Effect of micronutrients on growth, yield and quality of onion (*Allium cepa* L*)* cv Phule Samarth

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ABSTRACT

A field experiment was conducted to evaluate the effect of micronutrients on growth, yield and quality of onion (*Allium Cepa* L) cv Phule Samarth using six treatment combinations containing soil application and foliar spray of micronutrients along with control under RBD replicated four times, during kharif (rainy) season of 2022-23 at the Oilseeds Research Station, Mahatma Phule Krishi Vidyapeeth, Jalgaon, Maharashtra. Among different treatments, the application of 100 per cent RDF + 20 tonnes FYM + soil application of $ZnSO_4$ @ 25 kg/ha and 100 per cent RDF + 20 tonnes FYM + foliar spray of mixture of $ZnSO_4$ @ 0.5 per cent and borax @ 0.25 per cent at 30 and 45 DAT, resulted in higher plant height of 60.66 and 59.33 cm at 60 DAT, number of leaves of 8.73 and 8.50 at 45 DAT, polar diameter of 5.86 and 5.53 cm and yield of 25.55 and 23.98 MT per hectare respectively, as compared to all other treatmentw. However, the treatment 100 per cent RDF + 20 tonnes FYM + soil application of $ZnSO_4$ @ 25 kg/ha resulted in maximum bulb weight of 111.66 g among all the treatments applied.

Keywords: Onion; micronutrients; foliar spray; soil application; growth; yield; quality

INTRODUCTION

Onion (*Allium Cepa* L), belonging to the family Amaryllidacae, is one of the most popular and important bulbous crops. It is commercially regarded as the most important spice crop and is grown from ancient times in India. It is popularly used both immature as leafy vegetable and bulb. It is used in salads, soups, sauces and pickles in culinary purposes. It contains vitamins B and C with traces of minerals like iron and calcium. It is also rich in sulphur compounds that are responsible for pungent odour due to volatile oil known as allylpropyl disulphide.

In India, the area under onion is 1.43 million hectares with annual production of 26.09 million tonnes and productivity of 18.245 tonnes per hectare (Anon 2021). India is the second largest producer of onion in the world. The major onion producing states are Maharashtra, Madhya Pradesh, Karnataka, Rajasthan, Gujarat, Bihar, Andhra Pradesh, Haryana, West Bengal, Uttar Pradesh and Chhattisgarh in the country. These states account for almost 90 per cent of the total onion production of the country (Anon 2018). Maharashtra is the country's largest onion producer, cornering about 34 per cent of the national production (Biswas 2020).

Application of micronutrients to deficient soils has shown remarkable increase in quality and yield of onion crop. Micronutrients play an active role in the plant metabolic processes from cell wall development to respiration, photosynthesis, chlorophyll formation, enzyme activity, nitrogen fixation etc (Ballabh and Rana 2012). Zinc and boron are the most important micronutrients as well as essential for cell division, nitrogen carbohydrate metabolism and water relation in plant growth (Brady 1990). Looking to the importance of micronutrient application for increase in yield and quality of onion, the present investigations were undertaken to study the effect of micronutrients application on growth and yield of onion cv Phule Samarth during kharif at the Oilseeds Research Station, Mahatma Phule Krishi Vidyapeeth, Jalgaon, Maharashtra.

MATERIAL and METHODS

The field experiment was conducted during kharif (rainy) season on onion (*Allium cepa* L) with cv Phule Samarth. Recommended dose of fertilizers NPK (100:50:50 kg/ha) along with 20 tonnes FYM/ha was uniformly given to all the treatments. The treatments used were T_1 (100% RDF + 20 tonnes FYM + soil application of $ZnSO_4$ @ 25 kg/ha), T_2 (100% RDF + 20 tonnes FYM + foliar spray of $ZnSO_4$ @ 0.5% at 30 and 45 DAT), T_3 (100% RDF + 20 tonnes FYM + soil application borax @ 5 kg/ha), T_4 (100% RDF + 20 tonnes FYM + foliar spray of borax @ 0.25% at 30 and 45 DAT), T_5 (100% RDF + 20 tonnes FYM + foliar spray of mixture of $ZnSO_4$ @ 0.5% and borax @ 0.25% at 30 and 45 DAT) and T_6 [100% RDF + 20 tonnes FYM (Control)] spread in RBD with four replications. The spacing was kept 15 cm × 10 cm and all other cultural practices were uniformly undertaken in all the entire experimental plots. Ten plants under each replication were selected for taking the observations viz plant height, number of leaves per plant and days to maturity after transplanting. Other observations viz bulb diameter (polar and equatorial), bulb weight, TSS and bulb yield per hectare were taken at harvest of the crop.

