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RESEARCH ARTICLE

Effect of zinc and boron on seed yield and quality of onion (*Allium cepa* L.)

■ **S. H. Arunkumar, Jitendra Kumar S. Hilli and D. S. Uppar**

SUMMARY

The field experiment was carried out in the olericulture unit, MARS, University of Agricultural Sciences, Dharwad during 2019-2020 to study the effect of zinc and boron on seed yield and quality of onion on variety cv. Bhima super at different levels of both basal and foliar application. The treatments consists of soil application of zinc sulphate (5 kg/ha and 10 kg/ha), Borax (4 kg/ha and 6 kg/ha) and foliar application of zinc sulphate (0.25 % and 0.5 %), Borax (0.1 % and 0.2 %) and control without micronutrient application replicated thrice in a Randomized Block Design. The foliar application was given at 45 days after bulb planting. From the present investigation, a significant increase in seed yield and quality parameters were recorded with foliar spray of zinc sulphate (0.5 %) and borox (0.2 %) *viz*., seed yield per plant (4.29 g), seed yield per plot (214.13 g) and seed yield per hectare (9.91q/ha). The germination percentage was found maximum from the treatment foliar application of zinc sulphate (0.5 %) (84.8%) and the other seed quality parameters was found best from the treatment foliar spray of $ZnSO_4$ (0.5%) and B (0.2 %) *i.e.,* higher shoot length (8.83 cm), root length (7.21 cm), seedling vigour index (1352) and test weight (3.75 g). The non-significant differences were observed due to influence of soil and foliar application of zinc and boron on electrical conductivity and seedling dry weight.

Key Words : Onion, *Allium cepa* L. Zinc, Boron

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Onion (*Allium cepa* L.) is one of the world's main bulbous crops and one of the India's most common seasonal monocotyledonous and cool seasonal vegetable condiment crops. It originated in Central Asia and belongs to the *Allium* genus, which belongs to the Amaryllidaceae family. It is an edible bulb which is a modified stem. They are available in red, white and yellow coloured varieties. The pungent aspect of the onion is attributed to the existence of a sulphur-bearing compound in the volatile oil of allyl-propyl disulphide, which gives the vegetable a cherish taste (Maurya *et al.*, 2018). Worldwide, onion is grown in an area of 15.11 m ha with an annual production of 1.06 million tons of onion seed. India needs around 9400 tonnes of onion seed annually (assuming seed rate 8kg/ha) for covering 1.19 million hectares area and out of that organized sector contibutes only 40 per cent of the total seed requirement and rest is met by farmers own seed (Anonymous, 2019). It is, therefore, important to increase the supply of good quality seeds through the effective use of technology.

Onion is biennial crop which forms the bulb during first season and the seed crop in the second season. Onion seed production can be done in two different methods, *viz.*, seed to seed method and bulb to seed method out of these two methods bulb to seed method is commonly followed which involves the production of bulbs in the first season, selection of good ones and replanting them for seed production is done in next season. To obtain better crop growth and higher yield it is essential to go for the production of fresh onion seeds every year. Seed yield and quality of onion depends on number of factors, among which application of nutrients has a great influence on seed yield and quality. Application of micronutrients to soil deficient in them has shown remarkable increase in yield of several crops (Pramanik *et al.*, 2018). Micronutrients play an active role in the plant metabolic process from cell wall development to respiration, photosynthesis, chlorophyll formation, enzymes activity, nitrogen fixation etc. Intensive cropping, imbalanced fertilization and minimal usage of micronutrients and limited application of organic manures have resulted in the depletion of soil fertility in India (Acharya *et al.,* 2015).

The application of soil and foliar nutrition is the quickest way to deliver nutrients to the tissues and organs of the crop and is proved that application of these micronutrients beneficial to correct the certain nutrient deficiencies. Keeping all these above facts in view, the present investigation was undertaken with objective to study effect of zinc and boron on seed yield and quality of onion.

