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EFFECT OF MICRONUTRIENTS ON GROWTH AND TOTAL YIELD OF ONION (*ALLIUM CEPA* L.)

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ABSTRACT
A field experiment was conducted to evaluate the efficacy of micronutrients on the performances of onion (*allium cepa* L. var. Arka Kalyan) with respect to its growth attributes and total yield of bulbs during 2014-15 at CoH, OUAT, Sambalpur, Odisha under AINRP on Onion and Garlic. The experiment was laid out in RBD having four replication with 6 treatments. The result revealed significantly better vegetative growth in terms of plant height (62.28 cm), number of leaves plant^{-1} (12.36), collar thickness (15.94 mm) and chlorophyll content of leaves (16.81 SPAD) as well as average bulb weight (60.55 g), total bulb yield plot^{-1} (32.19 kg) and total bulb yield (268.28 qha^{-1}) was recorded when crop was treated with recommended 150:50:80:30 NPKS kg ha^{-1} +20 t ha^{-1} FYM + micronutrient mixture *i.e.* Fe-2.5 %, B-0.5%, Zn -3%, Cu -1% and Mn-1% @ 0.5% as foliar at 30 and 45 DAP. The second best result was found with recommended 150:50:80:30 NPKS kg ha^{-1} + 20 t ha^{-1} FYM + Borax @ 0.25% as foliar at 30 and 45 DAP. Hence, the result led to the conclusion that foliar application of micronutrient mixture @ 0.5 % followed by borax @ 0.25 % at 30 and 45 DAP not only enhances the growth attributing parameters but also increases the total yield of onion.

INTRODUCTION

Onion (*Allium cepa*L.), the "Queen of Kitchen" is one of the most important commercial crop not only in India but also in the world. India ranks second in position both in area (12.04 lakhs ha) and production (194.02 lakh tones) in the world (NHB, 2014). In India, it is treated as most important export oriented vegetable, exporting to the tune of 13, 58,193.00 MT of Rupees 2,87,713.00 lakhs during 2013 – 2014 (NHB, 2014). In India, onion is cultivated for vegetable as well as medicinal purposes. Its medicinal properties are steadily gaining more importance in the world. It has benefits in lowering total plasma cholesterol, reducing blood pressure, regulating blood sugar, acts as blood purifier *etc.* Deficiency of micronutrients during the last three decades has grown in both, magnitude and extent. This has become a major constraint to production and productivity of vegetables in general and onion in particular. Indian soils are exposed to multi-micronutrient deficiencies that closely associated with the yield and quality of crops. Proper plant nutrition is one of the most important factors in improving the quality as well as quantity of plant products. Even though, micronutrients are needed by the plants in a minor quantities but it is involved in a wide variety of metabolic processes as well as cellular functions within the plants. In addition, they play an essential role in improving growth and yield of the crops as reported by EI-Tohamy *et al*., 2009 and Alam *et al*., 2010. In general, micronutrients play an active role in the plant metabolic process starting from cell wall development to respiration, photosynthesis, chlorophyll formation, enzyme activity, nitrogen fixation *etc.* (Ballabh *et al*., 2013). De *et al*., 2013 reported that Biozyme have marked influence over growth and yield attributing characters of onion like plant height, number of roots per plant, diameter of bulb and bulb weight as well as yield. Foliar application of micronutrients during active crop growth stage was successfully used for correcting their deficits and improving the mineral status of the plants as well as increasing the crop yield (Kolota and Osinska, 2001). Damse *et al*., 2014 revealed integrated approach of nutrient management with both organic and inorganic sources have positive effect on growth and yield of garlic.

Producing of good quality onion bulbs is an important target by onion growers whom have an inadequate knowledge about beneficial role of micronutrients in increasing yield and quality of onion for local and foreign markets. Bulb size and yield enhanced when micronutrients were applied in combinations instead of their single application. Hence, its cultivation has been expanded in the newly reclaimed areas which characterized with low fertility, high pH value and low organic matter content, consequently low available of micronutrients in the soil. Keeping this in view, a field experiment was conducted at College of Horticulture (OUAT), Sambalpur, Odisha, India during *Rabi* 2014-15 to study about the effect of micronutrients on growth and total yield of onion bulb. Primary objective of this experiment was to study the efficacy of micronutrients on vegetative growth parameters and total bulb yield in onion.

