Effect of micronutrients on growth of Onion (*Allium cepa* L.)

Abstract

An experiment was conducted to determine the effect of micronutrients on growth of Onion (*Allium cepa* L.) during *Rabi* season of 2019-2020 at the Horticultural Research centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.). The experiment was laid out in Randomized Block Design (RBD) with three replications. The maximum plant height (27.18, 43.32, 49.22 and 47.45 cm at 30, 60, 90 and at harvest after days of transplanting, respectively), number of leaves (5.11, 8.83, 12.87 and 13.98 at 30, 60, 90 and at harvest after days of transplanting, respectively), diameter of stem per plant (6.64, 8.97, 11.13 and 10.95 mm at 30, 60, 90 and at harvest after days of transplanting, respectively) and length of longest leaf at harvesting (43.56 cm) were reported under treatment T_9 - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} whereas the minimum values for above parameters were recorded under T_{11} – control.

Keywords: Onion, RDF, Zinc, Borax and growth.

Introduction

Onion (*Allium cepa* L.) is the one of the most important commercial bulbous vegetable crops which is cultivated extensively in India. It belongs to the family Alliaceae. It originated from Central Asia. Onion is the cool season vegetable crop. However, it can be grown under a wide range of agro-climatic conditions. It grows well under a mild climate without extreme heat or cold or extreme rainfall. The edible part of the onion is green leaves, immature and mature bulbs. Green onions also called scallions are eaten for their immature bulb and green foliage. Onion has strong flavor due to the presence of sulphur containing compounds in very small quantities in the form of volatile oil allyl propyl disulphide responsible for distinctive smell and pungency.

In India, onion is cultivated for vegetable as well as medicinal purposes. Its medicinal properties are steadily gaining more importance in the world. It has benefits in lowering total plasma cholesterol, reducing blood pressure, regulating blood sugar, acts as blood purifier etc. Onion is one of the richest sources of flavonoids which reduce risk of cancer, heart disease and diabetes. Flavonoids are not only anti-cancer but also known as anti-bacterial, antiviral and anti-allergenic. Most of the medicinal effects of onion are preferable to a sulphur compound known as allicin **(Schulz, 1998),** which is influenced by both genetic and agronomical practices.

Onion is a biennial or perennial cultivated vegetable plant. It is one of the most important cash vegetable crops among all bulbous vegetable crops and semi-perishable in nature. It can be transported to a long distance without much post harvest losses. The significance of crop further enhances due to its multiple uses **(Bhattacharjee *et al.*2013).**

Plant nutrients play an important role in growth and development of bulbous vegetable crops like onion. Beside the major plant nutrients like nitrogen phosphorus and potassium, some micronutrients also play a beneficial effect in terms of plant metabolic process from cell wall development to respiration, photosynthesis, chlorophyll formation, enzyme activity, nitrogen fixation etc. Even though micronutrients are also needed by the onion in minor quantities and present in plant tissue in quantities measured in parts per million, it is involved in a wide range of metabolic processes and cellular functions within the plants. Also, they work as a coenzyme for a large number of enzymes. In addition to that they play an essential role in improving for better plant growth parameters of different crops **(Ballabh and Rana, 2012).**

The application of nitrogen increased plant growth of onion. Similarly, phosphorus has the most beneficial effect on early root development and plant growth of crop produce. Potassium plays an important role in crop productivity by functioning as an activator of numerous enzymes like pyruvic kinase, cytoplasmic enzymes and therefore, causes a pervasive effect on metabolic events. The judicious application of nutrient like sulphur has improved plant height and number of leaves of onion **(Kumar *et al.* 2017)**.

Zinc is a micronutrient which is required for plant growth and development relatively in small amounts. The functional role of Zn include auxin metabolism, influence on the activity of dehydrogenase, carbonic anhydrase enzymes, synthesis of cytochrome and stabilization of ribosomal fractions. Zinc also plays an important role in chlorophyll formation. Application of Zinc increased the growth of onion **(Phor *et al.* 1995)**.

