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Response on growth, yield and quality parameters of Multiplier Onion (*Allium cepa* L. var. *aggregatum* Don.) var. CO(On)5 with different doses and method of Zinc and Boron application

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Abstract

The experiment was carried out in order to study the effect of zinc and boron application on seeding transplanting multiplier onion CO(On)5 at different levels of both foliar and basal application. The treatment consist of soil application of zinc sulphate (5 kg ha^{-1} and 10 kg ha^{-1}), Borax (5 kg ha^{-1} and 10 kg ha^{-1}), foliar application of zinc sulphate (0.5% foliar) and Borax (0.25% foliar), zinc sulphate (5 kg soil + 0.5% foliar), zinc sulphate (10 kg ha^{-1} soil + 0.5% foliar), borax (5 kg ha^{-1} soil + 0.25% foliar), borax (10 ha^{-1} kg soil + 0.25% foliar) and control without micronutrient, replicated thrice in a randomized block design. Results were found to be significant in most of the yield contributing parameters of multiplier onion. The plant height (50.30 cm), number of leaves per plant (51.3), leaf girth (8.1 mm), fresh leaf weight (22.7 g), fresh bulb weight (85.4 g), total dry matter production (5.31 t ha^{-1}), bulb yield per plot (10.1 kg) and bulb yield per hectare (16.9 t ha^{-1}), Ascorbic Acid (16.70 mg 100g^{-1}) were highest in zinc sulphate 0.5% foliar spray; while 10 kg ha^{-1} borax soil application showed highest polar (26.0 mm) and equatorial diameter (27.2 mm) and borax (5 kg ha^{-1} soil + 0.25% foliar), highest number of bulblets per clump (8.8) in borax (10 kg ha^{-1} soil). The highest TSS content (21.30 °Brix) was observed in soil application of zinc sulphate (10 kg ha^{-1}) application.

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Introduction

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops being grown all over the country having diuretic properties, relieves heat sensation, hysterical faintness, insect bites and is also heart stimulation. Multiplier onion (*Allium cepa* L. var. *aggregatum* Don.) is one the very important type of onion grown extensively in Southern states of India and mainly famous for its pungency used in *Sambar* preparation, important dish in South Indian kitchen. Application of micronutrients to soil deficient in them has shown remarkable increase in yield of several crops. Micronutrients play an active role in the plant metabolic process from cell wall development to respiration, photosynthesis, chlorophyll formation, enzymes activity, nitrogen fixation etc. (Ballabh and Rana, 2012). In India, it is grown in 11.10 lakh hectare with production of 159.30 lakh tons and productivity of 14.5 t ha^{-1}. India ranks first in area and second to China in production but 102nd in terms of productivity (FAOSTAT, 2013).

In India, analysis of 2.52 lakhs surface soil samples collected from different parts of the country revealed the predominance of zinc deficiency in divergent soils. Zinc is a crucial component of the package of the practices recommended sodic soils reclamation. Deficiency of boron occurs widely in highly calcareous soils of Bihar, parts of Gujarat and Tamil Nadu. Indian soils are exposed to multi-micronutrient deficiencies that closely associated with the yield and quality of crops. Particularly, zinc deficiency is widely prevalent and it has been estimated that 60 % of Indian soil and more than 70 % of Tamil Nadu soils are found to be deficient and therefore, micronutrient fertilizer is almost essential in order to achieve the yield of crops (Singh, 2005).

Although there is enough research conducted on micronutrient application of the bellary onion, very less study has been done in multiplier onion that too seed transplanting multiplier onion. Foliar application of micronutrients during crop growth was successfully used for correcting their deficits and improving the mineral status of plants as well as increasing the crop yield and quality (Kolota and Osinska, 2001). The foliar application of micronutrients had a significant effect on plant growth, yield and quality (Sliman *et al.*, 1999; Gamelli, 2000., El-Shafie and El-Gamaily, 2002.; El-Tohamy *et al.,* 2009 and Alam *et al.,* 2010). In the same respect, spraying onion plants cv. Pusa Red with Fe or Zn at 60 and 70 days after transplanting date lead to significant increase of plant vegetative growth as well as bulb yield and quality (Singh and Tiwari, 1995). This multiplier onion variety CO(On)5 is only seedling transplanting as multiplier onion is shy flowering in nature. The purpose of this experiment was to study the effect of micronutrients especially zinc and boron on growth and yield of multiplier onion variety CO(On)5 under Coimbatore condition.