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* 2014-15 under

AINRP on Onion and Garlic at College of Horticulture, Chiplima, Sambalpur, Orissa University of Agriculture and Technology (OUAT), Odisha, India. Soil of the experiment area was sandy loam having pH of 5.89; available NPK151.25:15.78:178.75 kg ha^{-1}. The field trial was laid out by adopting RBD replicated four with six treatments. The details of treatment are presented in Table no.1. Onion seeds variety Arka Kalyan obtained from the IIHR, Bangalore were sown in the nursery beds (1 m width, 3 m length and 15 cm height) on 22.10.2014at a distance of 5 cm and at a depth of 2 cm. Nursery beds were prepared by mixing FYM @ 20 kg and NPK mixture @ 20 g bed-1.About 55 days old seedling of 10-15 cm, height were transplanted in the field on 01.12.2014 and 02.12.2014 at a spacing of 15 x 10cm. All the recommended package of practices was adapted uniformly to all the treatments except the application of micronutrients. The recommended dose of fertilizer (RDF) used for onion crop was150:50:80:30 NPK kg ha-1 along with FYM @ 20 t ha-1, applied uniformly in all the treatments. The sources of NPKS for the present study were Urea, Di Ammonium phosphate (DAP), Muriate of Potash (MOP) and Gypsum, respectively. The nutrient content of FYM used in the study was estimated at 1.04:0.59:0.97:0.25% NPKS, respectively. The whole FYM was applied 15 days prior to planting. The full dose of P, K, S and half dose of N was applied as basal at the time of planting. The remaining 50% of N was applied in two equal splits during 30 and 45 days after transplanting of onion seedlings. As per the treatment schedule (Table no. 2), micronutrients were applied to the experiment. Onion crop was harvested at neck fall stage when tops turned yellow to light brown showing the sign of drying. The data recorded on various parameters were subjected to statistical analysis as per the procedure suggested by Sukhatme and Amble (1995).

RESULTS AND DISCUSSION

Vegetative growth parameters

The present study clearly indicated that application of micronutrients significantly increased the better vegetative growth in terms of plant height, number of leaves $plant^{-1}$ and collar thickness than untreated control. Further, foliar application of micronutrient mixture (comprising iron - 2.5 %, boron - 0.5 %, zinc - 3 %, copper -1 % and Manganese – 1 %) @0.5% at 30 and 45 DAP showed significant increased vegetative growth parameters than application of zinc and boron alone as well as control, without micronutrients. The beneficial impact of micronutrients on growth of onion which might be due to the involvement of micronutrients in different physiological processes and cellular function within the plant.

Table 1 : Experimental techniques details

Crop	Onion (*Allium cepa L.*)
Variety	Arka Kalyan
Season	*Rabi* season (2014-15)
No. of Treatments	6 (Six)
Design and Experiments	Randomized Block Design (RBD)
No. of Replication	4 (Four)
Net plot area	6m X 2m
No. of plots	24
Spacing	15cm X 10cm

In addition they play an essential role in improving plant growth through biosynthesis of indigenous hormone which responsible for promoting plant growth (Hansch and Mendel, 2009 and Manna, 2013. Similarly, significant influence of zinc and boron on vegetative growth of onion as reported by Abedin *et al*. (2012). De *et al*., 2013 reported that Biozyme have marked influence over growth and yield attributing characters of onion like plant height, number of roots per plant, diameter of bulb and bulb weight as well as yield. Acharya *et al*. (2015) also reported that both zinc and boron was significantly increased the vegetative growth of onion variety multiplier under Coimbatore condition. Damse *et al*., 2014 revealed integrated approach of nutrient management with both organic and inorganic sources have positive effect on growth of garlic.

Plant height (cm)

The average plant height (62.28 cm) of onion crop was significantly increased with foliar application of micronutrient mixture (iron - 2.5 %, boron - 0.5 %, zinc - 3 %, copper -1 % and manganese – 1 %) @ 0.5% at 30 and 45 days after planting (DAP) closely followed by foliar application of borax @ 0.25% at 30 and 45 DAP (61.40 cm) as well as soil application of zinc sulphate @ 10 $kgha^{-1}$ (60.37 cm) as presented in Table-3. The significant increase in plant height due to application of micronutrient mixture; zinc as well as boron alone observed in the present study. It might be due to their role in the cell division and other physiological processes. The increased plant height by application of micronutrient might be due to the cell enlargement in a coincident enlargement of the protoplast through water uptake. Similar report of better efficacy of boron has been reported by zinc application has been reported by Chattapadhay and Mukhapadhay (2004), Thakre *et al*. (2007), Khan *et al*. (2007), Dake *et al*. (2011) in onion. Similarly, the better efficacy of both boron and zinc towards plant height has also been reported by Bari (2007-2008) and Acharya *et al*. (2015) in onion.

