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Growth and Yield of Solanaceous Vegetables in Response to Application of Micronutrients – A Review

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Abstract

Micronutrients are present in lower concentrations in soil than macronutrients but are equally significant in plant nutrition, since, plants grown in micronutrient-deficient soils show similar reductions in productivity as those grown in macronutrient-deficient soils. Solanaceous vegetables are the part of diet of all over the world. With growing demand for quality of vegetables as people are becoming more health conscious, there is a need to go for balanced fertilization of both macro and micronutrients. Since, micronutrients play a profound role in various metabolic functions of plant; therefore, without micronutrient application there occurs deficiency and eventually reduction in yield and quality. Foliar application of micronutrients shows better efficacy than soil application as the uptake and assimilation of micronutrients by later method takes more time. Owing to intensive agriculture and high yielding varieties of vegetables extra mining of nutrients takes place which leads to negative nutrient balance in the soil. Hence, to cope up with the needs of the crop, application of micronutrients in addition to macronutrients must be ensured.

Keywords: solanaceous vegetables, balanced fertilization, nutrients, foliar application

INTRODUCTION

Micronutrients are present in lower concentrations in soil than macronutrients but are equally significant in plant nutrition, since, plants grown in micronutrient-deficient soils show similar reductions in productivity as those grown in macronutrient-deficient soils (Havlin *et al*., 2005). The prerequisite criteria for improved growth, yield and quality of solanaceous vegetables is balanced fertilization. However, nutrients can be applied either by conventional methods or by foliar application but the major advantage of foliar application the instant availability of nutrients to plants.

Micronutrients play a catalytic role in nutrient absorption and balancing other nutrients (Singh and Kalloo, 2000). Micronutrients such as iron, zinc, manganese, copper and boron are the important elements with specific and essential physiological functions in plants; required in small quantities for normal growth and development of plants. Zinc is an essential component of a number of enzymes, *i.e*., dehydrogenase, aldolase, isomerases, proteinase, peptidase and phosphohydrolase (Mousavi, 2011). It is directly involved in the synthesis of indol acetic acid (IAA) and proteins. The principal function is a metal activator of enzymes in plants. Zinc deficiency may be related to weather conditions, as it increases in cold and wet weather, which might be due to the limited root growth in cool soils, or reduced activity of microorganisms and release of zinc from organic materials (Abdou *et al*., 2011; Alam *et al*., 2010; Terhan and Sekhon, 1977). Its deficiency symptoms appear generally on younger leaves starting with interveinal chlorosis. Boron helps in the absorption of water and carbohydrate metabolism (Haque *et al*., 2011), translocation of carbohydrates in plants, DNA synthesis in meristems, cell division and elongation, active salt absorption, fertilization, water relation and photosynthesis and involves indirectly in metabolism of nitrogen, phosphorous, fat and hormones. Boron also plays an important role in flowering and fruit formation (Nonnecke, 1989). Due to the lack of boron, there is hypertrophy, degeneration and disintegration of cambium cells in the meristematic tissues. Its deficiency may cause sterility, small fruit size, and poor yield (Davis *et al*., 2003) and affects translocation of sugar, starches, nitrogen and phosphorus, synthesis of amino acids and proteins. Iron helps in the synthesis of enzymes and chlorophyll. It is a component of various flavo-proteins and participates in oxidation-reduction process such as nitrate, sulphate and nitrogen fixation. Its deficiency symptoms are observed first on the youngest leaves, which become small but not deformed. If its deficiency continues, the entire leaf including veins exhibits chlorotic symptoms and the crop may exhibit bleached appearance, dry and finally die.

Seed is the primary input, without which, the increase in production of any vegetable crop cannot be expected. Among inputs other than seed and fertilizers, foliar application of micronutrients at most appropriate concentration assumes special significance for the production of higher yield with better quality seed of any vegetable crop. Therefore, the application of micronutrients to sustain soil health and crop productivity besides maintaining the quality of crops is of profound importance. Keeping in view the aforementioned facts, the topic, ‘Growth and Yield of Solanaceous Vegetables in Response to Application of Micronutrients’ was reviewed. However, major emphasis was given to boron, zinc and iron in this manuscript.

Effect of micronutrients on growth parameters

Spraying boron 1 ppm significantly increased the number of leaves per plant (68.9) and height of the plant (128.8 cm) compared to control in tomato (Verma *et al*., 1973). Sharma (1995) reported that borax at 20kg/ha and calcium carbonate at 10 kg/ha applied alone or in combination showed best results in for plant height (189.2 cm) and number of branches per plant (9.2). Sharma (1999) stated that application of borax 20kg/ha gave the maximum plant height (70.6 cm) and number of branches per plant (6.9), while the control registered the least plant height (59 cm) and number of branches per plant (5.8). Yoganand (2001) recorded the lowest plant height (53.43 cm) and number of branches per plant (5.18) with borax 0.2% sprayed at pre-flowering stage as against control (54.90 cm and 5.47, respectively).

The plant height (112.92 cm) increased considerably with the foliar spray of boron 0.5% at 50 per cent flowering in tomato (Hamsaveni *et al*., 2003). The soil application of boron 20 kg/ha increased plant height (60.53) and the number of branches (7.6) in tomato by promoting root growth, which enhanced nutrients absorption (Sathya *et al*., 2010). In tomato, foliar application of borax alone significantly enhanced the number of branches per plant and higher plant height (Rab and Haq, 2012). Sivaiah *et al*. (2013) recorded the higher growth rate (77.5%) with the application of boron in tomato. The plant height of tomato increased significantly with 50 and 75 kg $ZnSO_4$ ha^{-1} in combination with NPK over NPK alone (Reddy *et al*., 1985). Ingle *et al*.(1993) recorded the maximum plant height (78.53 cm) and number of branches per plant (9.73) in treatment of naphthalene acetic acid (NAA 10 ppm) + urea (1%) + $ZnSO_4$ (0.2%) as compared to control (70.93 cm and 8.13, respectively). The increased fresh weight and dry matter accumulation in shoots of tomato by foliar application of micronutrients *viz*., B, Zn, Mo, Cu, Fe, Mn and mixture of all occurs due to greater accumulation of photosynthates by vegetative parts in the plants (Bhatt and Srivastava, 2005). The application of NPK 100:100:50 kg/ha +*Azospirillum* + PSB each @ 125 g/ha as root dipping along with $ZnSO_4$ (0.2%) spray recorded significantly higher plant height, number of branches per plant and number of leaves per plant (Kiran *et al*., 2010). In chilli cv. Talhari, Kalroo *et al*. (2013) concluded that with increasing zinc level, the growth and yield contributing traits improved gradually. The highest concentration of zinc at 5 ml/l water resulted in 85.66 cm plant height, 77 cm plant spread, 13 branches per plant and took 56.33 days to flower emergence. Sivaiah *et al*. (2013) recorded the maximum growth rate (85.7%) with the application of zinc followed by the application of micronutrients mixture (78.2%) in tomato.