Materials and methods

Experimental Site

The experiment was carried out at College orchard, Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamil Nadu during *Kharif* season the year 2013-14. The experiment was laid out in a Randomized Block Design which was replicate thrice. Coimbatore is situated at 11° N latitude and 77° E longitude and at an elevation of 426.6 m above mean sea level. Coimbatore is cocooned between the Western Ghats in the north and western side, the Nilgiri Biosphere Reserve, Annamalai range, Munnar range and the western pass Palghat. As such, this location gives Coimbatore a peculiar rainfall pattern. It receives an average rainfall of 61.22 cms annually, spreading over an average of 44.5 days in a year. The south-west monsoon contributes rain in the months from June to August. A humid September is followed by an October-November rain by the retreating North-eastern monsoon.

Materials Used

The experimental soil is reddish brown calcareous clay soil with alkaline pH 8.12, low in organic carbon (0.42%), non-saline, electrical conductivity (0.85 dS m^{-1}), available nitrogen (216 kg ha^{-1}), available

phosphorus (18 kg ha^{-1}), available potassium (1501 kg ha^{-1}), available Zn (0.31 ppm) and available boron (0.48 ppm). The soil is deficient in available zinc and boron. Hence the soil application and foliar application (two times 30 and 45 days after transplanting) of micronutrient source, zinc sulphate for zinc and borax for boron was used as experimental material and its effect on the yield and quality of onion. The foliar spray was given 30 and 45 days after transplanting for both zinc sulphate and borax. N, P, K, and S were applied at 90-60-60-20 kg ha^{-1} respectively as basal dose.

Methodology

The treatments consist of T_1 (zinc sulphate soil application @ 5 kg ha^{-1}), T_2 (zinc sulphate soil application @ 10 kg ha^{-1}), T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT), T_4 (zinc sulphate soil application @ 5 kg ha^{-1}+ zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT), T_5 (zinc sulphate soil application @ 10 kg ha^{-1}+ zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT), T_6 (borax soil application @ 5 kg ha^{-1}), T_7 (borax soil application @ 10 kg ha^{-1}), T_8 (boric acid foliar spray 0.25% @ 30 and 45 DAT), T_9 (borax soil application @ 5 kg ha^{-1}+ boric acid foliar spray 0.25% @ 30 and 45 DAT), T_{10} (borax soil application @ 10 kg ha^{-1} + boric acid foliar spray 0.25% @ 30 and 45 DAT) and T_{11} (control without micronutrients) replicated thrice in a randomized block design. Growth and yield parameters such as plant height, number of leaves per plant, leaf girth, fresh leaf weight, fresh bulb weight, total dry matter production, number of bulblets per clump, equatorial diameter, polar diameter, bulb yield per plot and hectare, ascorbic acid and TSS were under study. Drip irrigation method was used in the entire period of the study. The results recorded in various experiments were statistically analysed for drawing out definite conclusions (Panse and Sukhatme, 1967).

Results

Growth Parameters

Plant Height

The application of zinc and boron on plant height of multiplier onion was found significant. At harvesting stage, the tallest plant height (59.1 cm) was observed in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) which was on par with T_2 (zinc sulphate soil application @ 10 kg ha^{-1}) with height of 58.0 cm whereas the shortest plant height was recorded by T_{10} (borax soil application @ 10 kg ha^{-1} + boric acid foliar spray 0.25% @ 30 and 45 DAT) which was 41.3 cm.

Table 1. Effect of zinc and boron application on growth parameters of multiplier onion var. CO(On)5.