Boron is an essential micronutrient required for normal plant growth and development. It is a very sensitive element and plants differ widely in their requirements but the ranges of deficiency and toxicity are narrow. It is necessary for normal cell division, nitrogen metabolism and protein formation. It is essential for proper cell wall formation **(Smriti *et al.* 2002).**

Materials and Methods

A field experiment was conducted during *Rabi* season of 2019-2020 at the Horticultural Research centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut

(U.P.). Onion variety Agrifound Light Red was used to conduct the experiment in Randomized Block Design (RBD) with eleven treatments and three replications. The crop was planted in a Net plot size (3.50 m x 1.25 m) at a spacing of 15 cm x 10 cm. Before fertilizer application, random soil samples were taken from the experimental field and were analyzed. The soil of the experimental plot was sandy loam in texture with pH 7.68. Nitrogen and Organic carbon content in soil were low, while the level of available phosphorus and potassium was medium. The treatments includes **T_1** - RDF (100:50:50:30 Kg NPKS + 20 tones FYM ha^{-1}), **T_2** - RDF + Zinc Sulphate 10 Kg ha^{-1}, **T_3** - RDF + Zinc Sulphate 20 Kg ha^{-1}, **T_4** - RDF + Zinc Sulphate 30 Kg ha^{-1}, **T_5** - RDF + Borax 5 Kg ha^{-1}, **T_6** - RDF + Borax 10 Kg ha^{-1}, **T_7** - RDF + Borax 15 Kg ha^{-1}, **T_8** - RDF + Zinc Sulphate 10 Kg ha^{-1} + Borax 5 Kg ha^{-1}, **T_9** - RDF+ Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}, **T_{10}**-RDF+ Zinc Sulphate 30 Kg ha^{-1} + Borax 15 Kg ha^{-1} and **T_{11}** - Control. Five plants were selected from each plot randomly as a unit for observation on growth parameters.

Results and Discussion

In present investigation, the treatment likes RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} positively improves the plant height as compared to control and other treatments presented in Table-1. The highest plant height (27.18, 43.32, 49.22 and 47.45 cm) was obtained from RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}. While, the minimum plant height (16.27, 30.18, 33.06 and 29.85 cm) was obtained from control treatment at 30, 60, 90 and at harvest after days of transplanting, respectively. In other hand the number of leaves $plant^{-1}$ were influenced by the treatment RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} in significant manner as compared to control and RDF during the cropping season. The maximum number of leaves $plant^{-1}$ (5.11, 8.83, 12.87 and 13.98) were recorded with the treatment RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} presented in Table-2. However, minimum numbers of leaves $plant^{-1}$ (2.51, 4.61, 6.76 and 7.68) were recorded under control treatment at 30, 60, 90 and harvest stage after days of transplanting. Likewise, maximum diameter of stem $plant^{-1}$ (6.64, 8.97, 11.13 and 10.95 mm) was measured with an application of RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} present in Table-3. Moreover, minimum diameter of stem $plant^{-1}$ (2.88, 4.39, 5.47 and 4.98 mm) was obtained in control at 30, 60, 90 and harvest of crop after days of transplanting. Similarly, the length of longest leaf $plant^{-1}$ (43.56 cm) was measured with the treatment like RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}.While, minimum length of longest leaf $plant^{-1}$ (22.86

cm) was recorded under control at maturity stage of crop present in Table-4. It might be due to the use of optimum levels of major nutrients and micronutrients that favored the vegetative growth.