Hussain *et al*. (1989) found that foliar spray of zinc, boron and iron in combination each at 0.1% showed the best response to increase plant height. Singh and Verma (1991) observed that the application of potassium 120, zinc 10 and boron 2 kg/ha alone or in combination resulted in optimum plant growth of tomato. On the other hand, Bose and Tripathi (1996) reported an improvement in growth parameters (plant height 81.56 cm and number of branches per plant 19) of tomato when micronutrients (Zn, Mn, Fe and B) were applied in combination at 30 and 60 days after transplanting. In chilli, foliar application of liquid fertilizer '*Polyfeed* and *Multi*' containing most of macro- and micronutrients alongwith NPK significantly improved the growth and number of branches per plant over straight NPK fertilizers (Sharma *et al*., 2000).

Bhatt *et al*. (2004) concluded that the mixture of boron, zinc, iron and manganese at 100 ppm resulted in maximum number of branches (9.61) and leaves per plant (132.16) in tomato. Foliar spray of HiGrow, *i.e*., a commercial foliar fertilizer, which is a composition of various macro- (N, P, K, Ca and Mg) and micronutrients (Fe, Mn, B, Cu and Mo) at the concentration of 8 ml/l recorded the highest plant height (68 cm) and maximum number of branches (6.93), closely followed by 67.86 and 66.46 cm plant height and 6.53 and 5.80 number of branches per plant at the concentration of 7 and 6, respectively (Baloch *et al*., 2008). Brahma *et al*. (2010) noticed that NAA 10 ppm and boron 1 ppm applied at first flowering stage considerably increased the plant height over control (water spray). The maximum plant height (80.40cm) and number of branches per plant (34.7) was recorded with combined application of H_3BO_3, $ZnSO_4$ and $CuSO_4$ each at 250 ppm in tomato (Barche *et al*., 2011). In tomato, the foliar spray of a nutrient mixture such as nitrogen 2%, boron 5% and zinc 6% provided substantial results of plant height and number of leaves as compared to control (Ejaz *et al*., 2011).

In tomato, Rab and Haq (2012) reported that combined application of $CaCl_2$ (0.6%) and borax (0.2%) resulted in the maximum plant height (86.60cm) and number of branches per plant (7.21).The significantly maximum plant height (cm), number of leaves per plant, leaf length (cm), number of flower clusters per plant and minimum number of days to flowering were obtained with combined application of nitrogen 5.5 g/100 ml+ boron 5 g/100 ml + zinc 5 g/ml as compared to other treatments in tomato (Ali *et al*., 2013).The maximum plant height and number of photosynthetic leaves per plant was registered with the application of boric acid, zinc sulphate and copper sulphate each at 250 ppm in tomato (Singh and Tiwari, 2013). A combined spray of zinc 100 mg/l and iron 200 mg/l on foliage resulted in maximum plant height (124.14 cm) and number of branches per plant (8.36) in tomato (Kazemi, 2013). In brinjal, the highest plant height (62.93 cm), number of branches (6.36) and number of leaves (55.67) per plant was recorded with foliar spray of boron 0.25% + APSA-80 (Gogoi *et al*., 2014).

The significantly maximum plant height (132.77 cm), number of branches per plant (5.96), fresh weight of plants (25.70 t/ha), dry matter yield of plants (7669.04 kg/ha) and days to last picking (166.01) was recorded with the application of recommended dose of fertilizers, *i.e*., nitrogen, phosphorus and potash at 75, 37.5 and 62.5 kg/ha, respectively and mixture of all the micronutrients (B, Zn, Cu, and Mn) in tomato (Saravaiya *et al*., 2014). Foliar spray of micro-elements either Greenzit or Novatren, *i.e*., a mixture of macro- (N, P, K and Mg) and micro-elements (Fe, Mn, Zn, Cu, Mo, and B) at different concentrations applied at 3 litre per fed on hot pepper (*Capsicum annuum* L.) recorded the best plant growth as compared with the other application levels (Shafeek *et al*., 2014).The maximum plant height (2.93 m) and number of leaves per plant (39.33) was obtained with combined application of boron 1.25 g/l and zinc 1.25 g/l in tomato under agro-climatic conditions of Allahabad (Shnain *et al*., 2014).

Effect of micronutrients on yield and its attributes

The yield per hectare increased with the application of boron (Govindan, 1952). Verma *et al*. (1973) observed that foliar spray of boron 1ppm significantly increased the fruit yield per plant (3.15 kg) as compared to control (2.5 kg/plant) in tomato. Reddy *et al*. (1985) obtained significantly more number of fruits per plant (29.2), fruit weight (61.29 g) and fruit yield (194 q/ha) with soil application of borax (15 kg/ha) along with recommended dose of NPK as compared to NPK alone in tomato crop. Like-wise in tomato, Umajyothi and Shanmugavelu (1985) reported that foliar application of boron 4 ppm significantly increased the number of fruits (11) and fruit yield per plant (1039.4 g) as compared to control (10.5 and 990.1 g, respectively). In tomato, Singh and Verma (1991) observed that soil application of boron (2 kg/ha), potassium (120 kg/ha) and zinc (10kg/ha) in combination was found to be the most effective and produced higher marketable fruit yield (285.04 q/ha) as compared to control (266.92 q/ha).

In tomato, Sharma (1995) reported that applying borax 20 kg/ha in soil exhibited pronounced beneficial effect on number of fruits per plant (23.1), fruit yield (762.7 q/ha) and seed yield (246.2 kg/ha) as compared to borax 10kg/ha (18.9, 635.7 q/ha and 176.5 kg, respectively). Verma *et al*. (1995) noticed that the marketable fruit yield (285.04 q/ha) increased markedly with the application of boron 2 kg/ha as compared to control (266.92 q/ha) in tomato. Sharma (1999) recorded the highest plant height (70.6 cm) and number of branches per plant (6.9) in bell pepper with boron 20 kg/ha and least with control (59 cm and 5.8, respectively). A combined application of borax 20 kg and calcium carbonate 20 kg/ha proved best in recording the highest fruit and seed yield per plant. A combined solution of macro- and micronutrient applied as foliar spray on chilli increased fruit yield over straight NPK fertilizers (Sharma *et al*., 2000).The optimum amount of boron stimulated the phosphorus uptake by plant roots and promoted development of flower clusters and flowering directly (Balley, 1999; Day, 2000).