Treatment	Plant Height (cm)	Number of leaves	Leaf girth (mm)	Fresh leaf weight per plant (g)	Fresh bulb weight per plant (g)	Dry matter production (t ha^{-1}) Tops	Bulbs
T_1	50.2	41.3	6.7	15.7	54.3	0.83	3.29
T_2	58.0	47.7	7.2	17.9	85.3	1.28	5.09
T_3	59.1	51.3	8.1	22.7	85.4	1.45	5.31
T_4	50.3	42.3	6.9	16.8	73.4	1.12	4.63
T_5	45.9	35.3	5.9	15.3	63.9	1.11	3.95
T_6	48.9	39.4	6.2	12.6	46.7	0.79	2.89
T_7	52.3	43.3	6.8	16.5	63.8	1.08	4.40
T_8	54.6	45.4	7.0	17.3	73.9	1.15	4.85
T_9	50.2	41.3	6.7	16.1	61.7	1.04	3.70
T_{10}	41.3	37.8	5.6	15.8	58.5	0.99	3.26
T_{11}	47.7	39.0	6.0	10.5	40.1	0.59	2.41
Mean	50.8	42.2	6.7	16.1	64.3	1.04	3.98
SEd	1.53	1.39	0.21	1.33	5.58	0.097	0.367
CD (0.05)	3.19	2.89	0.44	2.77	11.64	0.202	0.766

Number of leaves

There was significant effect of zinc and boron application on number of leaves which ranges from 37.8 to 51.3. The highest number of leaves per plant was recorded in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (51.3) followed by T_2 (zinc sulphate soil application @ 10 kg ha^{-1}) (47.7) at harvest. The lowest number of leaves per plant was observed in T_5 (zinc sulphate soil application @ 10 kg ha^{-1} + zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) which was noted as 37.3.

Leaf girth

The highest leaf girth was recorded in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (8.1 mm) which was on par with T_2 (zinc sulphate soil application @ 10 kg ha^{-1}) (7.2 mm). The lowest leaf girth was observed in T_{10} (borax soil application @ 10 kg ha^{-1} + boric acid foliar spray 0.25% @ 30 and 45 DAT) (5.6 mm) at harvest.

Fresh leaf weight

The fresh leaf weight range from 10.5 g to 22.7 g and significant response was observed among treatments. The highest fresh leaf weight was recorded in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (22.7 g) followed by T_2 (zinc sulphate soil application @ 10 kg ha^{-1}) (17.9 g) which was on par with T_8 (boric acid foliar spray 0.25% @ 30 and 45 DAT) (17.3 g). The lowest fresh leaf weight per plant was recorded in T_{11} (Control without micronutrients) which was recorded as 10.5 g.

Table 2. Effect of zinc and boron application on yield and yield parameters of multiplier onion var. CO(On)5.

Treatment	Polar diameter (mm)	Equatorial diameter (mm)	No. of bulblets per clump (nos.)	Yield per plot (kg)	Yield per hectare (t ha^{-1})
T_1	21.4	19.0	4.7	7.7	12.9
T_2	22.8	19.9	7.0	9.1	15.2
T_3	25.5	23.5	8.2	9.6	16.0
T_4	25.1	20.9	6.2	9.2	15.3
T_5	21.3	17.1	5.3	7.4	12.4
T_6	22.1	21.3	5.2	8.3	13.9
T_7	26.0	27.2	7.1	9.3	15.5
T_8	25.8	26.3	8.8	9.5	15.9
T_9	22.8	21.0	8.3	8.6	14.3
T_{10}	20.5	19.5	5.9	7.2	12.0
T_{11}	18.3	16.0	4.2	6.0	10.0
Mean	22.9	21.1	6.4	8.4	13.9
SEd	0.75	1.05	0.85	0.59	0.99
CD (0.05)	1.57	2.19	1.78	1.22	2.06

Fresh bulb weight

The highest fresh bulb weight was recorded in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (85.4 g) which was on par with T_2 (zinc sulphate soil application @ 10 kg ha^{-1}) (85.3 g). The lowest fresh bulb weight per plant was recorded in T_{11} (Control without micronutrients) (40.1 g).

