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Impact of Micronutrients on Growth, Yield and Quality of Onion (*Allium cepa)*

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ABSTRACT

Application of zinc sulphate, borax and micronutrient mixture through soil and foliar, significantly improved growth like plant height, number of leaves, neck thickness and bulb diameter and average bulb weight yield parameter. Improvement in growth and yield contributing characters significantly increased marketable and total yield in Onion and the highest value were recorded in the treatment with foliar spray of zinc sulphate @ 0.5% @ 30 and 45 DAT (34.13 t ha^{-1}and 38.28 t ha^{-1}) that was followed by soil application of zinc sulphate @ 10 kg/ha. There was improvement in quality of onion bulb in the form of TSS. Due to application of zinc sulphate borax and micronutrient mixtures. Hence micronutrients nutrient are beneficial for Onion.

Key words: *Onion, Foliar application, Zinc*

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial bulbous vegetable crop and is widely grown all over the world[13]. The most important chemical content in onion is *allyl propyl disulphide* which is responsible for its pungency. Rich in carbohydrates, protein, vitamin A, ascorbic acid etc. it is known for its unique flavor thus it is used in daily diet and to make different dishes and value added products. India ranks next to China, accounting for 26.8 percent of world area and 19.9 percent of onion production. The area and production of onion in India is about 1181'000 hectares and18924'000 tonnes of bulb, respectively, with an average yield of 16 t ha^{-1} (NHB[14]). 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[3]. 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.

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Boron and zinc are the most important micro-nutrients and essential for cell division, nitrogen and carbohydrate metabolism and water relation in plant growth[4]. Response of onion to zinc application has been reported Lal and Maurya[8]. Mishra *et al.*[12] have shown that foliar application of $ZnSO_4$ @ 0.5% and $FeSO_4$ @ 1.0% to onion significantly improved growth parameters. Therefore, an attempt was made to study the influence of foliar micronutrients nutrition on growth, yield and bulb quality of onion.

MATERIALS AND METHODS

The experiment was conducted under All India Network Project on Onion and Garlic at the Main Agricultural Research Station, UAS, Dharwad during kharif 2015. The chemical analysis of the composite soil sample of the experiment site before treatment imposition revealed that soil of the experimental site was neutral (P^H 6.95) low in soluble salts (EC 1.82 dsm-$^{-1}$), available nitrogen (228.5 kg ha^{-1}), medium in available phosphorous (21.10 kg P_2O_5ha^{-1}), high in available potassium (6.20 kg ha^{-1}), sufficient in available sulphur (30.00 kg ha^{-1}), deficit in DTPA extractable Zn (0.49 mg kg^{-1}) sufficient in DTPA extractable Fe (6.25 mg kg^{-1}), Mn (23.40 mg kg^{-1}) and Cu (1.54 mg kg^{-1}). The experiment was laid out in randomized block design with 4 replications. The treatments consisted of T_1-soil application of zinc sulphate @ 10.0 kg/ha, T_2-foliar application of zinc sulphate @ 0.5% at 30 and 45 DAT, T_3-soil application of borax @ 10.0 kg/ha, T_4-foliar application of borax @ 0.25 % @ 30 and 45 DAT, T_5-foliar application of micronutrient mixture (Composition ; Fe-2.5%, B-0.5%, Zn-3.0%, Cu-1.0%, Mn-1.0%) @ 0.5.0 % @ 30 and 45 DAT, T_6-control without micronutrient . RDF was common to all the treatments. Treatments were imposed during transplantation forty five days old seedlings and the crop was raised as per the recommended package of practice. The chemical analysis of the composite soil sample collected before harvest and soil samples collected treatment wise were analyzed as per the standard procedure. Total soluble solids (TSS) were determined by using hand held refractometer and expressed in degree brix. Statistical analysis was done as per the procedure given by Panse and Shukatme[15].

RESULTS AND DISCUSSION

Plant height in onion differed significantly due to different micronutrients treatments. Vegetative growth in onion significantly improved due to different micronutrient treatments (Table 1). Foliar application of zinc sulphate @ 0.5 % at 30 and 45 DAT produced taller plants (64.10 cm) and was significantly superior to soil and foliar application of borax respectively at 10 kg ha^{-1} and at 0.25 % concentration and control but statistically similar to soil application of zinc sulphate @ 10 kg ha^{-1} (63.13 cm) and foliar application of micronutrient mixture @ 0.5 % at 45 DAT (62.76 cm). Mishra *et. al.*[12] also reported significant increase in plant height of onion due to foliar application of zinc sulphate @ 0.5 %. The treatment with foliar application of zinc sulphate @ 0.5 % at 30 and 45 DAT produced higher number of leaves (8.50) and was significantly superior to all the treatments including control. Similarly, soil application of zinc sulphate also produced higher number of leaves in onion (7.25) and was on par with foliar nutrition with micronutrient mixture at 0.5 % concentration (6.50) but differed significantly to both soil and foliar nutrient with borax and control. Boron application either to soil or through foliage is borax from was not beneficial. Neck thickness is an important growth parameter which influences bulb weight and yield in onion. It was 1.02 cm in control and significantly increased due to different micronutrient treatments and the highest value of 1.89 cm was recorded in the treatment with foliar application of zinc sulphate @ 0.5 % (1.89 cm) and was significantly superior to all the treatments. Similarly, the treatment with soil application of zinc sulphate also produced significantly higher neck thickness and was significantly superior compared to treatments with borax

and micronutrient mixtures. Treatments receiving borax through soil and foliar and micronutrients mixture through foliar were statistically similar to each other. The present findings corroborated with Manna *et. al.*[10], who observed improvement in growth attributes in onion due to application of micronutrients. Similar results were also reported by Alam *et. al.*[2] and Abd-El-Sameed *et. al.*[1]. The favorable effect of micronutrients on growth attributes in onion might be due to their role in many physiological processes and cellular functions within the plants. Micronutrients play an important role in the biosynthesis of endogenous hormones which are responsible for promoting plant growth[6].

