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EFFECT OF FOLIAR FEEDING OF MICRONUTRIENTS ON GROWTH, YIELD AND INCOME FROM *RABI* ONION VAR. AGRIFOUND LIGHT RED

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ABSTRACT

A field experiment was conducted during rabi season of 2013-14 at the nursery of Department of Horticulture, College of Agriculture, Rewa (M.P.) to study the effect of foliar feeding of micronutrients on growth, yield and income from rabi onion var. Agrifound Light Red. The experiment was laid out in randomized block design with eleven treatments and three replications. Amongst the micronutrient treatments, foliar application of 10 ppm resulted in significantly higher growth parameters, yield attributes, bulb yield upto (407.3 q ha^{-1}), net income (₹.130069 ha^{-1}) and B:C ratio 2.77. From the view point of yield and net income, 4 ppm Cu and 2 ppm Mn spray stood as the second and third best treatments (₹.109671 and ₹.100675 ha^{-1}), respectively. This was followed by 1 ppm Mn (₹. 95822 ha^{-1}), 1 to 2 ppm B (₹. 84054 to 86989 ha^{-1}), 2 ppm Cu (₹. 74020 ha^{-1}) and 100 ppm Fe (₹. 69783 ha^{-1}).

Key words: Foliar feeding, micronutrients, *rabi* onion, Agrifound Light Red

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops and plays vital role in Indian economy. In Madhya Pradesh, the crop occupies 23.55 thousand hectares having its low productivity. The increased productivity with high quality of onion is the utmost demand of the onion growers. Lack of micronutrients addition in the balanced fertilization schedule is one of the important causes of low yield. Onion requires sufficient amount of plant nutrients and responds very well to the added nutrients (Alam et aL, 20l0). Zinc plays vital role in carbohydrate and protein metabolism as well as it controls the plant growth hormone IAA. Boron plays an important role in the development and differentiation of sugar in plant (Hansch and Mendel, 2009). The most well known function of iron is in enzyme system in which haem or haemin functions as prosthetic group (Mengel and Kirby, 1982). Deficiency of multi-micronutrients and their non-addition under fertilization programme has resulted in lower productivity of onion. The soils of Rewa region are, in general, deficient in organic matter and micronutrients. Therefore, systematic fertilization of different micronutrients for onion cultivation is needed for the organic matter and micronuthent deficient soils. Looking to these facts, the present research was undertaken to study the effect of foliar application of micronutrients on growth, yield and economics of onion.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* season of 2013-14 at the Department of Horticulture Nursery, College of Agriculture, Rewa (M.P.) The soil of the experimental area was clay-loam rich in organic matter and had good water holding capacity. The soil having pH 7.15 was low in available nitrogen (233.2 kg ha^{-1}) and available phosphorus (12.5 ha^{-1}) and high in potassium content (229.6 kg ha^{-1}). Organic carbon was 5.3 g kg^{-1} and electrical conductivity 0.30 dS/m. Available Zn, Cu, Mn and Fe were 0.5, 2.9, 5.1 and 6.1 mg ha^{-1}, respectively. The weather conditions including temperature, sunshine etc. were favourable for the growth and development of plants and the entire crop season was almost congenial. The treatments comprised foliar applied eleven micronutrient namely 2 and 4 ppm Cu, 5 and 10 ppm Zn, 1 and 2 ppm B, 50 and 100 ppm Fe, 1 and 2 ppm Mn and control-water spray only). The experiment was laid out in a randomised block design with three replications. The onion variety Agrifound Light Red was transplanted on 10 January, 2013. The uniform dose of 120 kg N, 80 kg P_2O_5 and 80 kg K_2O ha^{-1} was applied in each treatment through urea, SSP and MOP, respectively. The basal dose of FYM @ 10 t ha^{-1} was also applied uniformly before transplanting. The crop was grown as per recommended package of practices. The crop was harvested on the physiological maturity. Growth parameter, yield and yield attributes of onion were recorded as per schedule. Economics of onion production by various treatments was computed on the basis of prevailing prices of inputs and output.

RESULTS AND DISCUSSION

The data (Table 1) revealed that the foliar application of 10 ppm Zn resulted in significantly higher plant height (65.4 cm), leaves (13.86 plant'), leaf length (62.32 cm), leaf width (3.90 cm), leaf area

