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Review on Impact of Micronutrients (Zinc and Boron) in Relation to Growth, Yield and Quality of Onion

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A B S T R A C T

Onion is valued for its bulbs having characteristic odour, flavor and pungency. It is an export oriented vegetable and earns a valuable foreign exchange to our country. Boron helps in the uptake of calcium and encourages efficient utilization of calcium in plants, it also helps in protein synthesis. Zinc is a constituent element of number of enzymes i.e. ironic anhydrate of growth hormones (auxins). It enhances heat and frost resistance of plant and affects the uptake of phosphorus by plants. It also acts as a catalyst in chlorophyll formation. Micronutrients help increase the efficiency of the use of macronutrients. Micronutrients have a great role in the fertilizer program to achievement higher and sustainable crop yields. Unfortunately micronutrients have received less attention in fertilizer management research, development and extension. Growers should carefully follow recommendations for micronutrients to avoid unnecessary costs and possible toxic effects or deleterious interactions with other nutrients. The literature available on response of zinc and boron in relation to growth, yield and quality of onion under following heads: 1. Effect of zinc and boron on growth and yield of onion. 2. Effect of zinc and boron on yield of onion. 3. Cost economics analysis.

Introduction

Onion (*Allium cepa* L.) is world's one of the most important vegetable crops. It is a hardy bulbous plant. The onion crop is widely used throughout year as salad and culinary purpose for flavoring sauce and vegetables. Onion has great medicinal value. Pungency in onion is due to volatile oil (allyl propyl disulphide C6H, 202), which acts as gastric stimulant and promotes digestion. It also acts as a very good tonic to the nervous system and purified blood.

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. Thus, there is an urgent need for correction of individual nutrient deficiency and for arresting its further spread. The lower productivity of Indian onion is primarily due to cultivation of low yield potential varieties/ hybrids, susceptibility to both biotic (pests and diseases) and abiotic factors (i.e. moisture stress, high temperature, imbalance nutrition

etc). Therefore, imbalanced nutrition is treated as one of the major abiotic stress which adversely affects crop growth and yield in onion.

Boron and zinc are the most important micro-nutrients which are essential for cell division, nitrogen and carbohydrate metabolism and water relation in plant growth (Brady, 1990). Application of boron can increase bulb size and yield of onion.Similarly boron is also important. Boron deficiency is becoming important in many parts of India. Boron helps in the uptake of calcium and encourages efficient utilization of calcium in plants, it also helps in protein synthesis. Indian soils are becoming deficient in plant nutrients especially micro elements due to exhaustive condition, as a consequence of intensive cropping and imbalance and in adequate use of chemical fertilizers. Application of boron can increase bulb size and yield of onion (Smriti *et al.,* 2002).

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. Bhonde *et al.,* (1995) evaluated the effect of zinc, copper and boron on onion crop. Bulb size and yield as well as quality of bulb enhanced when micronutrients were applied in combinations instead of their single application.

Effect of zinc and boron on growth and yield of onion

Zinc is taken up by plants as Zn+2. The main source of zinc is minerals e.g. sphalerite (ZnS), Smithsonite ($ZnCO_3$). 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).

Sindhu and Tiwari (1993) sprayed Zn (3 or 5 ppm) on onion plants at 50 days and 65 days after painting and found that bulb yield and TSS were highest (275 q/ha and 15.36% respectively) when 3 ppm Zn was applied twice. Bhonde *et al.,* (1995) conducted trial on onion variety ' Agrifound dark red and stated that zinc had significant effect on bulb development and yield as well as bulb quality when applied in combination with copper and boron instead of singly. Foliar application of Zn 3 ppm at 30 and 45 DAT gave the highest net return to grower.

Singh and Tiwari (1995a) reported that sprays of 3 ppm Zn singly or combined with Fe and B were the most effective for increasing all the growth parameters. Singh & Tiwari (1996) in a pot trial onion in a silty loam soil were sprayed 60 to 70 days often transplanting with 1,2, or 3 ppm Zn + 50, 100 & 150 ppm Fe + 0.25, 0.50 or 0.75 ppm B. The total sugar & Ascorbic acid contents were obtained with 3 ppm Zn+ 100 ppm. Fe.+ 0.75 ppm B.