Total dry matter production

At harvest, total dry matter production was separately calculated as total dry matter production of tops (leaves) and bulb. At harvesting stage, the highest total dry matter production of tops (leaves) was observed in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (1.45 t ha^{-1}) which was on par with T_2 (zinc Sulphate soil application @ 10 kg ha^{-1}) (1.28 t ha^{-1}) followed by T_8 (boric acid foliar spray 0.25% @ 30 and 45 DAT) (1.15 t ha^{-1}). The lowest total dry matter production of leaves was recorded T_{11} (Control without micronutrients) (0.59 t ha^{-1}) at harvesting stage. The highest total dry matter production of bulb was observed in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (5.31 t ha^{-1}) which was on par with T_2 (zinc sulphate soil application @ 10 kg ha^{-1}) (5.09 t ha^{-1}) and T_8 (boric acid foliar spray 0.25% @ 30 and 45 DAT) (4.85 t ha^{-1}) respectively. The lowest total dry matter production of leaves was observed in T_{11} (Control without micronutrients) (2.41 t ha^{-1}) at harvesting stage.

Yield and Yield Parameters

Polar diameter

The application of zinc and boron shows significant effect in the bulb polar diameter of aggregatum onion. The highest bulb polar diameter was recorded in T_7 (borax soil application @ 10 kg ha^{-1}) (26.0 mm) which

was on par with T_8 (boric Acid foliar spray 0.25% @ 30 and 45 DAT) (25.8 mm), T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (25.5 mm) and T_4 (zinc sulphate soil application @ 5 kg ha^{-1} + zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (25.1 mm). The lowest bulb polar diameter was observed in T_{11} (Control without micronutrients) (18.3 mm).

Table 3. Effect of zinc and boron application on Ascorbic acid content ($mg100g^{-1}$) and TSS (°Brix) of multiplier onion var. CO(On)5.

Treatments	Ascorbic acid ($mg100g^{-1}$)	TSS (°Brix)
T_1	14.20	15.10
T_2	16.30	21.30
T_3	16.70	17.70
T_4	12.50	15.55
T_5	11.97	16.30
T_6	10.10	20.80
T_7	12.60	15.60
T_8	10.30	16.30
T_9	16.17	20.70
T_{10}	10.65	14.20
T_{11}	9.02	12.36
Mean	12.77	16.90
SEd	0.820	0.882
CD (0.05)	1.711	1.840

Equatorial diameter

The application of zinc and boron shows significant effect in the bulb equatorial diameter of multiplier onion. The highest bulb equatorial diameter was recorded by T_7 (borax soil application @ 10 kg ha^{-1}) (27.2 mm) which was on par with T_8 (boric acid foliar spray 0.25% @ 30 and 45 DAT) (26.3 mm). The lowest bulb equatorial diameter was observed in T_{11} (Control without micronutrients) (16.0 mm) which was on par with T_5 (zinc sulphate soil application @ 10 kg ha^{-1} + zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (17.1 mm).

Bulblets per clump

There was significant effect of zinc and boron application on the number of bulblets per clump. The highest number of bulblets per clump was noted in T_8 (boric acid foliar spray 0.25% @ 30 and 45 DAT) (8.8) which was on par with T_9 (borax soil application @ 5 kg ha^{-1} + boric acid foliar spray 0.25% @ 30 and 45 DAT) (8.3) respectively. The lowest number of bulblets per clump was recorded in T_{11} (Control without micronutrients) (4.2).

Bulb yield per plot

The response of aggregatum onion under different level of zinc and boron was found significant for the bulb yield per plot (kg). The highest bulb yield per plot was noted in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (9.6 kg) which was on par with T_8 (boric acid foliar spray 0.25% @ 30 and 45 DAT) (9.5 kg) and T_4 (zinc sulphate soil application @ 5 kg ha^{-1} + zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (9.2 kg) respectively. The lowest bulb yield per plot was recorded in T_{11} (control without micronutrient) (6.0 kg).