(2112.7 cm2) and neck diameter (1.96 cm) over rest of the micronutrients, The increase in these vegetative growth parameters may be due to increased availability of zinc in the zinc deficient soil which ultimately promoted plant growth by ensuring higher number of green leaves which increased photosynthesis and forming longer and stronger roots to absorb sufficient water and nutrients All these happened with the fact that zinc directly played role in the formation of several enzymatic actions which govern the metabolic reactions in the plant system. Zinc might have also regulated the oxidation-reduction reaction in the plant which may induce the formation of chlorophyll for photosynthetic activity. This micronutrient might have helped in the formation of different growth hormones specially IAA in the plant which directly encouraged the vegetative growth and yield traits. The beneficial impact of zinc on the plant growth parameters has been reported by Ballabh *et al*, (2013). The second best micronutrient after zinc was 2 ppm B because this treatment was common which encouraged plant height (58.2 cm), and leaves (10.64 plant) in the higher range and leaf area in the maximum range (1416.7 cm^2). However, the effect upto such extent was not observed in case of Cu, Fe or Mn due to their well known differential physiological role. But their effect was found significantly superior to control. In view of the above facts, it may be said that like zinc, boron and other micronutrients also played multifarious role on the growth and development of onion plants. Boron is mostly concerned with its uptake by roots and efficient use in plants. Boron might have helped to keep calcium soluble and increase the mobility in the plants. it might have regulated K:Ca ratio which have improved the growth of the plants. Boron has also been considered as the essential component for cell division which is very necessary for the growth and development of plant. Moreover, boron might have played unique role in precipitating excess cations, buffer action, maintenance of conducting tissues with regulatory effect on other elements. The results corroborate with those of Chattopadhyaya and Mukhopadhyay (2004), Alam *et al.* (2010) and Ballabh *et al.* (2013).

Table 1: Growth, yield attributes, of *rabi* onion under foliar applied micronutrients

Treatments	Plant height (cm) 90 DAT	Leaves/ plant at 90 DAT	Length of leaf (cm) at 90 DAT	Width of leaf (cm) at 90 DAT	Leaf area (cm^2) at 90 DAT	Neck diameter (cm) at 90 DAT
T_1 Cu (2 ppm)	57.6	8.25	52.10	3.08	831.13	1.34
T_2 Cu (4 ppm)	60.3	8.73	46.05	3.42	861.87	1.72
T_3 Zn (5 ppm)	59.3	11.95	44.43	3.43	1142.89	1.40
T_4 Zn (10 ppm)	65.4	13.86	62.32	3.90	2112.714	1.96
T_5 B (1 ppm)	54.8	9.87	57.26	3.15	1115.25	1.53
T_6 B (2 ppm)	58.2	1064	56.92	3.72	1416.76	1.54
T_7 Fe (50 ppm)	53.4	9.36	48.64	3.64	1035.47	1.37
T_8 Fe (100 ppm)	54.0	10.27	51.45	3.36	1113.54	1.46
T_9 Mn (1 ppm)	58.30	9.48	54.36	3.73	1204.34	1.34
T_{10} Mn (2 ppm)	60.8	9.15	50.73	3.47	1007.45	1.46
T_{11} Control	47.2	6.29	40.37	2.54	409.81	1.25
S.Em$\pm$	1.64	0.29	0.27	0.13	42.54	0.01
C.D.(P=0.05)	3.53	0.65	0.57	0.27	91.25	0.02

Yield attributes and yield

Out of micronutrients, 10 ppm Zn brought about significantly higher fresh weight of bulb, equatorial and polar diameter of bulb as compared to Cu, Fe, B and Mn in their lower and higher doses (Table 2). The increase in yield attributes of onion due to Zn application was in accordance with the increase in growth and development characters. The present findings are in close conformity with those of many research workers (Ballabh et al, 2013 and Verma *et al.* 2014). Amongst the other micronutrients, Mn, B and Cu at their higher levels performed better with respect to yield attributes of onion. This owed to increase in growth parameters due to unique functions of these micronutrients in the plant metabolism. The applied micronutrients at their higher levels attributed to acceleration in the development of growth and reproductive phases. Moreover, higher level of these micronutrients might have accelerated protein synthesis thus promoting the bulb development. These results are in accordance with those of Chattopadhyay el al. (2004) and Ballabh *et al.* (2013) who reported that yield characters like bulb diameters significantly influenced with higher level of micronutrients like Zn, B, Mn and Cu in onion. The results further indicate that the foliar application of higher close of Zn (10 ppm) resulted in significantly higher bulb yield (407.3 q ha^{-1}). This increase in yield might be attributed to the increase in yield attributing characters under the higher dose of Zn. The increase in yield due to Zn application may be due to the fact that Zn plays an important role in plant metabolism and reproduction. Similar observations were also reported by Akabari *et al.* (2011) in groundnut. The increase in onion yield due to Zn application has also been reported by Ballabh *et al.*, (2013) and Verma *et al.,* (2014).