Number of leaves $plant^{-1}$

Regarding production of number of leaves $plant^{-1}$ (Table-3), the results revealed significantly highest numbers by foliar application of micronutrient mixture (iron - 2.5 %, boron - 0.5 %, zinc - 3 %, copper -1 % and manganese – 1 %) @ 0.5% (12.36) and foliar application of borax @ 0.25% (12.20). Invariably, use of micronutrients increased the production of more leaves $plant^{-1}$ than control. This might be due to their role in cell division, meristematic activity of plant tissue and expansion of cell (Patil *et al*., 2009). The favorable effect of micronutrients on plant growth might be due to its role in physiological processes and cellular function within the plant. Bhattal *et al*., 2004 and Hansch and Mendel (2009) mentioned that in general the micronutrients play an essential role in biosynthesis of endogenous hormones which are responsible for promoting plant growth. Similar trend were also recorded by many scientists in onion (El-Tohamy *et al*., 2009 and Alam *et al*., 2010). Reports of increased number of leaves $plant^{-1}$ withapplication of zinc and boron was also reported by Dake *et al*. (2011), Manna *et al*. (2013) and Acharya *et al*. (2015).

Collar thickness (mm)

The collar thickness of onion plants was also significantly

Table 2 :Time of application of different micronutrients on different treatments

Treatments	Treatment details	Source
T_1	Soil application of Zinc Sulphate @ 10.0 kg ha^{-1}	Zinc Sulphate
T_2	Foliar application of Zinc Sulphate @ 0.5 % at30 & 45 days after planting (DAP)	
T_3	Soil application of Borax @ 10.0 kg ha^{-1}	Borax
T_4	Foliar application of Borax @ 0.25% at 30& 45 DAP	
T_5	Foliar application of Micronutrient Mixture0.5% at 30 & 45 DAP	Composition:Fe-2.5%, B–0.50%,Zn– 3.0%, Cu – 1.0% and Mn – 1.0%
T_6	Control (Without application of any micronutrients)	

Table 3 :Effect of micronutrients on Plant height, number of leaves plant^{-1}, Collar thickness, Chlorophyll content of leaves Average bulb weight (g), total bulb yield plot^{-1} (kg) and total yield (qha^{-1}) of onion var. Arka Kalyan

Treatments	Plant height (cm)	Number of leaves plant^{-1}	Collar thickness (mm)	Chlorophyll content of leaves (SPAD)	Average bulb weight (g)	Total bulb yield ` plot^{-1} (kg)	Total yield (qha^{-1})
T_1	60.37	11.82	14.20	15.49	55.40	26.15	217.89
T_2	57.31	11.86	14.48	16.24	57.08	26.10	217.50
T_3	59.43	11.80	15.05	15.34	56.68	25.38	211.47
T_4	61.40	12.20	14.99	15.76	59.10	28.72	239.37
T_5	62.28	12.36	15.94	16.81	60.55	32.19	268.28
T_6	58.18	11.23	14.12	15.26	51.95	25.25	210.45
Mean	59.83	11.88	14.80	15.82	56.79	27.30	227.49
SE (m) +	1.08	0.20	0.31	0.50	1.88	2.03	16.90
CD (5%)	2.30	0.43	0.66	1.07	4.00	4.32	36.02
CV (%)	2.55	2.40	2.95	4.47	4.67	10.51	10.51

influenced by micronutrients mixture (15.94 mm) than other micronutrients (14.20 to 15.05 mm) and control (14.12 mm) as presented in Table-3.

