www.hortflorajournal.com
HortFlora Research Spectrum, 4(2): 155-158 (June 2015) ISSN : 2250-2823

PHYSIOLOGICAL AND YIELD PARAMETERS OF MULTIPLIER ONION (*Allium cepa* L. var *aggregatum* Don.) VAR. CO(On)$_5$ AS INFLUENCED BY ZINC AND BORON APPLICATION

Umesh Acharya[1*], K. Venkatesan[2], T. Saraswathi[3] and K. S. Subramanian[4]

[1]*ForestAction Nepal, Satdobato, Lalitpur, Nepal*
[2]*Post Harvest Technology Centre, TNAU, Coimbatore, India*
[3]*Department of Vegetable Crops, HC & RI, TNAU, Coimbatore, India*
[4]*Department of Nano Science and Technology, TNAU, Coimbatore, India*
**E-mail : acharyaumesh07@gmail.com*

ABSTRACT : The field experiment was carried out in the College Orchard, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu during 2013 - 2014 to study the effect of zinc and boron on seedling transplanting of multiplier onion CO(On)$_5$ at different levels of both foliar and basal application. The eleven treatments consisted of different combination of the soil and foliar application of zinc sulphate as zinc source and borax as boron source replicated thrice in a randomized block design. The foliar spray was given 30 and 45 days after transplanting for both zinc sulphate and borax. Nitrogen, Phosphorus, Potassium, and Sulphur were applied @ 90-60-60-20 kg ha^{-1}, respectively as basal dose. Results were found to be significant in most of the physiological and yield contributing parameters of multiplier onion. The total chlorophyll content (1.38 mg 100 g^{-1}), total dry matter production (5.31 t ha^{-1}) and bulb yield per hectare (16.9 t ha^{-1}) were highest in zinc sulphate by 0.5% foliar spray. The highest benefit : cost ratio (2.08) was recorded in T$_3$ (zinc sulphate foliar spray @ 0.5 % at 30 and 45 DAT).

Keywords : *Multiplier onion, micronutrient, seedling transplanting, boron, zinc*

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops being grown all over the India for its diuretic properties, relieves heat sensation, hysterical faintness, insect bites and is also heart stimulation. Multiplier onion (*Allium cepa* L. var. *aggregatum* Don.) is one of 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. Micronutrients play an active role in the plant metabolic processes from cell wall development to respiration, photosynthesis, chlorophyll formation, enzymes activity, nitrogen fixation etc. (Ballabh and Rana, 3). Zinc is a crucial component of the package of the practices recommended for 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. The foliar application of micronutrients had a significant effect on plant growth, yield and quality (Alam *et al.,* 2). This multiplier onion variety CO(On)$_5$ is only seedling transplanting as multiplier onion is shy flowering in nature. Although there are some studies on micronutrient application on the bulb transplanting multiplier, very less study has been undergone for the seedling transplanting multiplier onion. 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

The experiment was carried out at College Orchard, Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu during Kharif season of the year 2013-14. The experiment was laid out in a Randomized Block Design which was replicated thrice. Coimbatore is situated at 11° N latitude and 77° E longitude 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. 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}),

Received:29-03-2015 ; Revised:17-05-2015 ; Accepted:24-05-2015

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 treatments consisted 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 % at 30 and 45 DAT), T_4 (zinc sulphate soil application @ 5 kg ha^{-1} + zinc sulphate foliar spray @ 0.5 % at 30 and 45 DAT), T_5 (zinc sulphate soil application @ 10 kg ha^{-1}+ zinc sulphate foliar spray @ 0.5 % at 30 and 45 DAT), T6 (borax soil application @ 5 kg ha^{-1}), T_7 (borax soil application @ 10 kg ha^{-1}), T_8 (boric acid foliar spray @ 0.25% at 30 and 45 DAT), T_9 (borax soil application @ 5 kg ha^{-1}+ boric acid foliar spray @ 0.25% at 30 and 45 DAT), T_{10} (borax soil application @ 10 kg ha^{-1} + boric acid foliar spray @ 0.25% at 30 and 45 DAT) and T_{11} (control without micronutrients) replicated thrice in a randomized block design. Physiological and yield parameters such as total chlorophyll content, total dry matter production, bulb yield per hectare and benefit : cost ratio were studied. The data recorded on various parameters were statistically analysed for drawing out definite conclusions (Panse and Sukhatme, 14).

RESULTS AND DISCUSSION

Physiological parameters

The physiological parameters such as total chlorophyll content and total dry matter content were found significant among the treatment (Table 1). The total chlorophyll content was recorded at vegetative stage (45 days after transplanting) and bulbing stage (60 days after transplanting). At 45 days after transplanting highest chlorophyll content (0.91 mg 100 g^{-1}) was recorded in T_5 (zinc sulphate soil application @ 10 kg ha^{-1} + zinc sulphate foliar spray @ 0.5 % at 30 and 45 DAT) which was on par with T_2 (zinc sulphate soil application @ 10 kg ha^{-1}) (0.89 mg 100 g^{-1}) and T_{10} (borax soil application @ 10 kg ha^{-1} + boric acid foliar spray @ 0.25% at 30 and 45 DAT (0.88 mg 100 g^{-1}). At 45 days after transplanting the lowest chlorophyll content was recorded in T_{11} (Control without micronutrients) with 0.60 mg 100 g^{-1}. At bulbing stage (60 days after transplanting), the highest total chlorophyll content was found in T_3 (zinc sulphate foliar spray @ 0.5 % at 30 and 45 DAT) in *kharif* season (1.38 mg 100 g^{-1}). The lowest total chlorophyll content was recorded in control without micronutrients (0.73 mg 100 g^{-1}) at bulbing stage.