RESULTS and DISCUSSION

Performance of micronutrients on vegetative growth of onion: The data on the performance of micronutrients on plant height and number of leaves per plant at 30, 45 and 60 DAT and days taken to maturity are given in Table 1.

There were significant differences in plant height at 45 and 60 DAT, however, no effect was seen at 30 DAT. At 45 days after transplanting, higher plant height of 50.03, 48.06, 47.53, 47.26 and 49.33 cm was recorded in T_1 (100% RDF + 20 tonnes FYM + soil application of $ZnSO_4$ @ 25 kg/ha), T_2 (100% RDF + 20 tonnes FYM + foliar spray of $ZnSO_4$ @ 0.5% at 30 and 45 DAT), T_3 (100% RDF + 20 tonnes FYM + soil application borax @ 5 kg/ha), T_4 (100% RDF + 20 tonnes FYM + foliar spray of borax @ 0.25% at 30 and 45 DAT) and T_5 (100% RDF + 20 tonnes FYM + foliar spray of mixture of $ZnSO_4$ @ 0.5% and borax @ 0.25% at 30 and 45 DAT) respectively, which were at par, as compared to 45.06 cm in T_6 [100% RDF + 20 tonnes FYM (Control)], which, on the other hand, was at par with T_3 (47.53 cm) and T_4 (47.26 cm). At 60 days after transplanting, higher plant height was observed in T_1 (60.66 cm) and T_5 (59.33 cm), the two being at par, as compared to T_2 (56.66 cm), T_3 (57.33 cm), T_4 (56.00 cm) and T_6 (55.00 cm), the latter four being at par.

Significant increase in plant height due to soil application of micronutrients like zinc and boron individually and foliar spray of zinc as well as boron individually and in mixture was observed in the present study. This could be due to the cell enlargement in a coincident of the protoplast through water uptake. Similar increase in plant height due to the use of boron and zinc has been reported in many crops by Chattopadhyay and Mukhopadhay (2004) and Thakare et al (2007). Similarly, in onion the better efficacy of both boron and zinc was reported towards plant height by Acharya et al (2015).

Number of leaves per plant is an important yield contributing trait which was influenced by application of the micronutrients zinc and boron at 45 and 60 days after transplanting. At 30 DAT, no significant variation in number of leaves due to application of micronutrients was observed. At 45 DAT, maximum number of leaves was observed in T_1 (8.73) and T_5 (8.50), the two being at par as compared to T_2, and T_4 (7.53 each), T_3 (7.73) and T_6 (7.13), the four being at par. At 60 DAT, higher number of leaves was observed in T_1 (9.66), T_2 (8.66), T_3 (9.00) and T_5 (9.33), which were at par, as compared to T_4 (8.33) and T_6 (7.66), which were at par.

Increase in number of leaves might be due to the role of micronutrients in cell division, meristematic activity of plant tissue and expansion of cells (Patil et al 2009). Increase in number of leaves per plant with the application of zinc and boron was also reported by Mann (2013) and Acharya et al (2015).

Minimum duration to maturity of 100 and 102 days was recorded in treatments T_5 and T_1 respectively, the two being at par, as compared to the maximum duration of 111 days in T_6 (Control).

Performance of micronutrients on yield parameters of onion: The data on the performance of micronutrients on onion crop are depicted in Table 2.

The polar diameter of bulbs was higher in T_1 (5.86 cm) and T_5 (5.53 cm), which were at par, as compared to T_2 (5.33 cm), T_3 (5.40 cm), T_4 (5.26 cm)

Table 1. Performance of different micronutrient treatments on vegetative growth of onion

Treatment	Plant height (cm)			Number of leaves/plant			Days taken to maturity
	30 DAT	45 DAT	60 DAT	30 DAT	45 DAT	60 DAT	
T_1	35.00	50.03	60.66	7.40	8.73	9.66	102
T_2	31.60	48.06	56.66	6.66	7.53	8.66	104
T_3	31.93	47.53	57.33	6.86	7.73	9.00	106
T_4	32.86	47.26	56.00	6.46	7.53	8.33	108
T_5	32.67	49.33	59.33	7.20	8.50	9.33	100
T_6	32.53	45.06	55.00	6.53	7.13	7.66	111
SE(m)	1.23	0.940	1.040	0.25	0.24	0.36	0.65
$CD_{0.05}$	NS	2.99	3.31	NS	0.77	1.15	2.07