Sindhu *et al.,* (1996) Reported that when pusa red cultivar of onion received foliar sprays of an (1 to 3 ppm), Zn (3 to 5 ppm), B (0.5 to 1.0 ppm) Fe (100 ppm), & Mn (0.25 ppm), individually or combined, bulb yield & total sugar contents were highest when 1 ppm Cu+ 3ppm Zn + 0.5 ppm B +100 ppm Fe was applied twice. Ascorbic acid concentration was highest with a single spray of 1 ppm B. Sliman *et al.,* (1999) reported that the effect of use of Fe (3g), Zn (3g), Mn (3g) & Cu (1gm) per litter as a sulphate of onion. Z spray applied was made at 2 & 4 weeks after transplanting. All the treatments increased yield over control & highest dry yield was obtained by foliar application of Zn SO4.

Mukesh Kumar *et al.,* (1998) conducted a field trial and concluded that highest fresh onion yield (18.40 tlha) was achieved in pots

treated only with Zn-EDTA at 10 kg/ha followed by those given only S at 30 kg/ha. Mukhopadhyay and Chatopadhay (2000) reported that application of the boron to soil at 0.56, 1.12 and 2.24 kg/ha generally caused progressive increase in growth and yield of onion in variety "PusaRathnar". The highest level of B gave greatest yield of bulbs (31.492 t/ha) as against 23.03 t/ha of control. A gradual increase in bulb length was observed with increasing boron concentration with the greatest length of 4.46 cm at 2.24 kg B/ha. Plants at 2.24 kg B/ha gave maximum yield (33.067 t/ha), which was 63.3% greater than of control.

Khalata et *al.,* (2002) studied the effect of trace elements on yield and quality of onion cv Baswant-780. The treatments were 0.1, 0.2 and 0.3% borax, 0.25, 0.50 and 1.0 % zinc sulfate and a control (no spray). First and seconds sprayings were done 30 and 45 days after planting, respectively. The seed yield per plot and seed yield/ha increased with application of trace element except with 2.0% ferrous sulfate. Selvaraj *et al.,* (2002) conducted trials on garlic. The effect of zinc, boron and molybdenum foliar sprays on yield and rubberization. Boron at 0.1% (w/v) plus sodium molybdate at 0.05% (w/v) recorded the highest healthy bulb yield of 24.9 tlha. The increase being 23.5% over unsprayed control and reduced premature filed sprouting of cloves in the field itself instead of bulking and reduced production on spongy bulbs 10 cally known as rubberization.

Singh et at (2002) studied the effect of basal application of farmyard manure (25 or 40 t/ha) combined with foliar application of NPK mixture (100:50:50 kg/ha) and micronutrient (zinc copper and boron) on growth yield, quality and storage of onion and found that basal and foliar treatments had on significant effects on the plant stand and neck thickness of onion.

Chandel (2003) conduced an experiment at College of Agriculture Indore and reported that the application of sulphur @ 30 kg/ha produced a significant increased in plant height, diameter of neck, number of leaves, bulb fresh weight per plant, number root, bulb scale. Bose *et al.,* (2004) reported that the spray of Zn (0.5%), Fe (0.5%) and Cu (0.5%) solution and root dip treatment with 30 and 50 ppm NAA exerted a positive influence on increasing the yield components over untreated check with regard to plant nutrient application all the tested micronutrients significantly increased the plant grown and yield number of leaves (10.2) neck diameter (1.9 cm) fresh weight of bulbs (78.63 gm), diameter of bulb (4.9 cm) and yield per hectare (32.970 q/ ha). The maximum growth and yield of onion was obtained treatment of NAA 50 ppm with copper 0.5% (357.33 / ha) followed by NAA 50% with Zinc (0.50%) (346 q/ ha). Which were significantly superior to all other treatment growth regulator with micronutrients spray significantly increased the plant growth and yield of onion.

Pariori *et al.,* (2005) observed that application of 0.03% boron through borax produced tallest plant (56.36cm) maximum number of leaves per plant (7.07) recorded with 0.02% Zn through Zn So4. The same treatment was found the best also for other yield parameters viz, bulb diameter (13.69cm), bulb weight (22g). number of clover/ bulb (23.40), clove length (3.62cm) clove weight (1.14g) and yield (7.55t/ha), highest ascorbic acid content (7.82 mg) was also recorded with 0.02% Zn thought ZnSo4 among 0.02% B through borax was found - to give the better result in most other parameters except ascorbic acid content. Banafer and Gupta (2005b) reported that the application of S,B and Zn either as soil application or as foliar application and FYM along with recommended dose of fertilizer i.e. 100 kg N 50 kg P and 50 kg K/ha improved the growth, productivity and quality of onion

significantly. Application of S also enhanced protein content.