MATERIAL AND METHODS

The field experiment was carried out in the Olericulture unit, MARS, University of Agricultural Sciences, Dharwad during 2019-2020 to study the effect of zinc and boron on seed yield and quality of onion on variety cv. Bhima super at different levels of both basal and foliar application. The experiment was laid out in Randomized Block Design with 3 replications. The treatments consisted of T_1- Control without micronutrient, T_2- soil application of zinc sulphate @ 5 kg/ha, T_3- soil application of zinc sulphate @10 kg/ha, T_4- soil application of Boron 4 kg/ha, T_5- soil application of Boron 6 kg/ha, T_6 soil application of mixture of ($ZnSO_4$ 5 kg/ha + B 4 kg/ha), T_7 soil application of mixture of ($ZnSO_4$ 10 kg/ha + B 6 kg/ha), T_8- foliar spray of $ZnSO_4$ (0.25 %), T_{9}-foliar spray of $ZnSO_4$ (0.5 %), T_{10}- foliar spray of Boron (0.1 %), T_{11}- foliar spray of Boron (0.2 %), T_{12}- foliar spray of mixture of $ZnSO_4$ (0.25%) and B (0.1%) and T_{13}- foliar spray of mixture of $ZnSO_4$ (0.5%) and B (0.2%). RDF was common to all the treatments. Soil application was done day before planting of onion bulbs and foliar application was given at 45 days after bulb planting. The chemical analysis of the composite soil sample collected before harvest and soil samples collected treatment wise were analyzed as per the standard procedure. Yield parameters *viz.,* seed yield per plant, seed yield per plot, seed yield per hectare and quality parameters *viz.*, germination percentage, shoot length, root length, seedling vigour index, test weight and electrical conductivity were under study. The results recorded from various parameters were statistically analyzed as per the procedure given by Panse and Shukatme (1978).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Seed yield :

The data recorded on seed yield presented in Table 1 on seed yield per plant, per plot and per hectare revealed significant variations from the various micronutrient treatments. The maximum seed yield per plant, per plot and seed yield per hectare was recorded from treatment T_{13} (foliar application of zinc sulphate 0.5 % + boron 0.2 %) (4.29 g, 214.13g and 9.91 q/ha, respectively) which is on par with the T_7 treatment (soil application of zinc sulphate 10 kg/ha + boron 6 kg/ha) (4.16 g, 209.15g and 9.68 q/ha, respectively) followed by T_{12} (foliar spray of zinc sulphate 0.25 % + boron 0.1 %) (3.77g, 189.14g and 8.74 q/ha, respectively) and minimum seed yield per plant was reported from the control treatment T_1 (3.36g, 170.03 g and 7.87 q/ha, respectively).

Seed quality parameters :

The experimental results recorded and depicted in the Table 2 and 3 showed that the seed quality characteristics of the harvested onion seed were greatly affected by the application of micronutrients. The maximum percentage of germination was observed from the treatment T_9 (Zinc sulphate 0.5 %) (84.8 %) which was on par with the treatment T_{13} (Zinc sulphate 0.5 % + boron 0.2 %) (84.3%) while the lowest seed germination was observed in the control treatment (80.2%).The observations recorded from the various treatments was not significantly influenced the field emergence percentage due to the application of micronutrients. Significantly highest shoot length

Table 1: Influence of zinc and boron on seed yield per plant, seed yield per plot and seed yield per hectare in onion