In chilli, Dongre *et al*.(2000) recorded the maximum fruit yield per plant (395.33 g) and per hectare (109.8 q) when boron was sprayed in the form of H_3BO_3 at 0.25% as against control (324.33 g/plant and 90.08 q/ha). Furthermore, highest average fruit length (11.12 cm) and fruit diameter (1.175 cm) was recorded when H_3BO_3 was sprayed at 0.1%. Foliar spray of boron (0.5%) at 50 per cent flowering period was found beneficial in increasing fruit weight (55.78g), number of fruits per plant (44.99) and fruit yield (31.82 t/ha) in tomato (Hamsaveni *et al*., 2003). In *Capsicum*, Verma *et al*. (2004) found that foliar spray of borax (0.5%) enhanced the seed yield as well as the number of fruits per plant. Karuppaiah (2005) found the foliar application of borax (0.5%) at 35, 50 and 65 days after transplanting to be the best in terms of number of flowers per plant, number of productive flowers per plant, number of fruits per plant, individual fruit weight and yield (32.15 t/ha), followed by copper sulphate (0.5%) and zinc sulphate (0.5%) sprayed at 35, 50 and 65 days after transplanting in brinjal.

The highest fruit yield (33 t/ha) was recorded through the soil application of boron (20 kg/ha) in tomato (Sathya *et al*., 2010). Foliar spray of borax 0.5% resulted in significantly highest number of fruits (8.3) and fruit yield per plant (377.8g) in bell pepper (Kumar and Malabasari, 2011). Application of boron 2kg/ha resulted in maximum number of flower clusters per plant, per cent fruit set and total yield of tomato (Naz *et al*., 2012). In tomato, Rab and Haq (2012) noticed that foliar application of borax alone significantly increased the number of flowers per cluster, fruits per cluster and fruits per plant, fruit weight, fruit firmness and total soluble solids content in the fruits. The foliar application of boron (H_3BO_3) at 150 ppm increased the number of flower buds per plant (70%), number of flowers per cluster (141%), number of flower clusters per plant (48%), total number of flowers per plant (122%), per cent fruit set (46%), number of fruits per plant (216%) and fresh weight of fruits per plant (88%) than that of control in brinjal (Suganiya *et al*., 2015).

In tomato grown on zinc deficient soils, Khomchack *et al*. (1971) found that addition of zinc 0.02% to irrigation water increased the yield by 16.3%. Gupta and Hansraj (1980) reported higher yield of tomato by maintaining 20 ppm or more zinc concentration in the plant. Mallick and Muthukrishnan (1980) observed that the foliar application of zinc at 5 and 10ppm increased the number of fruits per plant to the tune of 97 and 99% and fruit weight by 25 and 28%, respectively in tomato. The foliar application of $ZnSO_4$ 0.02 or 0.05% at 30, 50 and 70 days after planting had beneficial effect on fruit weight and yield of tomato (Elabdeen and Metwally, 1982).

Hussain *et al*. (1989) recorded the significantly higher yield and yield components of chilli with foliar application of zinc or boron or in combination of zinc, boron and iron each at 0.1% as compared to control. While studying the effect of zinc sulphate on yield of aubergine in calcareous soils, Bid *et al*. (1992) noted that zinc sulphate and copper sulphate at 10 and 20 kg/ha, respectively decreased zinc and copper deficiency symptoms and significantly increased the yield. Ravichandran *et al*. (1995) obtained the heaviest fruits (52.2 g) with soil application of $ZnSO_4$ (25 kg/ha) and the highest yield (27.1 t/ha) and number of fruits per plant (20) with soil application of $ZnSO_4$ (25 kg/ha) in combination with zinc (0.5%) foliar spray 30 days after transplanting in brinjal. Verma *et al*. (1995) obtained the highest marketable tomato yield (285.88 q/ha) when zinc sulphate was applied @ 10 kg/ha. Foliar application of zinc had positive impact on chilli (Radulovic, 1996).

Raj *et al*. (2001) found significant increase in yield, zinc and iron content of brinjal fruits with the application of zinc and iron either through soil or foliar spray. Among the treatments, soil application of $ZnSO_4$ 12.5 kg/ha along with three sprays of $ZnSO_4$ 0.2% and $FeSO_4$ 0.5% at weekly interval at later stages recorded significantly highest fruit yield of 37.7 t/ha with 23.6% increased over control in brinjal cv. Bhagyamathi. Foliar application of zinc 3 ppm, copper 1 ppm and boron 0.5 ppm produced the highest number of fruits per plant but the increasing *Polyfeed* spray frequency 3-4 times did not increase the number of fruits per plant in chilli (Jiskani, 2005).

In chilli, spraying ferrous sulphate 100 ppm significantly increased the number of fruits per plant (49.40) and fruit length (9.10 cm) as compared to control (Basavarajeshwari *et al*., 2010).The significantly higher number of fruits and fruit yield were registered with the application of NPK 100:100:50 kg/ha + *Azospirillum* + PSB each @ 125 g/ha (root dipping) along with $ZnSO_4$ (0.2%) spray (Kiran *et al*., 2010). Kalroo *et al*. (2013) revealed that zinc at 5 ml/l water resulted in maximum number of fruits per plant (481.33), fruit length (5.50 cm), fresh fruit yield (705 g/plant) and fruit yield (16.35 t/ha). However, the fruit yield (16.350 t/ha) did not increase significantly under concentration of zinc 5 ml/l water when compared with 4 ml/l water, which indicates that zinc at 4ml/l water was an optimum level for obtaining economical fruit yield (16.093 t/ha) in chilli. Similar results have also been reported by Jiudith *et al*. (2005) from England and Maheswari *et al*. (2003), Yadav *et al*. (2003), Bhatt and Srivastava (2006) and Hatwar *et al*. (2003) from India.