Gamelli (2000) studied that the plant height and fresh weight of leaves were positively affected by application of micronutrients. Maurya and Lal (1975) reported that application of Zn at 1, 2 and 3 ppm increased the yield and bulb quality significantly. Boron and zinc are the most important micro-nutrients and are essential for cell division, nitrogen and carbohydrate metabolism and water relation in plant growth (Brady, 1990). In general the growth characteristics of onion are markedly influenced by micronutrients (Baghel and Sarnaik, 1988; Bhonde *et al.*, 1995; Singh and Tiwari, 1995).

Lal and Maurya (1981); Abedin *et al.*, (2012) showed that both zincand boron significantly increased the dry weight of leaves in onion. Tisdale *et al.,* (1985) reported that zinc was involved in auxin metabolism and other enzymatic reactions increase leaf length.

Khan *et al.,* (2007) suggested the increased leaf length in onion due to application of zinc than the control plot. Baghel and Sarnaik (1988) observed significant increased in the number leavesplant-1 with a combined application of zinc (0.5%) and boron (0.2%) applied to the foliage in onion. Smriti *et al.*, (2002) reported that the numbers of leaves, leaf length, leaf width etc. were significantly increased up to 40 kg sulphur and 1 kg boron ha-1.Application of zinc and boron through soil or foliar or in combinations had a beneficial effect on the growth of onion (Acharya *et al.,* 2015). Zinc is a micro nutrient which usually required for plant growth and development relatively in small amount. Zinc is involved in a diverse range of enzyme system.

Alam *et al.,* 2010 reported that application of different micronutrients treatment influenced the fresh weight of roots of onion. The maximum fresh weight (3.6 g) of roots was observed under zinc @ 6 mgl-1 followed by zinc @ 4 mgl-1) and boron @ 1 mgl-1 *viz*., 3.2 g and 3.1 gas compared to control treatment.

Samad *et al.,* (2011) reported that growth parameters of onion plants were positively affected by application of micronutrients, specifically by application of zinc and / or iron.

Effect of Micronutrients on yield and yield attributing parameter

Singh and Tiwari (1995) found that bulb diameters of onion plants were recorded the highest values with spraying of zinc than other micronutrients. On the other hand, application of boron caused significant improvement in bulb diameter in onion (Manna, 2013). Acharya *et al.,* (2015) observed significantly better effect of foliar application of zinc and boron on polar as well as equitorial diameters in onion var. multiplier. They observed significantly higher polar and equitorial diameter with borax as soil application @ 10 kgha-1 followed boric acid as foliar spray 0.25% @ 30 and 45 days after transplanting.

Khan *et al.,* (2007) suggested that different zinc levels significantly affected individual bulb weight in onion. Application of Zn 10 kg ha-1 produced maximum bulb weight (113.7 gm), whereas minimum bulb weight (99.50 gm) was recorded in plots received no zinc (control).Application of boron caused significant improvement in individual bulb weight in onion (Manna, 2013) while with application of zinc and boron on fresh weight of bulbs in onion var. multiplier (Acharya *et al.*, 2015).

Thakare *et al.,* (2007) from a field experiment stated that yield of bulb per plot and bulb yield ha-1 was recorded as the maximum

under the application of 30 kgZnSO4 and 15 kg FeSO4 ha-1.The response of application of zinc and boron either in soil or foliar had 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 with zinc as zinc sulphate foliar spray 0.5 % @ 30 and 45 days after transplanting followed by boron as boric acid foliar spray 0.25% @ 30 and 45 DAT (Acharya *et al.,* 2015).

Satbir *et al.,* (1989) who suggested that bulb fresh weight was significantly improved by zinc and boron application. Kirk by and Romheld (2004) who reported that foliar spray of the micronutrients might increase plant growth attributes and act as components of cell wall and other membranes.

Effect of Micronutrients on quality attributing parameter of onion

Zubanova *et al.,* (1975) observed that addition of B increased the ascorbic acid content and protein N contents of the tomato plants. Boron and Zinc when applied to tomato and capsicum crops significantly increased the total fruit sugar content (Rawat and Mathpal, 1984). While Reddy *et al.,* (1985) observed that foliar application of Zn and B improved the crop quality in tomato.

Reddy and Reddy (1986) reported that application of Zn and B at 500 pp meach, improved the quality indices in brinjal. Lopez Andreu *et al.,* (1988) reported that the titratable acidity was lower in tomatoes grown under B deficient conditions.