Treatments		Seed yield /plant (g)	Seed yield /plot (g)	Seed yield /hectare (q)
T_1	Control (RDF)	3.36	170.03	7.87
T_2	$ZnSO_4$ @ 5 kg/ha	3.48	173.62	8.04
T_3	$ZnSO_4$ @ 10 kg/ha	3.61	178.05	8.24
T_4	Borax @ 4 kg/ha	3.45	174.67	8.09
T_5	Borax @ 6 kg/ha	3.65	182.82	8.46
T_6	$ZnSO_4$ @ 5 kg/ha + Borax @ 4 kg/ha	3.70	188.76	8.74
T_7	$ZnSO_4$ @ 10 kg/ha + Borax @ 6 kg/ha	4.16	209.15	9.68
T_8	$ZnSO_4$ @ 0.25 %	3.66	175.03	8.10
T_9	$ZnSO_4$ @ 0.50 %	3.72	179.25	8.30
T_{10}	Borax @ 0.1 %	3.57	172.77	8.00
T_{11}	Borax @ 0.2 %	3.74	178.41	8.26
T_{12}	$ZnSO_4$ @ 0.25 % + Borax @ 0.1 %	3.77	189.14	8.76
T_{13}	$ZnSO_4$ @ 0.5 % + Borax @ 0.2 %	4.29	214.13	9.91
	S.E. ±	0.17	8.31	0.38
	C.D (P=0.05)	0.51	24.27	1.12

Table 2: Influence of zinc and boron on germination and field emergence percentage, seedling vigour index, 1000 seed weight (g), mean seedling dry weight of 10 seedlings (mg) and electrical conductivity (dS/m) in onion

	Germination (%)	Field emergence (%)	Seedling vigour index	1000 seed weight (g)	Mean seedling dry weight of 10 seedlings (mg)	Electrical conductivity (dS/m)
T_1	80.2	68.83	1119	3.09	19.82	0.92
T_2	80.6	69.75	1160	3.23	20.27	0.854
T_3	81.0	70.83	1179	3.35	20.33	0.832
T_4	80.7	70.58	1164	3.31	20.15	0.878
T_5	81.4	71.58	1175	3.36	20.63	0.843
T_6	81.5	72.42	1191	3.40	20.79	0.844
T_7	81.7	73.42	1243	3.58	20.96	0.821
T_8	81.5	71.50	1184	3.29	20.86	0.859
T_9	84.8	74.08	1271	3.63	21.12	0.826
T_{10}	80.8	70.08	1147	3.24	20.07	0.849
T_{11}	81.0	71.25	1184	3.29	20.69	0.839
T_{12}	81.7	72.92	1206	3.41	20.54	0.832
T_{13}	84.3	74.75	1352	3.75	21.55	0.816
S.E. ±	0.76	2.11	18.00	0.08	0.77	0.05
C.D. (P=0.01)	2.98	NS	71.00	0.33	NS	NS

NS= Non-significant

Table 3: Influence of zinc and boron on shoot length, root length and total seedling length in onion

Treatments		Shoot length (cm)	Root length (cm)	Total seedling length(cm)
T_1	Control (RDF)	7.66	6.28	13.95
T_2	$ZnSO_4$ @ 5 kg/ha	7.88	6.52	14.39
T_3	$ZnSO_4$ @ 10 kg/ha	7.98	6.57	14.56
T_4	Borax @ 4 kg/ha	7.86	6.56	14.42
T_5	Borax @ 6 kg/ha	8.07	6.35	14.42
T_6	$ZnSO_4$ @ 5 kg/ha + Borax @ 4 kg/ha	8.10	6.50	14.60
T_7	$ZnSO_4$ @ 10 kg/ha + Borax @ 6 kg/ha	8.25	6.97	15.22
T_8	$ZnSO_4$ @ 0.25 %	8.16	6.37	14.53
T_9	$ZnSO_4$ @ 0.50 %	8.33	6.65	14.98
T_{10}	Borax @ 0.1 %	7.83	6.35	14.18
T_{11}	Borax @ 0.2 %	8.13	6.48	14.62
T_{12}	$ZnSO_4$ @ 0.25 % + Borax @ 0.1 %	8.17	6.60	14.77
T_{13}	$ZnSO_4$ @ 0.5 % + Borax @ 0.2 %	8.83	7.21	16.04
	S.E. ±	0.17	0.15	0.18
	C.D. (P=0.01)	0.65	0.59	0.70

(8.83cm), root length (7.21cm), total seedling length (16.04 cm), seedling vigour index (1352) was recorded from the treatment T_{13} (Zinc sulphate 0.5 % + boron 0.2 %) and the minimum shoot length (7.66 cm), root length (6.28 cm), total seedling length (13.95 cm), seedling vigour index (1119) was observed from the control treatment. The significantly highest test weight (3.75 g) was observed from the treatment T_{13} ($ZnSO_4$ 0.5 % + B 0.2 %) and the minimum was noticed in the control plot (3.09 g). The recorded data on the electrical conductivity and seedling dry weight did not revealed significant effect among control and micronutrients treatments.