Foliar spray of zinc, boron and iron in combination each at 0.1% increased the number of fruits per plant (Hussain *et al*., 1989). Bose and Tripathi (1996) reported that the combined application of zinc, manganese, iron and boron each at 0.2% increased the number of flower clusters per plant, number of flowers per cluster and number of fruits per plant. Combined application of zinc, iron and boron at 1% as foliar spray was found effective in respect of number of branches per plant (11.2), stem diameter (1.54 cm) and spread of plant (53.54) in chilli (Hatwar *et al*. 2003). Khedr *et al*. (2004) reported that spraying boron 50, zinc 100 and calcium 2000 mg/l singly three times at 20 days interval started one month after transplanting enhanced earliness of flowering, fruit set, total yield and fruit quality of brinjal.

In chilli, foliar application of HiGrow, *i.e*., a composition of various macro- (N, P, K, Ca and Mg) and micronutrient (Fe, Mn, B, Cu and Mo) at a concentration of 8 ml/l resulted in significantly maximum number of fruits per plant (118.86), length of fruit (4.19 cm), fresh fruit weight (395 g/plant) and yield of fresh fruit (14977 kg/ha) followed by 117.20 and 112.36 fruits per plant, 4.14 and 3.89 cm fruit length, 391.33 and 351.66 g/plant fresh fruit weight, and 14562.33 and 12696.33 kg/ha fresh fruit yield at the concentration of 7 and 6 ml/l, respectively (Baloch *et al*., 2008). Shivprasad *et al*. (2009) recorded the highest yield of chilli with NPK at the rate of 100:50:50 kg/ha and secondary and micronutrients.

In tomato, combined application of micronutrients produced the maximum fruit yield followed by individual application of boron and zinc. The application of NAA 10 ppm and boron 1 ppm at first flowering stage recorded the highest per cent fruit set, number of fruits per plant and average fruit weight among all the treatments, whereas, untreated control (water spray) recorded the lowest values for all the characters (Brahma *et al*., 2010). In tomato, the number of fruits per plant (35.67), fruit yield per plant (1.18 kg) and fruit yield (375.94 q/ha) increased significantly with combined application of H_3BO_3, $ZnSO_4$ and $CuSO_4$ at 250 ppm each in tomato (Barche *et al*., 2011).In tomato, Rab and Haq (2012) observed that foliar application of $CaCl_2$ (0.6%) and borax (0.2%) in combination resulted in the maximum number of flowers per cluster (32.36), fruits per plant (96.37), fruit weight (96.33g), fruit yield (21.33 t/ha), fruit firmness (3.46 kg/cm^2) and total soluble solids (6.10%) and the lowest blossom end rot incidence (6.25%). Foliar application of boron, zinc, copper, iron and manganese mixture each at 100 ppm and molybdenum at 50 ppm thrice at 10 days interval starting from 40 days after transplanting of tomato significantly enhanced fruit yield to the extent of 28.67% over control (Kumar *et al*., 2012).

In tomato, Ali *et al*. (2013) recorded the maximum per cent fruit set, number of fruits per plant, fruit weight, fruit length, fruit diameter, number of large sized fruits with least number of small fruits, yield per plant and yield per hectare with combined foliar application of nitrogen 5.5 g/100ml, boron

5 g/100ml and zinc 5 g/100 ml as compared to other treatments. Foliar application of zinc (100 mg/l) + iron (200 mg/l) resulted in maximum number of flowers per cluster (18.14), fruits per cluster (8), fruits per plant (90.14), fruit weight (95.14g) and yield (25.14 t/ha) in tomato (Kazemi, 2013). The maximum number of flowers per plant, number of fruits per plant, yield per plant and fruit yield per hectare was registered with the application of boric acid + zinc sulphate + copper sulphate at 250 ppm each as a foliar spray in tomato (Singh and Tiwari, 2013).

Sivaiah *et al*. (2013) found that foliar spray of zinc, molybdenum, boron, copper, manganese and iron in combination each at 100 ppm except manganese (at 50 ppm) increased the maximum fruit yield per plant followed by application of boron and zinc individually. The highest yield (1138 kg/ha) was recorded with combined application of zinc and boron (3 and 1 kg/ha, respectively), which was closely followed by zinc 3 + boron 2 kg/ha and zinc 4.5 + boron 2 kg/ha, and the lowest (703 kg/ha) in control. However, from regression analysis, the optimum-economic dose of zinc was found to be 3.91 kg/ha, whereas, it was 1.70 kg/ha for boron (Shil *et al*., 2013). Foliar application of boron 0.25% + APSA-80 resulted in earliest flowering and fruiting (72 and 94 days, respectively) and highest number of fruits per plant (8.63) and total yield (356.55 q/ha) in brinjal (Gogoi *et al*., 2014).

In tomato, the highest fruit weight (73.17 g) was recorded with the application of nitrogen, phosphorus and potash at 46.29, 37.02 and 37.02 g/m^2, respectively + farmyard manure 1.5 kg/m^2 + micronutrients 2.5 ml/l, while the highest number of fruits per plant (84.33), yield per plant (6.008 kg) and total yield per plastic house (3.172 t/220 m^2) was obtained through the application of nitrogen, phosphorus and potash at 46.29, 37.02 and 37.02g/m^2, respectively + farmyard manure 2.5 kg/m^2 + micronutrients 2.5 ml/l (Mohammed *et al*., 2014). The highest number of fruits per plant (34.43), fruit length (5.47 cm), fruit diameter (4.57 cm), fruit volume (65.94 cm^3), single fruit weight (49 g), fruit weight per plant (1.69 kg), number of locules per fruit (3.01), pericarp thickness (6.27 mm), fruit yield per plot (70.86 kg), fruit yield per hectare (46.87 t) and marketable fruit yield (45.68 t/ha) was obtained with recommended dose of fertilizers, *i.e*., nitrogen, phosphorus and potash at 75, 37.5 and 62.5 kg/ha, respectively and mixture of all micronutrients (B, Zn, Cu and Mn) in tomato (Saravaiya *et al*., 2014). In hot pepper (*Capsicum annuum* L.), application of Greenzit (minor nutritional fertilizer) or Novatren, *i.e*., a mixture of macro- (N, P, K and Mg) and micronutrients (Fe, Mn, Zn, Cu, Mo and B) at different concentrations as foliar spray at 3 litre per fed gave the best yield as compared to other application levels (Shafeek *et al*., 2014).