Bulb yield per hectare

The application of zinc and boron was found to have significant effect on the bulb yield per hectare of aggregatum onion. The highest bulb yield per hectare was recorded in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) with bulb yield of 16.0 t ha^{-1} followed

by T_8 (boric acid foliar spray 0.25% @ 30 and 45 DAT) (15.9 t ha^{-1}) and T_4 (zinc sulphate soil application @ 5 kg ha^{-1} + zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (15.3 t ha^{-1}). The lowest bulb yield was observed in T_{11} (control without micronutrients) (10.0 t ha^{-1}).

Quality parameters

Ascorbic acid

The effect of zinc and boron application on the ascorbic acid content is presented in Table 3. The highest ascorbic acid was observed in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) (16.70 mg $100g^{-1}$), which was on par with T_2 (zinc sulphate soil application @ 10 kg ha^{-1}) (16.30 mg $100g^{-1}$) and T_9 (borax soil application @ 5 kg ha^{-1} + boric acid foliar spray 0.25% @ 30 and 45 DAT) (16.17 mg $100g^{-1}$) respectively. However, the lowest ascorbic acid content was noted in T_{11} (Control without micronutrients) (9.02 mg $100g^{-1}$)

Total Soluble Solid

The application of zinc and boron at different levels was found to have significant effect on the Total Soluble Solid (TSS) in multiplier onion (Table 3). The treatment T_2 (zinc sulphate soil application @ 10 kg ha^{-1}) noted the highest TSS content of 21.30 °Brix which was on par with T_6 (borax soil application @ 5 kg ha^{-1}) (20.80 °Brix) and T_9 (borax soil application @ 5 kg ha^{-1} + boric acid foliar spray 0.25% @ 30 and 45 DAT) (20.70 °Brix). The lowest TSS content was recorded in T_{11} (Control without micronutrients) (12.36 °Brix).

Discussions

Growth parameters

The highest plant height, number of leaves per plant and leaf girth was observed in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) followed by T_2 (zinc sulphate soil application @ 10 kg ha^{-1}). Other treatments like T_4 (zinc sulphate soil application @ 5 kg ha^{-1}+ zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT), T_5 (zinc sulphate soil application @ 10 kg ha^{-1}+ zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT), T_9 (borax soil application @ 5 kg ha^{-1}+ boric acid foliar spray 0.25% @ 30 and 45 DAT) and T_{10} (borax soil application @ 10 kg ha^{-1} + boric acid foliar spray 0.25% @ 30 and 45 DAT). Application of zinc and boron through soil or foliar or in combination had a beneficial effect on the growth of onion. This may be due to initial soil application and one foliar application of zinc sulphate. Zinc is essential for tryptophan synthesis, which is a prerequisite for auxin formation, therefore amount of auxin decreases by zinc deficiency (Pedler *et al.,* 2000; Marschner, 1995; Cakmak *et al.,* 1989). Zinc deficiency decreases plant growth by increasing the concentration of boron in the young leaves and tips of the branches. The favorable effect of zinc on plant growth may be due to its role in many physiological process and cellular function within plants. In addition, zinc and boron play an essential role in improving plant growth, through the biosynthesis of endogenous hormones which is responsible for promotion of plant growth (Bhatt *et al.,* 2004; Hansch and Mendel, 2009). Increase in number of leaves per plant may be attributed to the role of micronutrients (Zn, B) in cell division, meristematic activity of plant tissue and expansion of cells (Patil *et al.,* 2009). Application of zinc and boron through soil or foliar or in combination had a beneficial effect on the growth of onion regardless of stages. It is quite obvious that the experimental soil is deficient in zinc and boron and external application will favorably enhance the growth of onion. The same trends were also recorded by many authors in onion (Sindhu and Tiwari, 1993; Sliman *et al.,* 1999; Gamelli *et al.,* 2000; El-Shafie and El-Gamaily, 2002; Nasreen *et al.,* 2007; El-Tohamy *et al.,* 2009; Alam *et al.,* 2010; Abd El-Samad *et al.,* 2011; Ballabh and Rana, 2012; Manna, 2013; Trivedi and Dhumal, 2013).