Ryabykh and Chuprikova (1989) observed that foliar sprays with boric acid increased the fruit vitamin C and total sugars in tomatoes. Ascorbic acid content of fruits was enhanced by the addition of 6 ppm B to the soil (Ahmedand Hargitai, 1989).Maurya and Lal (1981) observed increased content of reducing, non-reducing and total sugar by zinc nutrition while Samad *et al.,* (2011) mentioned that foliar spraying of zinc and iron could give the best result of quality of onion bulbs.

Effect of Micronutrients on economics of onion production

The treatment combination of 40 kg sulphur + 1 kg boron per hectare gave thehighest net return and benefit: cost ratio (Smriti *et al.,* 2002).Marginal analysis showed that the maximum marginal rate of return (MMR) was obtained when the crop was fertilized with zinc only (Nasreen *et al.,* 2007; Nasreen *et al.,* 2009).

In conclusion the general, the yield improvement in onion can be increased by increased vegetative growth and development. Higher photosynthesis accumulation in the bulbs would ensure higher individual bulb weight, large bulb diameter and neck thickness, which can be achieved through use of micronutrients. Micronutrients are used in smaller quantities. They are as important as the macronutrients in respect of their functions in plants and have a great role in the fertilizer program to achieve higher and sustainable crop yields. Application of micronutrients such as zinc or boron towards increased vegetative growth, yield and quality parameter as they are the most important micro-nutrients which are essential for cell division, nitrogen and carbohydrate metabolism and water relation in plant growth.

References

AbedinMd J, AlamMd N, HossainMd J, Ara NA and Faisal Md HK. 2012. Effect of micronutrients on growth and yield of onion under calcareous soil

environment. *International Journal of Biosciences (IJB),* 2 (8): 95-101.

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

Ahmed, A. J. and Hargitai, L. 1989. Agrokem Talajtan, 38: 270-284.

Alam MN, Abedin MJ and Azad MAK. 2010. Effect of micronutrients on growth and yield of onion under calcareous soil environment. *Journal of Agriculture Science*, 1(3): 56-61.

Baghel BS and Sarnik DA. 1988. Comparative study of soil and foliar application of zinc and boron on growth, yield and yield quality of onion (*Allium cepa*L.) cv. Pusa red. *Research and Development Reporter*, 5(1-2): 76-79.

Banafar, R.N.S. and Gupta, N.K. 2005b. Effect of fertilizer mixture with and without sulphur and spray of zinc on quality of onion. National seminar Agro- technology, quality, processing and export of spices. March 20-21; 66.

Bhonde SRL, Ram UB, Pandey and Tiwari HN. 1995. Effect of micronutrients on growth, yield and quality of kharif onion. News letter National Horticulture Research and Development Foundation, 14-15 (1): 16-20.

Bhonde, S.R., Ram I., Pandey, U.B. and Tiwari, H.N. 1995. Effect of micronutrient on growth yield and quality of Kharif onion. News

Bhonde, S.R.L., Ram, U.B., Pandey, Tiwari, H.N. 1995. Effect of micronutrients on growth, yield and quality of kharif onion. Newsletter National Horticulture Research and Development Foundation. 14-15(1):16-20.

Bose U.S., Tripathi S.K. and Khan R.A. 2004. Effect of Zn, Cu, Fe, and growth regulator on the growth and yield of onion. National seminar on opportunities and potentials of spices for crop diversification. January 19-21; 119-120.

Brady NC. 1990. The Nature and Properties and Soils. 10th Ed., A.K. Ghosh.

Chandel P.P. 2003. Influence of soil and foliar application of sulphur, boron and zinc on growth, yield and quality of onion (*Allium cepa* Lin.).

Dake SD, Hiwale BG, Patil VK and Naik PG. 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. Pp. 205.

Gamelli EL, Hanna, Hadi EL 2000. The effect of some foliar fertilizers application on growth, bulb yield, quality and storage ability of Giza 20 onion cultivar (*Allium capa*L). Annals of Agril. Sci. Moshtohor. 38 (3): 1727-1737.Hall of India Pvt. Ltd., New Delhi. p. 383.

Khalate.S.P Sanghavi KU, Kadam - J. R. 2002. Effect of some micronutrients on seed yield and seed quality of onion (cv Baswant-780), South *India Horticulture*, 50(1-3): 248-250.

Khan AA, 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 Journal of Agriculture*, 23(4).

Khan AA, 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 Journal of Agriculture*, 23(4).

Kumar, Mukesh, Munsi , P.S. Das, D.K. Chatopadhayay , T.K. and Kumar M.C. 1998. Effect of Zn and sulphur application on yield and post harvest

quality on onion *(Allium cepa L.)* under different methods of storage, J. *interacaemica,* 2(3): 158-163.