Chlorophyll contents of leaves (SPAD)

Foliar application of zinc, boron or micronutrient mixture significantly increased the chlorophyll content (16.81 SPAD) than the soil application of Zinc sulphate (16.24 SPAD) and without application of micronutrients (15.26 SPAD) as presented in Table-3. The significantly better efficacy of micronutrient mixture comprising of comprising iron - 2.5 %, boron - 0.5 %, zinc - 3 %, copper -1 % and manganese – 1 % towards chlorophyll content of leaves might be due to the presence of micronutrients especially iron, copper, manganese, zinc and boron which are essential for chlorophyll synthesis and further both zinc and boron accelerates many physiological processes including photosynthesis. The better efficacy of increased chlorophyll by foliar spray of micronutrient mixture, zinc and boron might be due to better absorption and utilization of supplied micronutrients directly by plant than the soil application. A similar observation of increased chlorophyll content with application of micronutrients was also reported by Trivedi and Dhamal (2013) in onion.

Average bulb weight (g)

Application of micronutrients in combination *i.e.*, T_5 had significant impact on increased bulb weight (60.55 g) which was closely followed by foliar application Boron *i.e.*, T_4 (59.10 g) in onion as compared to without micronutrients (51.95 g). This might be due to the better utilization of photosynthates and increased allocation of photosynthates towards the economic parts, the bulb in onion. Further the increased in bulb weight might also be due to improved growth and yield attributes as a result of positive influence of micronutrients and growth regulators. Similar findings were also recorded by Mandal *et al*. (2003). Similar report on better efficacy of foliar application micronutrients of zinc and boron in onion was also reported by Acharya *et al*. (2015). The better efficacy of micronutrients towards the fresh weight of onion bulb was reported by Abedin *et al*. (2012).De *et al*., 2013 reported that Biozyme have marked influence over growth and yield attributing characters of onion like plant height, number of roots per plant, diameter of bulb and bulb weight as well as yield.

Total bulb yield plot^{-1} (kg)

A perusal of Table no. 3 revealed significant variations among the treatments for total bulb yield plot^{-1} which varied from 25.25 kg in T_6 to maximum of 32.19 kg (T_5). Significantly highest total per plot bulb yield was recorded in T_5, *i.e.;* foliar application of micronutrient mixture @ 0.5% at 30 and 45 DAP (32.19 kg) than other treatments, except T4 *i.e.*; foliar application of borax @ 0.25 % at 30 and 45 DAP (28.72 kg), which were *statistically at par*. Similar finding was obtained by Thakare *et al*. (2007).

Total bulb yield (q ha^{-1})

Invariably, the present study indicated (Table-3), application of micronutrients either soil or foliar spray increased the total yield of onion bulb from 211.47 qha^{-1} to 268.28 qha^{-1} as compared to the control, without any micronutrients (210.45 qha^{-1}). The better efficacy of micronutrients might be due the pivotal role of micronutrients in strengthening the plant cell wall and translocation of carbohydrates from leaves to other plant parts. Further the improvement of bulb yield was due to better vegetative growth as observed in the present study. The higher photosynthesis accumulation in the bulbs would ensure higher individual bulb weight and large bulb diameter which collectively increases the bulb yield in onion. Similar report of increased bulb yield was observed by several workers (Paul

et al., 2007 as well as Abedin *et al.*, 2012). Similarly, the better efficacies of zinc towards increased bulb yield of onion were obtained by Alam *et al*. (2010) and Trivedi and Dhamal (2013). The better efficacy of boron towards enhanced bulb yield was also observed by several research workers in onion (Paul *et al*., 2007) as well as Manna, 2013). Increased bulb yield due to added zinc or boron with recommended fertilizer was reported by Nasreen *et al*. (2009) in garlic. Damse *et al*., 2014 revealed integrated approach of nutrient management with both organic and inorganic sources have positive effect on yield of garlic.

Abedin *et al*. (2012) concluded that the response of different micronutrients for onion production can be expressed the following orders: (Zinc + Boron) > Zinc > Boron > Molybdenum. The result of present investigations well corroborates the findings of Abedin *et al*. (2012) in onion.

REFERENCES

Abedin, Md. J., Alam, Md. N., Hossain, Md. J., Ara, N. A. and Faisal Md. H. K. 2012. Effect of micronutrients on growth and yield of onion under calcareous soil environment. *International J. Biosciences (IJB).***2(8):** 95-101.

Acharya, U., Venkatesan, K., Saraswathi, T. and Subramanian, K. S. 2015. Effect of zinc and boron application on growth and yield parameters of multiplier onion (*Allium cepa*L. var. aggregatum Don.) var. CO-5. *International J. Research (IJR).* **2(1):** 757-765.