Table 2: Effect of foliar applicartion of micronutrients on yield and economics of rabi seasons

Treatments	Fresh weight of bulb (g)	Bulb diameter equatorial (cm)	Bulb diameter polar (cm)	Bulb yield (q ha^{-1})	Net income (₹. ha^{-1})	B:C ratio
T_1 Cu (2 ppm)	58.7	5.70	5.20	294.8	74020	2.01
T_2 Cu (4 ppm)	60.1	5.90	5.30	367.2	109671	2.48
T_3 Zn (5 ppm)	64.2	6.20	5.80	267.4	60369	1.82
T_4 Zn (10 ppm)	84.5	7.10	6.70	407.3	130069	2.77
T_5 B (1 ppm)	68.1	6.70	6.20	314.6	84054	2.15
T_6 B (2 ppm)	78.2	6.80	6.30	321.3	86989	2.18
T_7 Fe (50 ppm)	64.6	6.60	6.20	264.5	59201	1.81
T_8 Fe (100 ppm)	64.7	6.70	6.30	286.1	69783	1.95
T_9 Mn (1 ppm)	69.1	6.70	6.20	338.0	95822	2.31
T_{10} Mn (2 ppm)	74.5	6.90	6.60	348.2	100575	2.37
T_{11} Control	30.3	5.20	4.90	240.8	47969	1.66
S.Em$\pm$	1.23	0.08	0.07	9.70	--	--
C.D.(P=0.05)	2.64	0.17	0.15	20.81	--	--

As regards the yields obtained from other micronutrient treatments, it was found significantly higher to that of control treatment. Amongst the micronutrients other than Zn, foliar application of 4 ppm Cu resulted in higher onion yield (367.2 q ha^{-1}). This was followed by foliar application of 2 ppm Mn, the yield being 348.2 q ha^{-1} and the lower dose of 1 ppm Mn increase in growth and development characters. The present findings are in close conformity with those of many research workers (Baliahh et al, 201 3 and Verma *et al.*, 2014). Amongst the other micronutrients, Mn, B and Cu at their higher levels performed better with respect to yield attributes of onion. This was owing to increase in growth parameters due to unique functions of these micronutrients in the plant metabolism, The applied micronutrients at their higher levels attributed to acceleration in the development of growth and reproductive phases. Moreover, higher level of these micronutrients might have accelerated protein synthesis thus promoting the bulb development. These results are in accordance with those of Chattopadhyay *et al.* (2004) and Ballabh *et al.* (2013) who reported that yield characters like bulb diameters significantly influenced with higher f micronutrients like Zn, B, Mn and Cu in onion, The results further indicate that the foiiar application of higher dose of Zn (10 ppm) resulted in significantly higher bulb yield (407.3 q ha^{-1}). This increase in yield might be attributed to the increase in yield attributing characters under the higher dose of Zn. The increase in yield due to Zn application may be due to the fact that Zn plays an important role in plant metabolism and reproduction. Similar observations were also reported by Akabari *et al.* (2011) in groundnut. The increase in onion yield due to Zn application has also been reported by Ballabh et al. (2013) and Verma *et al* (2014).

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Economics

Foliar application of 10 ppm Zn resulted in maximum net income (₹. 130069 ha^{-1}) with B:C ratio of 2.77. The second best micronutrient was 4 ppm Cu (₹. 109671 ha^{-1}) with B:C ratio of 2.48. The third best micronutrients was 2 ppm Mn (₹. 100575 ha^{-1}, 2.37 B:C ratio). This was followed by 1 ppm Mn (₹. 95822 ha^{-1} with B:C ratio of 3.31). The lowest net income (₹. 47969 ha^{-1}) was obtained from the control with a B:C ratio of 1.66. Thus, the net income obtained from the applied micronutrients was in accordance with the onion yield received per hectare from such treatments and their sale value in the market. The results concluded that amongst the micronutrients, 10 ppm Zn gave the maximum bulb yield and net income from Agrifound Light Red variety of rabi onion. The second and best third micronutrients were 4 ppm Cu and 2 ppm Mn, respectively.

REFERENCES

Akabari, K.N., Kanzaria, K.K., Vora, V.D., Sutaria, G.S. and Padmani, D.R. (2011) Nutrient management practices for sustaining groundnut yield and soil productivity of sandy-loam soil. *Journal of the Indian Society of Soil Science* **59**: 308-311.

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. *International Research Journal of Plant Science* **1**: 56-61.

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

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

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

Mengel, K. and Kirby, E.A (1982) *Principles of Plant Nutriention* International Potash Institute, Bern Switzerland.

Samad, A.El., Khalifa, R.K.M., Lashine, Z.A. and Shafeek, M.R. (2011) Influence of urea fertilization and foliar application of some micronutrients on growth, yield and bulb quality of onion. *Australian Journal of Basic Applied Science* **5**: 96-103.

Verma, C.K., Kedar Prasad and Yadav, D.D. (2012) Studies on response of S, Zn and B levels on yield, economics and nutrients uptake of mustard. *Crop Research* **44**(1 & 2): 75-78.

Verma, Dharmesh, Singh, Harendra, Singh, Narendra and Sharma, Y.K. (2014) Effect of inorganic fertilizers and FYM on onion productivity and soil fertility. *Annals of Plant and Soil Research* **16**(2): 117-120.