DAT = Days after seedlings transplanting, NS = Non-significant
T_1: 100% RDF + 20 tonnes FYM + soil application of $ZnSO_4$ @ 25 kg/ha, T_2: 100% RDF + 20 tonnes FYM + foliar spray of $ZnSO_4$ @ 0.5% at 30 and 45 DAT, T_3: 100% RDF + 20 tonnes FYM + soil application borax @ 5 kg/ha, T_4: 100% RDF + 20 tonnes FYM + foliar spray of borax @ 0.25% at 30 and 45 DAT, T_5: 100% RDF + 20 tonnes FYM + foliar spray of mixture of $ZnSO_4$ @ 0.5% and borax @ 0.25% at 30 and 45 DAT, T_6: 100% RDF + 20 tonnes FYM (Control)

Table 2. Performance of different micronutrient treatments on vegetative yield parameters of onion

Treatment	Polar diameter (cm)	Equatorial diameter (cm)	Bulb weight (g)	TSS (°B)	Yield (MT/ha)
T_1	5.86	6.20	111.66	13.60	25.55
T_2	5.33	5.60	88.06	13.40	22.03
T_3	5.40	5.73	88.46	13.10	20.74
T_4	5.26	5.40	84.86	13.06	18.70
T_5	5.53	5.80	92.40	13.53	23.98
T_6	5.13	5.26	81.60	12.76	13.51
SE(m)	0.14	0.16	5.44	0.498	0.65
$CD_{0.05}$	0.45	0.50	17.38	NS	2.08

NS = Non-significant
T_1: 100% RDF + 20 tonnes FYM + soil application of $ZnSO_4$ @ 25 kg/ha, T_2: 100% RDF + 20 tonnes FYM + foliar spray of $ZnSO_4$ @ 0.5% at 30 and 45 DAT, T_3: 100% RDF + 20 tonnes FYM + soil application borax @ 5 kg/ha, T_4: 100% RDF + 20 tonnes FYM + foliar spray of borax @ 0.25% at 30 and 45 DAT, T_5: 100% RDF + 20 tonnes FYM + foliar spray of mixture of $ZnSO_4$ @ 0.5% and borax @ 0.25% at 30 and 45 DAT, T_6: 100% RDF + 20 tonnes FYM (Control)

and T_6 (5.13 cm), which were at par with T_5 (5.53 cm). The equatorial diameter of bulbs was higher in T_1 (6.20 cm), T_3 (5.73 cm) and T_5 (5.80 cm), which were at par, as compared to T_2 (5.60 cm), T_4 (5.40 cm) and T_6 (5.26 cm), the three being at par and also with T_3 (5.73 cm). This might be due to the reason that micronutrients application enhanced the enzymes activity, which in turn triggered the physiological processes like protein and carbohydrate metabolism in the plants. Almost similar observations were also reported by Smriti et al (2002), El-Tohamy et al (2009), Alam et al (2010), Shukla et al (2015) and Aske et al (2017) in onion.

Maximum bulb weight of 111.66 g was found in T_1 which was higher over T_2 (88.06 g), T_3 (88.46 g), T_4 (84.86 g), T_5 (92.40 g) and T_6 (81.60 g), all five being at par. Similar observation was made by Paul et al (2007), Abedin et al (2012), Manna et al (2014), Karthik (2015) and Aske et al (2017) in onion crop.

The TSS in onion bulbs ranged from 12.76 to 13.60°B but there were no significant differences among the treatments for this trait. The results are contrary to the finding of Ballabh et al (2013), Srivastava et al (2005) and Trivedi and Dhumal (2005).

Highest bulb yield was recorded in T_1 (25.55 MT/ha) and T_5 (23.98 MT/ha) as compared to lowest in T_6 (13.51 MT/ha). These findings are in accordance with the work of Alam et al (2010), Ballabh and Rana (2012) and Manna et al (2014) in onion.

CONCLUSION

The application of 100 per cent RDF + 20 tonnes FYM + soil application of $ZnSO_4$ @ 25 kg/ha or 100 per cent RDF + 20 tonnes FYM + foliar spray of mixture of $ZnSO_4$ @ 0.5 per cent and borax @ 0.25 per cent at 30 and 45 DAT resulted in higher plant height at 60 DAT, number of leaves at 45 DAT, polar diameter and yield per hectare. However, the treatment 100 per cent RDF + 20 tonnes FYM + soil application of $ZnSO_4$ @ 25 kg/ha resulted in maximum bulb weight among all the treatments.

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