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 zinc sulphate soil application @ 10 kg ha^{-1} (1.28 t ha^{-1}) followed by T_8 (boric acid foliar spray @ 0.25% at 30 and 45 DAT (1.15 t ha^{-1}). The lowest total dry matter production of leaves (0.59 t ha^{-1}) was recorded with T_{11} (control without micronutrients) at harvesting stage. The highest total dry matter production of bulb (5.31 t ha^{-1}) was observed in T_3 (zinc sulphate foliar spray @ 0.5 % at 30 and 45 DAT) 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% at 30 and 45

Table 1 : Effect of zinc and boron application on total chlorophyll content (mg 100g^{-1}) and dry matter production (t ha^{-1}) of multiplier onion var. CO(On)$_5$.

Treatments	Total chlorophyll content (mg 100g^{-1})		Dry matter production (t ha^{-1})		Yield (t ha^{-1})	Benefit:Cost Ratio
	45th DAT	60th DAT	Tops	Bulbs		
T_1	0.74	0.83	0.83	3.29	12.9	1.49
T_2	0.89	1.00	1.28	5.09	15.2	1.92
T_3	0.81	1.38	1.45	5.31	16.0	2.08
T_4	0.86	0.92	1.12	4.63	15.3	1.93
T_5	0.91	0.87	1.11	3.95	12.4	1.36
T_6	0.71	0.85	0.79	2.89	13.9	1.69
T_7	0.84	0.89	1.08	4.40	15.5	1.98
T_8	0.79	0.98	1.15	4.85	15.9	2.06
T_9	0.85	0.92	1.04	3.70	14.3	1.74
T_{10}	0.88	0.86	0.99	3.26	12.0	1.28
T_{11}	0.60	0.73	0.59	2.41	10.0	1.07
Mean	0.81	0.93	1.04	3.98	13.9	1.69
CD (P=0.05)	0.058	0.104	0.202	0.766	2.06	0.162

DAT) (4.85 t ha^{-1}), respectively. The lowest total dry matter production of bulb (2.41 t ha^{-1}) was observed in T_{11} (Control without micronutrients) at harvesting stage.

It may be due to the synthesis of tryptophan, the precursor of IAA, which is responsible to stimulate the plant growth. In addition to this, carbonic anhydrase is an enzyme that has a zinc atom that catalyzes CO_2 hydration. Enzyme activity location is in chloroplasts and cytoplasm and the enzyme activity is dependent to zinc value in the plant. The main functions of this enzyme are dehydration of carbon dioxide, increasing absorption of carbon dioxide per leaf area unit, increasing the photosynthesis and biomass production. In the plants that are confronted with zinc deficiency, activity of this enzyme is retarded (Dell and Wilson, 6; Marschner, 10; Ohki, 12). This was in line with the findings of Bybordi and Malakouti (5) and Singh and Tiwari (17) in onion, and Singh and Tiwari (18) in tomato.

Yield parameters

There was significant response of the zinc and boron application on yield parameters among the treatment (Table 1). 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% at 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 % at 30 and 45 DAT) (15.3 t ha^{-1}). The lowest bulb yield (10.0 t ha^{-1}) was observed in T_{11} (control without micronutrients).

This may be due to the improved growth characters as a result of foliar application of micronutrients which would have enhanced photosynthesis and other metabolic activities, which lead to increase in cell division and elongation (Hatwar *et al.,* 8). Especially boron application enhances the enzyme activity which in turn triggers the physiological processes like protein and carbohydrate metabolism in plants. Similar results were reported by Smriti *et al.* (19); Alam *et al.* (2) and Manna (9). Zinc is one of the most important elements in the carbohydrates metabolism, most enzymes that play a role in carbohydrates metabolism. 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, 11; O'sullivan, 13). Similar findings were reported by Smriti *et al.* (19); El-Tohamy *et al.* (7); Alam *et al.* (2); Abd El-Samad *et al.* (1); Ballabh and Rana (3); Manna (9) and Trivedi and Dhumal (20) in onion.

Economics

The highest benefit: cost ratio (2.08) was observed in T_3 (zinc sulphate foliar spray @ 0.5 % 30 and 45 DAT) followed by T_8 (boric acid foliar spray @ 0.25% at 30 and 45 DAT) (2.06) whereas the lowest (1.07) was estimated in T_{11} (control without micronutrients). This may be due to the high bulb yield. Micronutrient application along with major nutrients have enhanced the soil fertility, photosynthetic activity and increased the accumulation of organic compounds, proteins, carbohydrates leading to higher yields of onion which ultimately increased the benefit cost ratio (Singh and Verma, 16). Similar results were reported by Sati (15) in multiplier onion and Bhatt *et al.* (4) in tomato.