Yield parameters :

The increase in seed yield per plant is ascribed to the presence of more number of umbels per plant and application of boron increases umbel diameter, which resulted in the more flowers per umbel, and maximum seed set percentage. The higher values of flowers per umbel and seed setting percentage might be attributed to the beneficial effect of zinc and boron. Foliar applied zinc and boron is found more effective in increasing seed yield than the soil application. The plant during its reproductive stage requires more amount of boron and foliar spray of boron immediately becomes available to plant when compared with soil applied boron. The increase in the seed yield per plant can be ascribed to boron as it is directly related with the fertilization process, enhances the pollen producing ability of anther, viability of pollen grains, germination of pollen and pollen tube development. Further it is actively involved in the translocation of sugar molecules across cell membranes, cell differentiation and growth, nitrogen metabolism and more water retention etc. the accumulation of higher photosynthates in the seed might be the reason for increased seed yield. The outcomes of the present experiment are in harmony with the discoveries of Sivaiah *et al*. (2013) and Kumar *et al*. (2014).

Zinc is considered as the important element in the synthesis of protein and the boron aids in arresting flower drop. Similar findings were reported in onion seed crop for maximum amount of flowers and seeds per umbel by Hamsaveni *et al*. (2003), by Natesh *et al*. (2005), in chilli, by Geetarani *et al*. (2008), in onion, by Kumar *et al*. (2009) in cowpea and in soybean by Nagaraju and Kumar (2010), by Sivaiah *et al*. (2013), in tomato. Boron plays an important role in the nitrogen-based synthesis and it also actively takes part in the RNA metabolism, owing to which DNA repair and RNA synthesis can be increased. In addition, zinc assists in the synthesis of protein, which in turn improves seed yields (Hamsaveni *et al*., 2003). Boron aids in enhanced seed set by enhancing better assimilation of photosynthates and translocation of sugar molecules to the reproductive parts. Above findings are in similarity with the outcomes of Deepika in radish who revealed that foliar spray of zinc sulphate and boric acid resulted in the enhanced seed recovery percentage. The outcomes of the present experiment are in accordance with the findings of Nagaraju and Kumar (2010) in soybean and Dogra *et al*. (2019) in onion, with the application of zinc and boron.

Quality parameters :

Among the various micronutrient treatments foliar application of $ZnSO_4$ @ 0.5 % resulted in the highest seed germination percentage (84.8 %). The higher germination percentage is ascribed to the zinc enhanced the metabolic activity through the activation of certain enzymes resulted in the breakdown of complex macromolecules into simple form (glucose, amino acids and fatty acids etc) and made available higher amount of metabolites in the seed which in turn aids in the resumption of the embryonic growth. These outcomes are in corroborative with the findings of Hamsaveni *et al*. (2003) in tomato, Natesh *et al*. (2005) in chilli, Deepika (2015) in radish. The increased length of the seedling is ascribed to the foliar spray of micronutrients increased protein syntheisis further it also enhanced the photosynthetic and enzymatic activity resulting in the efficient translocation and assimilation of photosynthates and food reserves from the source to sink resulting in higher vigour index. The other quality parameters like electrical conductivity, seedling dry weight were found non significant among different micronutrient treatments. The maximum test weight is due to the efficient translocation of photosynthates and increased accumulation of food reserves in the seed. These outcomes are analogous with Deepika (2015) in radish, Arvind Kumar *et al*. (2016) in bitter gourd and Hossain *et al*. (2017) in onion.