Singh *et al*. (2014) obtained higher yield (23.10 and 18.33 t/ha) of tomato with the application of different micronutrients (boron and zinc) in combination and at different concentrations (0.2 and 0.4%) as compared to control (14.52 t/ha) where micronutrients were not applied. The highest number of flower clusters per plant (12.33), number of fruits per cluster (7.17), number of fruits per plant (88.33), yield per plant (6.33kg) and total yield (113.628 t/ha) was registered with combined application of boron 1.25 g/l + zinc 1.25 g/l in tomato under agro-climatic conditions of Allahabad (Shnain *et al*., 2014).

Effect of micronutrients on seed yield and its quality parameters

Verma *et al*. (1973) observed that spray of boron 1ppm significantly increased the fresh and dry weight of root (28.5 g and 6.25 g, respectively) in tomato. The application of boron 1 ppm significantly increased seed content in tomato fruits (Arora *et al*., 1982). Sharma (1995) concluded that boron 20 kg/ha showed pronounced beneficial effect on test weight (3.94 g) and per cent seed germination (96.5) as compared to boron 10 kg/ha (3.41 g and 94.33%, respectively) in tomato. Sharma (1999) recorded the highest per cent seed germination (91.2) and test weight (6 g) with combined application of borax 20 kg and calcium carbonate 20 kg/ha as against control (83.6%) in bell pepper (*Capsicum annuum* L.). The average number of seeds per fruit (55.66) and weight of 500 seeds (2.549 g) were significantly recorded with spray of H_3BO_3 0.50%, while the maximum seed yield was obtained with spray of $ZnSO_4$ 0.50% (Dongre *et al*., 2000).

The soil application of zinc sulphate 20 kg/ha + $ZnSO_4$ 0.5% foliar spray before flowering showed significant increase in seed yield and its components in chilli (Singh *et al*., 1989). In bell pepper, Yoganand (2001) noticed lower germination (64.81%), root length (4.86 cm) and shoot length (5.95 cm) with the application of $ZnSO_4$ (0.2%) at pre-flowering stage of bell pepper as compared to control (64.91%, 4.25 cm and 5.22 cm, respectively). Chandra and Verma (2003) found that the application of boron 2 kg and calcium 2 kg/ha to soil prior to transplanting was most effective for obtaining the highest fruit and seed yield in tomato. Foliar spray of boron 0.5% at 50 per cent flowering period significantly increased the number of seeds per fruit (142.83) and seed yield (241 kg/ha). Further, it has resulted in better seed quality parameters, *viz*., test weight (2.92 g), germination (93.88%), vigour index (1281) with least electrical conductivity (0.98 dSm^{-1}) in tomato (Hamsaveni *et al*., 2003).

In *Capsicum*, Verma *et al*. (2004) concluded that foliar spray of borax 0.5% showed positive effect on seed yield, per cent seed germination (85.66) and test weight (5 g), which were significantly better than the other treatments. Foliar spray of borax (0.1%) at flowering stage in chilli (*Capsicum annuum* L.) cv. Byadagi Kaddi recorded the higher seed yield (170 kg/ha) and number of seeds per fruit (83.4) as compared to control (Natesh *et al*., 2005). Foliar spray of borax (0.5%) recorded significantly higher number of seeds (221.20) and seed yield per fruit (1.06 g), per plant (8.63 g) and per hectare (342.45 kg), seed germination (83.82%), seedling vigour index (1000.4) and seedling dry weight (51.10 mg) with lower electrical conductivity (0.36 dSm^{-1}) in bell pepper (Kumar and Malabasari, 2011). Kumari (2012) suggested that foliar application of boron, iron and manganese each at 100 ppm at 30 days after transplanting at an interval of 10 days resulted in maximum seed yield and per cent seed germination (95, 92 and 88%, respectively) in tomato.

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Hussain *et al*. (1989) obtained higher weight of hundred seeds (0.56 g) with zinc spray at 0.1% as against soil application of Devimicro Shakti at 5 kg/ha in chilli. Yoganand (2001) recorded the maximum mean seed germination (64.81%), root length (4.86 cm) and shoot length (5.95 cm) when the plants were sprayed with $ZnSO_4$ (0.2%) at pre-flowering stage of bell pepper. Basavarajeshwari *et al*. (2010) reported that the foliar application of zinc sulphate 100 ppm significantly increased the number of seeds per fruit (128.43). In chilli (*Capsicum annuum* L.) cv. ByadagiKaddi, Natesh *et al*.(2005) recorded higher seed yield (248.26 kg/ha) with increased quality parameters by foliar spray of $ZnSO_4$ (0.1%) at flowering stage as compared to control. Kiran *et al*. (2010) recorded significantly higher number of seeds per fruit, test weight, seed yield, per cent seed germination, field emergence, seedling vigour index and seedling dry weight with the application of NPK 100:100:50 kg/ha + *Azospirillum* + PSB each at the rate of 125 g/ha (root dipping) along with $ZnSO_4$ (0.2%) spray.

The maximum number of seeds per fruit (57.93) was recorded, when $FeSO_4$ was applied at 0.25% in chilli (Dongre *et al*., 2000). Basavarajeshwari *et al*. (2010) stated that foliar spray of ferrous sulphate 100 ppm significantly increased in the number of seeds per fruit (128.26) as well as the seed yield (136.48 kg/ha) of chilli.

Hussain *et al*. (1988) reported that the combined spray of zinc, boron and iron each at 0.1% showed the best response to increase in number of seeds per fruit, seed yield per hectare and test weight (0.57 g). Bajpai *et al*. (2001) reported an increase in seed recovery rates with micronutrients application in okra. Foliar spray of NAA 10 ppm and boron 1 ppm applied at first flowering stage ranked higher with regard to number of seeds per fruit and test weight, which had a positive effect on seed yield over control (Brahma *et al*., 2010). In tomato, Salam *et al*. (2010) recorded maximum number of seeds per fruit (96) with combined application of boron 2.5 and zinc 6 kg/ha and recommended dose of NPK followed by 94 seeds per fruit at boron 2 and zinc 4 kg/ha along with recommended dose of NPK as compared to control (79).The increase in seed quality might be due to the participation of micronutrients (Zn, Fe and B) in catalytic activity and breakdown of complex substances into simplex form (glucose, amino acids, fatty acids, *etc*.), which in turn reflected on enhanced germination and elongation of root and shoot of brinjal seedlings (El-Nemr *et al*., 2012). The highest seed yield per fruit (8.50 g) and seed viability was observed with foliar spray of boron 0.25% + APSA-80 as compared to other treatments in brinjal (Gogoi *et al*., 2014).