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. *J. Agriculture Science.* **1(3):** 56-61.

Ballabh, K., Rana, D. K. and Rawat, S. S. 2013.Effects of foliar application of micronutrients on growth, yield and quality of onion. *Indian J. Horticulture.* **70(2):** 260-265.

Bari. Bangladesh Agriculture Research Institute. 2007. Effect of NPKS and Zn, B on garlic. Annual Report (2007-08).

Bhattal, B., Srevastava, 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.

Chattopadhyay, S. B and Mukhopadhyay, T. P. 2004. Response of boron and molybdenum as foliar feeding on onion in tarai soil of West Bengal. *Environmental Ecology*. **22(4):** 784-787.

Dake, S. D., Hiwale, B. G., Patil, V. K and Naik, P. G. 2011. Effect of micronutrients on growth, yield and quality of onion (*Allium cepa* L.) cv. Baswant 780. In. Proc. National Symposium on Alliums: Current Scenario and Emerging Trends, 12-14 March, 2011, Pune, India.p. 205.

Damse, D. N., Bhalekar, M. N., and Pawar, P. K. 2014. Effect of integrated nutrient management on growth. *The Bioscan*. **9(4):** 1557-1560, 2014

De, S., Manna, D., Sarkar, A. and Maity, T. K. 2013. Influence of Biozyme on growth, yield and quality of onion (Allium cepa L.) cv. Sukhsagar. *The Bioscan*.**8(4):** 1271-1273

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, *Australia J. Basic Applied Sci*ence. **3(1):** 201-205.

Hänsch, R. and Mendel ,R. R. 2009. Physiological functions of mineral micronutrients (Cu, Zn, Mn, Fe, Ni, Mo, B, Cl). *Current Opinion in Plant Biology*. **12:** 259-266.

Khan, A. A., Zubair, M., Bari, A. and Maula, F. 2007. Response of onion (*Allium cepa*) growth and yield to different levels of nitrogen and zinc in swat valley. *Sarhad J. Agriculture.* **23(4):**

Kolota, E. and Osinska, M. 2001. Efficiency of foliar nutrition of field vegetables grown at different nitrogen rates. *Acta Horticultura*e. **563**: 87-91.

Mandal, S., Nath, S., Ghanji, P. and Sukala, N. 2003. Effect of doses and methods of application of GA3 and NAA on growth and yield of onion (*Allium cepa* L.). *Environment and Ecology*. **21(3):** 568-571.

Manna, D., Maity, T. K. and Ghosal, A. 2013. Influence of foliar application of boron and zinc on growth, yield and bulb quality of onion (*Allium cepa* L.). *J. Crop and Weed.* **10(1):** 53-55.

Manna D. 2013. Growth, yield and bulb quality of onion (*Allium cepa* L.) in response to foliar application of boron and zinc. *SAARC J. Agriculture*. **11(1):** 149-153.

Nasreen, S., Yousuf, M. N., Mamun, A. N., Brahma, M. S. and Haquc, A. M. 2009. Response of garlic to zinc, boron and poultry manure application. *Bangladesh J. Agriculture Research*. **34(2):** 239-245

NHB, 2014 (http://www.nhb.gov.in/area-pro/NHB_Database_2015.pdf)

Patil, V. K., Yadlod, S. S., Tambe, T. B. and Narsude, P. B. 2009. Effect of foliar application of micronutrients on flowering and fruit set of tomato (*Lycopersicon esculentum* Mill.) cv. Phule raja. *International J. AgriculturalSciences*. **6(1):** 164-166.

Paul, J. K., Halder, B. C. and Khan, M. A. 2007. Effects of boron and sulphur on the growth and yield of onion. *J. Science technology* (Dinajpur). **5:** 60-66

Ranganna, S. 2004. Handbook of analysis and quality control for fruit and vegetable products (2nd Edn.), Tata McGraw, Hill Publishing Co. Ltd., New Delhi

Thakare, R. G., Jadhao, B. J., Nandre, D. R., Ghawade, S. M. and Khewale P. 2007: Effect of zinc and iron levels on growth and yield of potato. *Indian J. Plant Archives*. **7(1):** 275-276.

Trivedi, A. P. and Dhamal, 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. Agriculture Research.***38(1):** 41-4