Micronutrients play an important role in many physiological processes and cellular functions in the plants. In addition to that they play a vital role in improving plant growth through biosynthesis of endogenous hormones which is responsible for promoting plant growth. Zinc is essential for the cell division and other physiological processes like photosynthesis, nitrogen metabolism and it is also a part of several other enzymes such as superoxide dismutase and catalase, which prevents oxidative stress in the plant cells. Zinc plays an important role in production of tryptophan which in turn is a precursor of auxin, which acts as essential growth hormone for proper growth of plant. The above facts that the optimum use of micronutrient might improve all growth parameters in present investigation. Similar results were also indicated to support the study with earlier findings of **Gamili *et al.* (2000), Acharya *et al.* (2015), Shukla *et al.* (2015), Manna and Maity (2016) and Maurya *et al.* (2018)**.

Application of boron has beneficial effects as it helps in cell division and also increases calcium content of growing tissues thereby causing better vegetative growth. The beneficial effect of boron on growth parameters were also reported by **Smriti *et al.* (2002), Manna *et al.* (2014), Acharya *et al.* (2015) and Bhat *et al.* (2018)**.

Therefore, the combined effect of zinc and boron was found to be most superior in comparison with single effect and control. These findings also are in close conformity with the earlier findings of **Alam *et al.* (2010), Manna *et al.* (2014), Acharya *et al.* (2015), Prusty *et al.* (2020) and Mandal *et al.* (2020).**

CONCLUSION

On the basis of results summarized above, it can be concluded that the treatment like RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} was found to be most superior in terms of plant height (cm), number of leaves plant $^{-1}$, diameter of stem plant (mm) and length of longest leaf at harvesting (cm). Therefore, it is suggested that a dose of RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1} recommended for onion growers of Western Uttar Pradesh.

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Table: 1 Effect of micronutrients on plant height (cm) at various successive stages of growth

Treatments	Plant height (cm) at various successive stages of growth			
	At 30 DAT	**At 60 DAT**	**At 90 DAT**	**At Harvest**
T_1 - RDF (100:50:50:30 Kg NPKS + 20 tones FYM ha^{-1})	19.91	35.11	38.95	35.87
T_2 - RDF + Zinc Sulphate 10 Kg ha^{-1}	22.52	38.14	42.57	40.28
T_3 - RDF + Zinc Sulphate 20 Kg ha^{-1}	24.01	39.81	44.80	42.64
T_4 - RDF + Zinc Sulphate 30 Kg ha^{-1}	23.17	38.86	43.65	41.38
T_5 - RDF + Borax 5 Kg ha^{-1}	20.13	35.54	39.48	36.67
T_6 - RDF + Borax 10 Kg ha^{-1}	21.97	37.48	41.73	39.23
T_7 - RDF + Borax 15 Kg ha^{-1}	21.05	36.35	40.57	37.86
T_8 - RDF + Zinc Sulphate 10 Kg ha^{-1} + Borax 5 Kg ha^{-1}	25.76	41.68	46.95	44.82
T_9 - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}	27.18	43.32	49.22	47.45
T_{10} - RDF + Zinc Sulphate 30 Kg ha^{-1} + Borax 15 Kg ha^{-1}	26.93	42.93	48.53	46.62
T_{11} - Control	16.27	30.18	33.06	29.85
SEM(+/-)	**0.02**	**0.01**	**0.01**	**0.01**
C.D.at 5% of level	**0.06**	**0.03**	**0.03**	**0.03**

Table: 2 Effect of micronutrients on number of leaves per plant at various successive stages of growth