CONCLUSION

Micronutrients are indispensable for growth and development of crops in general and vegetables in particular. The nutritional value of crops is becoming a major issue. Therefore, the application of micronutrients to sustain soil health and crop productivity besides maintaining the quality of vegetables is of profound importance. However, foliar application of micronutrients shows better efficacy than soil application as the uptake and assimilation of micronutrients by later method takes more time.

REFERENCES

Abdou, A.S., Al-Darwish, F.H., Saleh, M.E., El-Tarabily, K.A., Azirun, M.S. and Rahman, M.M., 2011. Effects of elemental sulphur, phosphorus, micronutrients and *Paracoccus versutus* on nutrients availability of calcareous soils. *Australian Journal of Crop Science,* **5**(5): 554-561.

Alam, M.N., Abedin, M.J. and Azad, M.A.K., 2010. Effect of micronutrients on growth and yield of onion under calcareous soil environment. *International Research Journal of Plant Science,* **1**(3): 56-61.

Ali, S., Javed, H.U., Rehman, Ur.R.N., Sabir, I.A., Naeem, M.S., Siddiqui, M.Z., Saeed, D.A. and Nawaz, M.A., 2013. Foliar application of some macro and micronutrients improves tomato growth, flowering and yield. *International Journal of Biosciences,* **3**(10): 280-287.

Arora, S.K., Pandita, M.L. and Singh, K., 1982. Effect of para-chlorophenoxy acetic acid, boron, copper, molybdenum and zinc on the fruit quality of tomato varieties in summer and the rainy season. *Indian Journal Agricultural Science*, **52**: 648-652.

Bajpai, S., Chouhan, S.V.S. and Bajpai, S., 2001. Effect of zinc, boron and manganese on yield of okra (*Abelmoschus esculentum*). *Indian Journal of Agricultural Sciences*, **71**(5): 332-333.

Balley, L.H., 1999. *Principles of Vegetable Cultivation*. Discovery Publication, House, New Delhi, India, 910 p.

Baloch, Q.B., Chachar, Q.I. and Tareen, M.N., 2008. Effect of foliar application of macro and micro nutrients on production of green chilies (*Capsicum annuum* L.). *Journal of Agricultural Technology,* **4**(2): 177-184.

Barche, S., Singh, P., Mahasagar, H. and Singh, D.B., 2011. Response of foliar application of micronutrients on tomato cv. Rashmi. *Indian Journal of Horticulture*, **68**(2): 278-279.

Basavarajeshwari, C.P., Ajjappalavara, P.S. and Dhotre, M., 2010. Effect of micronutrients on seed production in chilli. Bhuvaneshwar, India, 305-310.

Bhatt, L. and Srivastava, B. K., 2005. Effect of Foliar Application of Micronutrients on Nutrient Uptake in Tomato. *Vegetable Science,* 32(2): 158-161.

Bhatt, L. and Srivastava, B.K., 2006. Effect of foliar application of micronutrients on the nutritional composition of tomato. *Indian Journal of Horticulture*, **63**(3): 312-317.

Bhatt, L., Srivatsava B.K. and Singh M.P., 2004. Studies on the effect of foliar application of micronutrients on growth, yield and economics of tomato (*Lycopersicon esculentum* Mill.). *Progressive Horticulture,* **36**(2): 331-334.

Bid, N.N., De, A.K., Srivastava, B.K. and Kole, K.K., 1992. Response of micronutrients, zinc and copper on brinjal (*Solanum melongena* L.). In: *Proceedings of the Workshop on Micronutrients*, January 22-23, 1992, Bhuvaneshwar, India, pp. 305-310.

Bose, U.S. and Tripathi, S.K., 1996. Effect of micronutrients on growth, yield and quality of tomato cv. Pusa Ruby in MP. *Crop Research*, **12**: 61-64.

Brahma, S., Phookan, D.B., Kachari, M., Hazarika, T.K. and Das, K., 2010. Performance of capsicum as influenced by bio-regulators and micronutrients inside polyhouse under Assam conditions. *Indian Journal of Horticulture*, **67**(Special Issue): 467-469

Chandra, A. and Verma, B.K., 2003. Effect of boron and calcium on plant growth and seed yield of tomato. *JNKVV Research Journal*, **37**(2): 13-16.

Davis, J.M., Sanders, D.C., Nelson, P.V., Lengnick, L. and Sperry, W.J., 2003. Boron improves the growth, yield, quality and nutrient content of tomato. *Journal of the American Society for Horticultural Science*, **128**: 441-446.

Day, S.C., 2000. Tomato Crop.In: *Vegetable Growing* (Eds.). Agrobios, Jodhpur, India, pp. 59-61.

Dongre, S.M., Mahorkar, V.K., Joshi, P.S. and Deo, D.D., 2000. Effect of micronutrients spray on yield and quality of chilli (*Capsicum annuum*L.) cv. Jayanti. *Agricultural Science Digest*, **20**(2): 106-107.

Ejaz, M., Rehman, S.U., Waqas, R., Manan, A., Imran M., and Bukhari M.A.,2011. Combined efficacy of macro-nutrients and micro-nutrients as foliar application on growth and yield of tomato grown by vegetable forcing. *International Journal for Agro-Veterinary and Medical Sciences*, **5**(3): 327-335.

Elabdeen, A.Z. and Metwally, A.M., 1982. Effect of zinc on growth, yield and quality of tomato. *Agriculture Research Review*, **60**: 143.

El-Nemr, M.A., EL-Desuki, M., Fawzy, Z.F. and El-Bassiony, A.M., 2012. Yield and fruit quality of eggplant as affected by NPK-sources and micronutrient application. *Journal of Applied Sciences Research*, **8**(3): 1351-1357.

Gogoi, S., Das, M.R., Bora, P. and Mazumder, N., 2014. Effect of foliar application of nutrients on fruit and seed production of brinjal. *International Journal of Advances in Applied Sciences*, **2**(1-2): 23-27.

Govindan, P.R., 1952. Influence of boron on yield and content of carbohydrates in tomato fruits. *Current Science*, **21**:14-15.

Gupta, V.K. and Hansraj, 1980. Effect of source and zinc levels on tomato plants. *Haryana Journal of Horticultural Sciences*, **9**: 74-76.

Hamsaveni, M.R., Kurdikeri, M.B., Shekhargouda, M., Shashidhara S.D. and Dharmatti, P.R., 2003. Effect of gypsum and boron on seed yield and quality on tomato cv. Megha. *Karnataka Journal of Agricultural Sciences*, **16**(3): 457-459.