Yield and yield attributes

Yield attributing characters and bulb yield in onion differed significantly due to various micronutrient treatments. Average bulb weight in onion was 69.51 gm in control and increased to 75.04 and 78.79 gm due to soil and foliar application of zinc sulphate, respectively and both were significantly superior to other treatments but the difference between these two treatments was also significant. Soil and foliar application of borax and foliar nutrition of micronutrient mixtures also produced significantly higher bulb weight than control. Similar trend was also recorded in bulb diameter except that foliar application of borax @ 0.25 % resulted in numerically higher bulb diameter than control. Improvement in individual bulb weight and bulb diameter due to foliar application of 0.5 % borax n onion was also reported by Dake *et. al.*[5]. Meena, O.S. and Singh, D.[11] observed beneficial effect of zinc in increasing bulb weight in onion. Improvement in growth and yield attributes due to different micronutrients, treatments increased marketable and total yield in onion. Marketable and total yields of onion in control were 25.76 and 29.89 t ha^{-1} respectively and increased significantly due to application of micronutrients through soil and foliage. The treatment with 0.5 % foliar spray of zinc sulphate recorded higher marketable (34.13 t ha^{-1}) and total (38.28 t ha^{-1}) yield followed by its soil application @ 10 kg ha^{-1} (marketable yield, 30.35 t ha^{-1} and total yield, 36.04 t ha^{-1}). The results obtained by Khan *et. al.*[7] was also in close confirmity in this regard. The improvement in growth and yield attributes might have led to higher marketable and total yield in onion. These results confirm the findings of Manna[9] who observed improvement in growth and bulb yield of onion due to foliar nutrition of zinc and boron. Higher photosynthesis accumulation in the bulb would ensure higher individual bulb weight, bulb diameter and neck thickness.

A total soluble solid which is an indicator of quality in onion was significantly influenced by application of zinc and boron either to soil or foliar micronutrient mixture spray. Foliar nutrition with zinc sulphate @ 0.5 % produced higher TSS of 14.24 ^{0}B followed by its soil application (13.41^{0}B) whereas, control recorded lower value (12.86 ^{0}B). The beneficial effect of zinc on onion quality might be due to its involvement in auxin metabolism in plants[2,1].

From the above results it could be concluded that soil and foliar application of zinc and foliar application of boron and micronutrient mixture improves growth and yield contributing characters and marketable and total yield and quality in onion in Vertisol of Northern transitional zone (Zone-8) of Karnataka.

Available nutrients after harvest of the crop

Available nitrogen, phosphorus, potassium and sulphur content were 224.48, 23.36, 623.53 and 31.78 kg ha^{-1} and decreased due to soil and foliar application of micronutrients (Table.3). The decrease in available nutrients in soil with micronutrients application might be attributed to higher bulb yield of onion and higher uptake of these nutrients from the soil. In T2 sulphur was added to soil through iron sulphate. Even then there was numerical decrease in available sulphur content in soil. This might be due to higher sulphur requirement of onion crop.

Table 1: Effect of micronutrients application on growth parameters in Onion

Treatment	Plant height	No. leaves	Neck thickness
T_1	63.13	7.25	1.66
T_2	64.10	8.50	1.89
T_3	61.08	5.75	1.42
T_4	60.16	5.75	1.44
T_5	62.76	6.50	1.48
T_6	59.39	5.50	1.02
SEM±	1.103	0.319	0.050
CD (5.0%)	3.325	0.963	0.150
CV (%)	3.572	9.768	6.744

Table 2: Effect of micronutrients application on yield parameters and yield in Onion

Treatment	Avg. bulb weight	Bulb diameter	Marketable yield (t/ha)	Total yield (t/ha)	TSS
T_1	75.04	58.23	30.35	36.04	13.41
T_2	78.79	60.02	34.13	38.28	14.24
T_3	73.18	57.32	27.51	32.43	13.32
T_4	72.66	55.74	26.84	33.03	12.98
T_5	72.60	58.03	28.47	33.39	13.11
T_6	69.51	54.65	25.76	29.89	12.86
SEm±	0.549	0.487	0.124	0.585	0.119
CD (5.0%)	1.655	1.469	0.392	1.846	0.359
CV (%)	1.491	1.701	4.534	4.383	1.792

Table 3: Available major nutrients, status of soil after the harvest of the crop

Treatment	Available nutrients in soil (Kg/ha)			
	N	P	K	S
T_1	219.25	18.50	589.33	28.50
T_2	223.40	19.30	593.90	29.05
T_3	213.65	17.20	579.70	24.80
T_4	216.58	18.60	590.30	27.88
T_5	220.35	20.00	595.85	29.78
T_6	224.48	23.36	623.53	31.78
SEm±	1.775	1.100	5.0652	1.859
CD (5.0%)	5.353	3.317	15.268	5.604
CV (%)	1.617	11.292	1.7013	12.989

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