Treatments	Number of Leaves per plant at various successive stages of growth			
	At 30 DAT	**At 60 DAT**	**At 90 DAT**	**At Harvest**
T_1 - RDF (100:50:50:30 Kg NPKS + 20 tones FYM ha^{-1})	3.40	6.32	9.44	10.17
T_2 - RDF + Zinc Sulphate 10 Kg ha^{-1}	4.14	7.66	11.03	11.97
T_3 - RDF + Zinc Sulphate 20 Kg ha^{-1}	4.68	8.18	11.67	12.49
T_4 - RDF + Zinc Sulphate 30 Kg ha^{-1}	4.54	7.93	11.36	12.23
T_5 - RDF + Borax 5 Kg ha^{-1}	3.85	6.95	10.15	10.87
T_6 - RDF + Borax 10 Kg ha^{-1}	3.99	7.49	10.82	11.84
T_7 - RDF + Borax 15 Kg ha^{-1}	3.91	7.32	10.64	11.15
T_8 - RDF + Zinc Sulphate 10 Kg ha^{-1} + Borax 5 Kg ha^{-1}	4.86	8.46	12.07	13.13
T_9 - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}	5.11	8.83	12.87	13.98
T_{10} - RDF + Zinc Sulphate 30 Kg ha^{-1} + Borax 15 Kg ha^{-1}	4.92	8.62	12.25	13.64
T_{11} - Control	2.51	4.61	6.76	7.68
SEM(+/-)	**0.01**	**0.02**	**0.01**	**0.01**
C.D.at 5% of level	**0.04**	**0.07**	**0.04**	**0.03**

Table: 3 Effect of micronutrients on diameter of stem per plant (mm) at various successive stages of growth

Treatments	Diameter of stem per plant (mm) at various successive stages of growth			
	At 30 DAT	**At 60 DAT**	**At 90 DAT**	**At Harvest**
T_1 - RDF (100:50:50:30 Kg NPKS + 20 tones FYM ha^{-1})	5.13	6.96	8.65	8.23
T_2 - RDF + Zinc Sulphate 10 Kg ha^{-1}	6.11	8.13	9.94	9.58
T_3 - RDF + Zinc Sulphate 20 Kg ha^{-1}	6.32	8.49	10.36	10.04
T_4 - RDF + Zinc Sulphate 30 Kg ha^{-1}	6.21	8.32	10.13	9.73
T_5 - RDF + Borax 5 Kg ha^{-1}	5.91	7.82	9.12	8.64
T_6 - RDF + Borax 10 Kg ha^{-1}	5.95	8.03	9.66	9.21
T_7 - RDF + Borax 15 Kg ha^{-1}	5.96	7.94	9.27	8.90
T_8 - RDF + Zinc Sulphate 10 Kg ha^{-1} + Borax 5 Kg ha^{-1}	6.48	8.56	10.68	10.36
T_9 -RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}	6.64	8.97	11.13	10.95
T_{10} - RDF + Zinc Sulphate 30 Kg ha^{-1} + Borax 15 Kg ha^{-1}	6.56	8.75	10.88	10.59
T_{11} - Control	2.88	4.39	5.47	4.98
SEM(+/-)	**0.01**	**0.01**	**0.01**	**0.01**
C.D.at 5% of level	**0.04**	**0.04**	**0.03**	**0.03**

Table: 4 Effect of micronutrients on length of longest leaf at harvesting (cm) stages of onion

Treatments	Length of longest leaf at harvesting (cm)
T_1 - RDF (100:50:50:30 Kg NPKS + 20 tones FYM ha^{-1})	30.06
T_2 - RDF + Zinc Sulphate 10 Kg ha^{-1}	35.41
T_3 - RDF + Zinc Sulphate 20 Kg ha^{-1}	38.68
T_4 - RDF + Zinc Sulphate 30 Kg ha^{-1}	36.53
T_5 - RDF + Borax 5 Kg ha^{-1}	31.37
T_6 - RDF + Borax 10 Kg ha^{-1}	34.23
T_7 - RDF + Borax 15 Kg ha^{-1}	32.78
T_8 - RDF + Zinc Sulphate 10 Kg ha^{-1} + Borax 5 Kg ha^{-1}	40.70
T_9 - RDF + Zinc Sulphate 20 Kg ha^{-1} + Borax 10 Kg ha^{-1}	43.56
T_{10} - RDF + Zinc Sulphate 30 Kg ha^{-1} + Borax 15 Kg ha^{-1}	42.62
T_{11} - Control	22.86
SEM(+/-)	**0.12**
C.D.at 5% of level	**0.34**