Lal S and Maurya AN. 1981. Effect of zinc on onion. *Haryana Journal of Horticulture Science,* 10(3-4): 231-235.

Lal S, Maurya AN 1981. Effect of zinc on onion. Haryana J. Hort. Sci.10(3-4): 231-235.

Lopez Andreu, F. J. 1988. Anales deficiency Edafologia Y. Agrobiologiua, 47(7-8): 1181-1190.

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.

Matuewas- S.2002.effect of foliar application of micronutrients on the growth and yield of garlic *(Allium sativurn L) South Indian Horticulture* 50: 1-3 159-168.

Nasreen S, Haque MM, Hossain MA and Farid ATM. 2007. Nutrient uptake and yield of onion as influenced by nitrogen and sulphur fertilization. *Bangladesh Journal of Agriculture Research,* 32(3): 413-420.

Nasreen S, Yousuf MN, Mamun AN, Brahma MS and Haquc AM. 2009. Response of garlic to zinc, boron and poultry manure application. Bangladesh Journal of Agriculture Research, 34(2): 239-245.

Pariori A, Mandal A.K., Sharangi A.B and Chatterjee , R. 2005. Response of garlic *(Allium sativum L.)* to different concentrations and sources of Boron and Zinc. National seminar on Agro-technology, quality, processing and export of spices. March 20. 21; 88-89.

Pedler JF, Parker DR, and Crowley DE. 2000. Zinc Deficiency-induced phytosiderophore release by the Triticaceae is not consistently expressed in solution culture. Planta, 211: 120-126.

Rawat, P. S. and Mathpal, K. N. 1984. Sci. Cult., 50(8): 243-244.

Reddy, F. S. *et al.* 1985. South Indian Hort., 33(1): 23-25.

Reddy, K. B. and Reddy, E. N. 1986. South Indian Hort., 34(2): 100-104.

Ryabykh, R. S. and Chuprikova, O. A. 1989.Khim. Sel. Sk. Khoz., 7: 51-53.

Samad A, Khalifa RKM, Lashine ZA and Shafeek MR. 2011. Influence of urea fertilization and foliar application of some micronutrients on growth, yield and bulb quality of onion. *Australian Journal Basic Applied Science,* 5: 96-103.

Satbir Singh, Tiwari RS and Sindhu SS. 1989. Effect of micronutrients on the growth characters of onion (*Allium cepa* L.) cv. Pusa red, *Haryana Journal of Horticultural Science,* 18(1-2):146-149.

Sindhu SS, Tiwari RS.1993.Effect of micronutrients on yield and quality of onion (*Allium cepa* L) *cv*. Pusa red. Progressive Hortic. 25(3-4): 176-180.

Singh D.K. Pandey A.K., Pandey UB Bhonde- SR. 2002. Effect of baron yard manure combined with foliar application of NPK mix here and malcontents on growth, yield, and quality of onion. *National Horticulture Research and Development Foundation Naskik 21*-22: 1, 3-4. 1-7.

Singh DP and Tiwari RS. 1995. Effect of micronutrients on growth and yield of onion (*Allium cepa*L.) variety Pusa Red. *Recent-Horticulture*, 2(2): 70-77.

Singh, F. Singh. V. and Singh, R. 1995.Effect of different doses and sources of sulphur on yield and up take of sulphur by garlic, J. *Indian. Soc. Soil Sci, 43* (1):130-131.

Singh, H. Singh, S and Singh, V. 1996.Response of onion *(Ailium cepa* L.) to nitrogen and sulphur. *Annals of Agric. Res, 17 (4):441444.*

Smiriti, S., Kumar, R. and Singh, S.K. 2002.

Effect of sulphur and boron nutrition on growth, yield and quality of onion (*Allium cepa* L.) Patna. Indian Journal of Applied Biology. 12(1/2): 40-46.

Smriti S, Kumar R, and Singh SK. 2002.Effect of sulphur and boron nutrition on growth, yield and quality of onion (*Allium cepa* L.). *Journal of Applied Biology*, 12: 40-46.

Thakare RG, Jadhao BJ, Nandre DR, Ghawade SM and Khewale P. 2007: Effect of zinc and iron levels on growth and yield of potato. *Indian Journal of Plant Archives.* 7(1) 275-276.

Tisdale SL, Nelson WL, Beaton JD. 1985. Elements required in plant nutrition. In soil fertility and fertilizers, Zinc, pp:85-86. Macmillan Publishing Company 866 third avenue, New York, 10022.

Zubanova, L. S. *et al.* 1975. In: Hort. Abstr., 47: 358.

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