Yield and yield parameters

The yield parameters under study were number of bulblets per clump, polar diameter, equatorial diameter and yield per plot and hectare. The number of bulblets per clump was significantly higher in T_8 (boric acid foliar spray 0.25% @ 30 and 45 DAT) followed by T_7 (borax soil application @ 10 kg ha^{-1}) and T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45

DAT). This may be due to the improved growth characters as a result of foliar application of micronutrient which would have enhanced photosynthesis and other metabolic activities, which lead to increase in cell division and elongation (Hatwar *et al.,* 2003). This result is in agreement with Schmidt (1964); Katare *et al.* (1971); Smriti *et al.* (2002); Manna (2013) in onion.

The polar diameter, equatorial diameter influence the yield of onion and consumer preference. The polar and equatorial diameter was higher in T_7 (borax soil application @ 10 kg ha^{-1}) followed T_8 (boric acid foliar spray 0.25% @ 30 and 45 DAT). This may be due to the micronutrient application especially boron which enhances the enzyme activity which in turn trigger the physiological processes like protein and carbohydrate metabolism in plants. Similar results were reported by Schmidt (1964); Katare *et al.* (1971); Lal and Maurya (1981); Smriti *et al.* (2002); Alam *et al.* (2010); Manna (2013).

The response of application of zinc and boron either in soil or foliar had a favorable influence in the bulb yield of onion in a slightly sodic soil with the zinc and boron deficient soil than critical level. The highest bulb yield per plot and hectare was recorded in T_3 (zinc sulphate foliar spray 0.5 % @ 30 and 45 DAT) followed by T_8 (boric acid foliar spray 0.25% @ 30 and 45 DAT). This may be due to zinc, which is one of the most important elements in the carbohydrates metabolism, most enzymes that play a role in carbohydrates metabolism are activated by zinc. In addition Carbonic anhydrase, Fructose-1, 6-bisphosphate and Aldolase enzymes are activated by zinc. These enzymes are active in the chloroplasts and cytoplasm, six-carbon sugar molecule are separated between chloroplasts and cytoplasm by Fructose-1,6-bisphosphate and three-carbon sugars molecule in photosynthesis are transported from cytoplasm to chloroplasts by Aldolase. The activity of these enzymes decreased in zinc deficiency condition, in resulting carbohydrate accumulation in plant leaves (Marschner and Cakmak, 1989; O'sullivan, 1970). Similar finding were reported by Schmidt (1964); Katare *et al.* (1971); Sindhu and Tiwari (1993); Meena and Singh (1998); Sliman *et al.* (1999); Gamelli (2000); El-Shafie and El-Gamaily (2002); Smriti *et al.* (2002); El-Tohamy *et al.* (2009); Alam *et al.* (2010); Abd El-Samad *et al.* (2011); Ballabh and Rana (2012); Manna (2013); Trivedi and Dhumal (2013) in onion.

Quality parameters

The quality of onion could be determined by the assessment of certain parameters like total soluble solids and pyruvic acid content. These parameters would be used by the consumers and importers of onion. This also determines the quality of the crop and presence of essential nutrients present in them for which this is consumed. The application of zinc and boron was found to have significant effect on TSS and ascorbic acid either foliar or soil application. The foliar spray as well as soil application of zinc and boron shows higher value of total soluble solid and ascorbic acid in multiplier onion. The increase in qualitative parameters of bulb may be due to increased carbohydrates production during photosynthesis. Zinc and boron play very important role in photosynthetic activities of plant (Marschner, 1995; Dell and Wilson 1985; Ohki, 1976). Similar findings were reported by Jawaharlal and Veeraragavathatham 1988; Sindhu and Tiwari (1993); Ballabh and Rana (2012); Manna (2013); Trivedi and Dhumal (2013) in onion.

Conclusion

The application of zinc and boron shows positive effect towards the growth, yield and yield parameters of aggregatum onion. Growth parameters such as plant height, number of leaves and leaf girth and physiological parameters such as dry matter production were highly responsive to foliar spray and soil application of zinc sulphate and borax. Yield and quality parameters highly responded to boron as well as zinc, so judicial application of zinc and boron may provide highest yield.

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