	Leaf number	Bulb diameter (cm)	Neck thickness (cm)	Bulb weight (g)	Marketable yield (t ha^{-1})	Total yield (t ha^{-1})	TSS (^oB)	Dry matter (%)	Pyruvic acid (µ mol g-1)
Boron (%)										
0	53.50	5.75	4.29	1.11	44.31	18.81	21.59	9.77	13.42(21.47)	3.05
0.1	56.25	6.56	4.68	1.22	50.70	21.03	23.41	11.62	13.99(21.89)	3.88
0.2	60.275	6.87	4.77	1.30	54.90	24.50	27.47	12.72	14.11(22.06)	4.19
0.5	63.93	7.25	4.84	1.39	57.14	25.89	30.74	13.45	14.65(22.54)	5.94
SEm (±)	**2.271**	**0.488**	**0.086**	**0.047**	**1.556**	**0.699**	**0.848**	**0.749**	**0.238**	**0.20**
LSD(0.05)	**7.267**	**NS**	**0.275**	**0.152**	**4.981**	**2.237**	**2.713**	**2.396**	**0.761**	**0.651**
Zinc (%)										
0	60.14	5.92	3.97	1.19	43.95	19.62	24.43	9.60	13.83(21.81)	2.85
0.1	62.95	6.50	4.35	1.29	47.57	27.59	30.53	11.52	14.06(22.06)	3.32
0.2	65.75	7.05	4.80	1.40	51.77	28.73	31.17	12.55	14.24(22.14)	4.23
0.5	67.25	7.75	5.13	1.47	57.04	31.52	33.34	14.57	14.94(22.71)	5.86
SEm(±)	**1.595**	**0.584**	**0.080**	**0.042**	**1.906**	**1.286**	**1.902**	**0.602**	**0.124**	**0.193**
LSD(0.05)	**5.102**	**NS**	**0.258**	**0.135**	**6.097**	**4.116**	**6.086**	**1.927**	**0.397**	**0.619**

Figures within parentheses indicate angular transformation data of dry matter percentage. NS: Nonsignificant (P >0.05).

Similarly, maximum Plant height (67.25 cm) was recorded with the application of 0.5% zincand it was observed that the effects of zinc was significant but number of leaves per plant were not statistically significant with the application of zinc.The obtained results were in good accordance with Mishra *et al*., (1990), who noted that foliar application of $ZnSO_4$ (0.5%) significantly increase plant height and other growth parameter of onion than control. The same results were also recorded by many authors on onion plants (Alam *et al*., 2010 and Abd El-Samad *et al*., 2011). They reported that growth parameters of onion plant were positively affected by application of micronutrients. Application of zinc also has significant effect on yield and yield contributing characters(Table 2). The bulb diameter (5.13 cm), neck thickness (1.47 cm), individual bulb weight (57.04 gm), marketable (31.52 t h^{-1}) and total yield (33.34 t h^{-1}) were higher in plants treated with 0.5% zinc while the lowest value was found in control (0% Zn). The results of Sliman *et al*., 1999 and Khan *et al*., 2007 are also in close conformity in this regard. Dry matter content in bulb also significantly increases with the application of boronand zinc as compare to control. This result is agreement with those of Meena and Singh (1998), who reported that zinc significantly increase dry weight of bulb.Foliar application of different zinc levels significantly affected quality parameters of onion in terms of total soluble solid (TSS) and pyruvic acid content. This results

conformity with those of Alam *et al*., (2010) and Abd El-Samad *et al*., (2011). They stated that bulb yield and quality of onion was mostly enhanced by foliar spraying of Zn followed by Fe. Micronutrient like, Fe, Zn and boron were effective in improving growth, yield and quality of onion cv. Baswant 780 reported by Dake *et al.,* (2011).

The favourable effect of micronutrients on plant growth might be due to its role in many physiological processes and cellular functions within the plants. In addition, they play an essential role in improving plant growth, through biosynthesis of endogenous hormones which responsible for promoting of plant growth (Hänsch and Mendel, 2009). The yield advantage of different treatments was due to better growth and development. Thus higher photosynthates accumulation in the bulbs for higher leaves per plant would ensure higher individual bulb weight, large bulb diameter and neck thickness. More-over, appliedboronand zinc in combination of nitrogen, phosphorus, potash and sulphur undoubtedly increased the yield, indicating that the soil was deficient in those nutrients.

From the above results it could be concluded that, the foliar application of boron and zinc significantly influenced the growth, yield and quality of onion,under the plains of West Bengal with the special reference of New Alluvial Zone.

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