Haque, M.E., Paul, A.K. and Sarker, J.R., 2011. Effect of nitrogen and boron on the growth and yield of tomato (*Lycopersicon esculentum* Mill.). *International Journal of Bio-resource and Stress Management*,**2**: 277-282.

Hatwar, G.P., Gondane, S.M., Urkade, S.M. and Gahukar, O.V., 2003. Effect of micronutrients on growth and yield of chilli. *Journal Soils and Crops*, **13**(1): 123-125.

Havlin, J.L., Beatson, J.D., Tisdale, S.L. and Nelson, W.L., 2005. *Soil Fertility and Fertilizers — An Introduction to Nutrient Management*, (7th ed.) Pearson Education, Inc., Pearson Prentice Hall.

Hazra, P., Rout, A., Roy, U., Nath, S., Roy, T., Dutta, R., Acharya, S. and Mondal, A.K., 2003. Characterization of brinjal (*Solanum melongena* L.) germplasm. *Vegetable Science*, **30**: 145-149.

Hussain, S.A., Mohammad, S. and Rao, B.V.R., 1989. Response of chilli (*Capsicum annuum* L.) to micronutrients. *Indian Journal of Agronomy*, **34**(1): 117-118.

Ingle, V.G., Thakre, A.U., Badhe, S.B. and Khan, M.A.H., 1993. Effect of foliar spray of auxins, micronutrients with urea on fruit drop and yield of chilli cv. CA 960. *Punjabrao Krishi Vidyapeeth Research Journal*, **17**: 142-145.

Jiskani, M.M., 2005. Foliar fertilizers- fast acting agents. Daily DAWN, the Internet Edition, Monday December 5, 2005.

Jiudith, C., Miguel, G., Ever, M. and Cesar, L., 2005. Effect of heavy metals on the growth of the tropical chilli. *Revista de Biología Tropical*, **53**(3/4): 325-330.

Kalroo, M.W., Laghari, A.M., Depar, M.S., Chandio, A.S., Pathan, A.K., Samoon H.A. and Meghwar B.L., 2013. Impact of micronutrient (zinc) foliar spray on fruit yield of chillies (*Capsicum annuum* L.). In: *Abstract of Life Science International Journal*, 11 p.

Karuppaiah, P., 2005. Foliar application of micronutrients on growth, flowering and yield characters of brinjal cv. Annamalai. *Plant Archives*, **5**(2): 605-608.

Kazemi, M., 2013. Effects of Zn, Fe and their combination treatments on the growth and yield of tomato. *Bulletin of Environment*, *Pharmacology and Life Sciences*, **3**(1): 109-114.

Khedr, Z.M.A., Fathy, E.L.E. and Moghazy, A.M. 2004. Effect of some nutrients and growth substances on productivity of eggplant (*Solanum melongena* var. esculentum) growing under high temperature conditions. *Annals of Agricultural Sciences*, **42**(2): 583-602.

Khomchack, M.E., Shiyan, O.I. and Zaporozhan, Z.E., 1971. Effect of zinc on growth, yield and quality of tomato. *Nauchnye Trudy Ukrainskoi Sel Skokhozyaistvrennoi Akademi*, **57**: 376-381.

Kiran, J., Vyakaranchal, B.S., Raikar, S.D., Ravikumar, G.H. and Deshpande, V.K., 2010. Seed yield and quality of brinjal as influenced by crop nutrition. *Indian Journal of Agricultural Research*, **44**(1): 1-7.

Kumar, A., Singh, R.K. and Parmar, A.S., 2012. Effect of foliar application of micronutrients on yield characters and yield of tomato (*Lycopersiconesculentum* Mill).*Technofame*: *A Journal of Multidisciplinary Advance Research*,**1**(2): 10-14.

Kumar, D.M.R. and Malabasari, T.A., 2011. Effect of planting geometry and foliar spray of micronutrients on plant growth, seed yield and quality of bell pepper (*Capsicum annuum* L.). M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka, India, 52 p.

Kumari, S., 2012. Effect of micronutrient quality of fruit and seed in tomato (*Solanum lycopersicum* L.). *International Journal of Farm Sciences*, **2**(1): 43-46.

Maheswari, T.U., Haripriya, K. and Kamalakannan, S., 2003. Impact of foliar organic nutrients on nutrient uptake pattern of chilli (*Capsicum annuum* L.) cv. K 2. *South Indian Horticulture*, **51** (1/6): 168-172.

Mallick, M.F.R. and Muthukrishnan, C.R., 1980. Effect of micronutrients on the quality of tomato (*Lycopersicon esculentum* Mill.). *Vegetable Science*, **7**: 6-13.

Mohammed, H.S., Prasad, V.M. and Saravanan, S., 2014. Effect of FYM, N P K and micronutrients on yield of tomato (*Lycopersicon esculentum* Mill.) cv. HeemSohna under protected cultivation. *International Journal of Agricultural Science and Research*, **4**(1): 17-26.

Mousavi, S.R., 2011. Zinc in crop production and interaction with phosphorus. *Australian Journal of Basic and Applied Sciences*, **5**(9): 1503-1509.

Nandkarni, K.M., 1927. *Indian Materia Medica*. Nandkarni & Co., Bombay, India.

Natesh, N., Vyakaranahal, B.S., Shekhargouda, M. and Deshpande, V.K., 2005. Effect of micronutrients and organics on growth, seed yield and quality of chilli. *Karnataka Journal of Agricultural Sciences*, **18**(2): 334-337.

Naz, R.M.M., Muhammad, S., Hamid, A. and Bibi, F., 2012. Effect of boron on the flowering and fruiting of tomato. *Sarhad Journal of Agriculture*, **28**(1): 37-40.

Nonnecke, I.B.L., 1989. *Vegetable Production*. AVI Book Publishers. New York, USA, pp. 200-229.

Rab, A. and Haq-Ihsan-Ul, 2012.Foliar application of calcium chloride and borax influences plant growth, yield, and quality of tomato (*Lycopersicon esculentum* Mill.) fruit. *Turkey Journal of Agriculture and Forestry*,**36**: 695-701.

Radulovic, M., 1996. Soil and vegetable nutrients supply in the region of the Zeta Montenegro. *Review of Research Work at the Faculty of Agriculture*, Belgrade, **41**(1): 31-40.

Raj, G.B., Patnaik, M.C., Reddy, I.P. and Rao, A.P., 2001. Response of brinjal (*Solanum melongena* L.) to zinc and iron. *Vegetable Science*, **28**(1): 80-81.