Conclusion:

The application of zinc and boron shows positive effect towards the yield and quality parameters of onion cv Bhima super. Yield parameters such as seed yield per plant, per plot and per hectare were highly responsive to foliar spray and soil application of zinc sulphate and borax. Quality parameters highly responded to boron as well as zinc, so judicial application of zinc and boron may provide highest yield and good quality seeds.

REFERENCES

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(On)5, *Int. J. Res*., **2** (1) : 757-765.

Anonymous (2019). Area, production and productivity of onion in India, (2018-19), Agricultural Statistics Division, Directorate of Economics and Ministry of Agriculture and Farmer welfare, Govt. of India.

Arvind Kumar, P. R., Vasudevan, S. N. and Patil, M. G. (2016). Effect of NAA, triacontanol and boron on seed viability and vigour in bitter gourd (*Momordica charantia* L.) cv. Pusa visesh. *Int. J. Agric. Sci*., **12**: 365-369.

Deepika, C. (2015). Effect of zinc and boron on growth, seed yield and quality of radish (*Raphanus sativus* L.) cv. Arka Nishanth. *Curr. Agric. Res. J.,* **3** : 85-89.

Dogra, R., Thakur, A. K. and Sharma, U. (2019). Studies on agronomic bio-fortification with micronutrients in onion (*Allium cepa* L.) *Seed. Crop. Int. J. Econ. Plants*, **6** (3) : 136-139.

Geetharani, P., Manivannan, M. I. and Ponnuswamy, A. S. (2008). Seed production of onion as influenced by the application of growth regulators and nutrients. *Asian. J. Hort.,* **3** (2) : 301-303.

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. J. Agric. Sci.,* **16** (3) : 457-459.

Hossain, Md, Ahmed, M., Haq, Md., Shefat-Al-Maruf, Md., Majumder, S. and Matin, Md. (2017). Quality seed of onion: Effect of micro and macronutrients. *Annu. Res. Rev. Biol.*, **20** : 1-11.

Kumar, C., Gupta, A. K. and Uniyal, S. P. (2014). Influence of boron and lime on growth and seed yield of snowball cauliflower (*Brassica oleracea var. botrytis* L.) cv. Pusa Snowball K-1. *Prog. Hort.,* **46** (1) : 107-110.

Kumar, D. M. A., Vyakaranahal, B.S. and Deshpande, V. K. (2009). Influence of pelleting with micronutrients and botanical on growth, seed yield and quality of vegetable cowpea. *Karnataka. J. Agric. Sci.,* **22**: 898–900.

Maurya, P. K., Yadav, L. M., Thakur, G. S. and Patel, P. (2018). Effect of micronutrient application on growth and yield of *Kharif* onion (*Allium cepa* L.). *Int. J. Curr. Microbiol. App. Sci.,* **7** (03): 601-608.

Nagaraju, A.P. and Kumar, M.H.K. (2010). Effect of micronutrients and bioinoculants on growth and yield of soybean (*Glycine max* L.). *Mysore. J. Agric. Sci.,* **44** : 260–265.

Natesh, N., Vyakaranahal, B.S., Shekhar Gouda, M. and Deshpande, V. K. (2005). Effect of micronutrients and organics on growth, seed yield and quality of chilli. *Karnataka J. Agric. Sci.,* **18** (2) : 334-337.

Panse, V. G. and Sukhatme, P. V. (1978). *Stat. Math. Agric.* Work. ICAR. Publication, New Delhi, India.

Pramanik, K., Tripathy, P., Mandal, P., Pradhan, M. and Biswal, M. (2018). Effect of micronutrients on quality of onion (*Allium cepa* L.). *Int. J. Chem. Studies*, **6** (6) : 1324-1327.

Sivaiah, N. K., Swain, S. K., Raju, B. and Sandeep Varma, V. (2013) Influence of micronutrients application on growth and seed yield in tomato (*Lycopersicon esculentum* MILL.). *Int. J. Dev. Res.,* **3** (11):191-195.

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