Acknowledgement

*This paper is a part of M.Sc. Thesis entitled "Effect of Zinc and Boron application on Yield and Quality of Multiplier Onion (*Allium cepa* L. var. aggregatum Don.) var. CO(Cn)$_5$ " of the first author. First author is highly thankful to Professor and Head, Department of Vegetable Crops, Horticultural College and Research Institute, TNAU, Coimbatore, India, and Department of Agricultural Research and Education, Government of India for providing the financial assistance in the form of Nepal-Aid Fund Scholarship Scheme through Embassy of India, Kathmandu, Nepal.

REFERENCES

1. Abd El-Samad, E. H., Khalifa R. Kh. M., Lashine, Z.A. and Shafeek, M. R. (2011). Influence of Urea fertilization and foliar application of some micronutrients on growth, yield and bulb quality of onion. *Aust. J. Basic Appl. Sci.,* **5**(5): 96-103.
2. 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. *Intern. Res. J. Plant Sci.,* **1**(3): 56-61
3. Ballabh, K and Rana, D. K. (2012). Response of micronutrients on qualitative and quantitative

parameters of onion (*Allium cepa* L.). *Prog. Hort.,* **44**(1): 40-46.

4. Bhatt, B., Srivastava, 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). *Prog. Hort.,* **36** (2): 331-334.
5. Bybordi, A. and Malakouti, M. J. (1998). A study on the effects of different nitrogen sources and its interaction with sulfur on onion yield and nitrate accumulation. *Soil and Water J.,* **12**(6): 42-48.
6. Dell, B., and Wilson, A. S. (1985). Effect of zinc supply on growth of three species of eucalyptus seedling and wheat. *Plant Soil,* **88**: 377-384.
7. El-Tohamy, W.A., Khalid, A. K., El-Abagy, H.M. and Abou-Hussein, S. D. (2009). Essential oil, growth and yield of onion (*Allium cepa* L.) in response to application of some micronutrients. *Aus. J. Basic Appl. Sci.,* **3** (1): 201-205.
8. Hatwar, G. P., Gondane, S. U., Urkude, S. M. and Gahukar, O. V. (2003). Effect of micronutrients on growth and yield of chilli. *J. Soil Crops,* **13**:123-125.
9. Manna, D. (2013). Growth, yield and bulb quality of onion (*Allium cepa* L.) in response to foliar application of boron and zinc. *SAARC J. Agri.,* **11**(1): 149-153.
10. Marschner, H. (1995). *Mineral Nutrition of High Plant.* Academic Press,pp: 330-355.
11. Marschner, H. and Cakmak, J. (1989). High light intensity enhances chlorosis and necrosis in leaves of zinc, potassium, and magnesium deficient bean (*Phaseolus vulgaris*) plants. *J. Plant Physiol.,* **134**: 924-934.
12. Ohki, K. (1976). Effect of zinc nutrition on photosynthesis and carbonic anhydrase activity in cotton. *Plant Physiol.,* **38**: 300-304.
13. O'sullivan, M. (1970). Aldolase activity in plants as an indicator of zinc deficiency. *J. Sci. Food Agri.,* **21**: 607-609.
14. Panse, V. G. and Sukhatme, P. V. (1967). *Statistical Methods for Agricultural Workers.* ICAR, New Delhi.
15. Sati, J. (2013). Effect of zinc and iron application on the yield and quality of aggregatum onion var. CO_4. *Master's Thesis.* Tamil Nadu Agricultural University, Coimbatore
16. Singh, S.S. and Verma, S. K. (1991). Influence of potassium, zinc and Boron on growth and yield of tomato (*Lycopersicon esculentum* Mill.). *Veg. Sci.,* **18**(2): 122-129.
17. Singh, D. P. and Tiwari, R. S. (1995). Effect of micronutrients on growth and yield of onion (*Allium cepa* L.) variety Pusa Red. *Recent Hort.,* **2**(2): 70-77.
18. Singh. H. M. and Tiwari, J. K. (2013). Impact of micronutrient spray on growth, yield and quality of tomato (*Lycopersicon esculentum* Mill.). *HortFlora Res. Spectrum,* **2** (1): 87-89.
19. Smriti, S., Kumar, R. and Singh, S. K. (2002). Effect of sulphur and boron nutrition on growth, yield and quality of onion (*Allium cepa* L.). *J. Appl. Biol.,* **12**: 40-46.
20. Trivedi, A. P. and Dhumal, K. N. (2013). Effect of soil and foliar application of zinc and iron on the yield and quality of onion (*Allium cepa* L.). *Bangladesh J. Agril. Res.,* **38**(1): 41-48.

❑

Citation : Acharya U., Venkatesan K., Saraswathi T. and Subramanian, K.S. (2015). Physiological and yield parameters of multiplier onion (*Allium cepa* L. *var aggregatum* Don.) var. $CO(On)_5$ as influenced by zinc and boron application. *HortFlora Res. Spectrum*, **4**(2) : 155-158