Ravichandran, M., Jerome, J.J. and Sriramachandra-Sekharan, M.V., 1995. Effect of zinc and copper on yield and quality of brinjal. *Annals of Agriculture Research*, **16**(3): 282-285.

Reddy, P., Reddy, S., Ramakrisna, M.G., Veeraraghavaiah, R., Subramanyam, K. and Reddy, D.S., 1985. Response of tomato to micronutrients. *South Indian Horticulture*, **33**: 23-25.

Salam, M.A., Siddique, M.A., Rahim, M.A., Rahman, M.A. and Saha, M.G., 2010. Quality of tomato (*Lycopersicon esculentum* Mill.) as influenced by boron and zinc under different levels of NPK fertilizers. *Bangladesh Journal of Agriculture Research*, **35**(3): 475-488.

Saravaiya, S.N., Wakchaure, S.S., Jadhav, P.B., Tekale, G.S., Patil, N.B., Dekhane, S.S. and Patel, D.J., 2014. Influence of foliar application of micronutrients on tomato (*Lycopersicon esculentum* Mill.) cv. “Gujarat Tomato 2”. *International Journal of Development Research*, **4**(8): 1539-1542.

Sathya, S., Mani, S., Mahedran, P.P., Arulmozhiselvan, K., 2010. Effect of application of boron on growth, quality and fruit yield of PKM 1 tomato. *Indian Journal of Agricultural Research*, **44**(4): 274-280.

Shafeek, M.R., Helmy, Y.I., Awatef, Beheiry, G., Fatma, A. Rizk and Nadia, M. Omar, 2014. Foliar application of some plant nutritive compounds on growth, yield and fruit quality of hot pepper plants (*Capsicum annuum* L.) grown under plastic house conditions. *Current Science International*, **3**(1): 1-6.

Sharma, B.R., Chadha, A.P.S. and Bajpai, H.K., 2000. Response of chilli (*Capsicum annuum* Linn.) to nitrogen and phosphorus levels under irrigated condition. *Advances in Plant Sciences*, **9**(2): 213-214.

Sharma, S.K., 1995. Response of boron and calcium nutrition on plant growth, fruit and seed yield quality of tomato. *Vegetable Science*, **22**(1): 27-29.

Sharma, S.K., 1999. Effect of boron and calcium on seed production of bell pepper (*Capsicum annuum* L.). *Vegetable Science*, **26**(1): 87-88.

Shil, N.C., Naser, H.M., Brahma, S., Yousuf, M.N. and Rashid, M.H., 2013. Response of chilli (*Capsium annuum* L.) to zinc and boron application. *Bangladesh Journal of Agricultural Research*, **38**(1): 49-59.

Shivprasad, M., Mohankumar, H.D., Astaputre, S.A., Chittapur, B.M., Tatagar, M.H. and Mesta, R.K. 2009. Yield and quality of chilli (cv. Bydagi Dabbi) as influenced by secondary and micronutrients. *Karnataka Journal of Agricultural Sciences*, **22**(5): 1090-1092.

Shnain, R.S., Prasad, V.M. and Saravanan, S., 2014. Effect of zinc and boron on growth, yield and quality of tomato (*Lycopersicon esculentum* Mill.) cv. Heem Sohna, under protected cultivation. *European Academic Research*, **2**(3): 4572-4597.

Singh, D.K., Rudra, B.C. and Gangopadhyaya, P.K., 2014. Role of micronutrients in the Productivity enhancement of tomato. *Journal of Agricultural Technology*, **1**(1): 68-69.

Singh, H.M. and Tiwari, J.K., 2013. Impact of micronutrient spray on growth, yield and quality of tomato (*Lycopersicon esculentum* Mill). *Hort Flora Research Spectrum*, **2**(1): 87-89.

Singh, K.P. and Kalloo, G., 2000. Nutrient management in vegetable crops. *Fertilizer News*, **45**: 77-81.

Singh, S.D., Singh, Y.V. and Bhandari, R.C., 1989. Tomato yield as related to drip lateral spacing and fertilizer application on total and wetted area basis. *Canadian Journal of Plant Science*, **69**: 991-999.

Singh, S.S. and Verma, S.K., 1991. Influence of potassium, zinc and boron on growth and yield of tomato (*Lycopersicon esculentum* Mill.). *Vegetable Science*, **18**: 122-129.

Sivaiah, N.K., Swain, S.K., Sandeep, V. and Raju B., 2013. Effect of foliar application of micronutrients on growth parameters in tomato (*Lycopersicon esculentum* Mill.). *Journal of Agriculture and Food Sciences*. **1**(10): 146-151.

Suganiya, S., Kumuthini and Harris, D., 2015. Effect of boron on flower and fruit set and yield of ratoon brinjal crop. *International Journal of Scientific Research and Innovative Technology,* **2**(1): 135-141.

Terhan, S.P. and Sekhon, G.S., 1977. Effect of clay, organic matter and $CaCO_3$ content of zinc adsorption by soil. *Plant and Soil*, **46**: 329-336.

Umajyothi, K. and Shanmugavelu, K.G., 1985. Studies on the effect of triacontanol, 2, 4-D and boron on the yield of brinjal cv. MDU 1. *South Indian Horticulture*, **33**: 234-239.

Verma, A.N., Ram, K. and Sharma, R.K., 1973. Growth, yield and quality of tomato (*Lycopersicon esculentum* Mill.) as affected by foliar applications of boron in sand culture. *Mysore Journal of Agricultural Sciences*, **7**: 130-132.

Verma, S.K., Singh, S.S. and Awasthi, C.P., 1995. Response of zinc and boron fertilization on yield and quality of tomato fruits at different stages of picking. *Vegetable Science*, **22**: 5-8.

Verma, T.S., Singh, Lakhanpal, K.D. and Singh, R.V., 2004. Micronutrients application for enhancing seed yield in capsicum variety California Wonder. *SeedResearch*, **32**(2): 224-225.

Yadav, P.V.S., Tikkoo, A. and Sharma, N.K., 2003. Effect of zinc and boron application on growth, flowering and fruiting of tomato (*Lycopersicon esculentum* Mill.). *Haryana Journal of Horticultural Sciences*, **13**(6): 107-112.

Yoganand, D.K., 2001. Effect of mother plant nutrition and growth regulators on plant growth, seed yield and quality of bell pepper cv. California Wonder. M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka, India.