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Impact of micronutrients on growth, yield and its attributing traits of onion crop

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Abstract
A field experiment was conducted during Kharif season of 2019-20 at Horticulture Farm of Department of Horticulture, SHUATS, and Prayagraj. The experiment was conducted in Randomized Block Design (RBD), with 11+1 treatments, replicated thrice the treatments were T_0 Control, T_1 10 Kg/ ha $ZnSo_4$, T_2 10 Kg/ha $FeSo_4$, T_3 10 Kg/ha Borax, T_4 10 Kg/ha $CuSo_4$, T_5 5 Kg/ha $ZnSo_4$ + 5 Kg/ha $FeSo_4$, T_6 5Kg/ha $FeSo_4$ + 5 Kg/ha Borax, T_7 5 Kg/ha Borax + 5 Kg/h $ZnSo_4$, T_8 5 Kg/h $ZnSo_4$ + 2.5Kg/ha $FeSo_4$ + 2.5Kg/ha Borax, T_9 5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ ha $ZnSo_4$, T_{10} 5Kg/ha Borax + 2.5 Kg/ ha $ZnSo_4$+ 2.5Kg/ha $CuSo_4$, T_{10} 30 Kg $ZnSo_4$ + 10 Kg $FeSo_4$ + 10 Kg $CuSo_4$. From the present investigation it was found that the treatment T_8 5 Kg/h $ZnSo_4$ + 2.5Kg/ha $FeSo_4$ + 2.5Kg/ha Borax was superior in respect of the parameters plant height (63.80 cm), number of leaves per plant (11.20), bulb size (7.20 cm), bolting percentage (15.50%) fresh weight of bulb per plant (65.89 g), weight of cured bulb (58.56), Bulb thickness (5.80 cm), yield per plot (3.20 kg), yield per hectare (205.75 qt/ha),total soluble solid (10.89 ^{o} Brix) and ascorbic acid (10.12 mg/100g).

Keywords: Foliar application, micronutrients, onion, quality and yield

Introduction
Onion (*Allium cepa* L.) is a diverse food source due to its distinct flavour and odour. It gives flavour and spice to numerous recipes in the shape of veggies. It's the one of a kind ingredient in cuisines ranging from the opulent to the humble. The strong odour of onions is due to sulphur-containing chemicals, which have health-promoting properties. It includes quercetin, which has anti-inflammatory, anti-cholesterol, anti-cancer, and anti-oxidant properties. Pyaj is the local name for onion, which belongs to the Amaryllidaceae family. It is an old world crop that was domesticated in Central Asia, specifically Iran and Pakistan. This crop may thrive in a variety of agro-climatic conditions. Regardless of price, demand in the market is nearly continuous since it is largely used as a spice for a broad variety of foods in practically every home, widely consumed as salad as culinary purpose for flavouring as spice in pickles and sauce. The immature and mature bulbs, as well as the green leaves, are eaten raw or used in vegetable recipes. The nutritional value of onions varies by type; little onions are more nutritious than large onions, and their main benefit is flavour. Onion has a medium calorie count, low protein content, and a poor vitamin content. The onion represents for 70% of our entire foreign exchange revenues from fresh vegetable exports. The Indian government has now classified onion to be an essential item. The most significant bulb vegetable crop and an essential commodity among bulb crops is onion. Onion is a cool season crop that develops mostly throughout the winter season in India. It is one of the adaptable vegetable crops that can be stored for an extended length of time and can safely tolerate the risks of rigorous handling, including long distance transit.

Onion is grown across India; however the most major onion producing states are Maharashtra, Gujarat, Karnataka, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, M.P., Bihar, and Assam. The onion crop is frequently consumed all year as a salad and for culinary purposes such as seasoning pickles, sauces, and vegetables. The onion is a valuable medicinal plant. Onion's pungency is caused by the volatile oil allylpropyl disulphide ($C_6H_{12}O_2$), which serves as a stomach stimulant and aids digestion. Onion juice soothes bug bites, skin ailments, and rheumatic symptoms. It can also be used to cure night blindness.

Manures and fertilizers are mostly provided by vegetable farmers, who provide enough amounts of main components. Trace components, on the other hand, are often overlooked. Any nutrient shortage in the soil or plant results in poor development and productivity.

Micronutrient insufficiency is quite frequent in older soil, especially in soil that has been ploughed for a long time. Micronutrients are just as necessary as macronutrients for crop growth; however they are utilized in lesser amounts. Plants require iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B), molybdenum (Mo), chlorine (Cl), and nickel (Ni) as micronutrients. The availability of these nutrients in soil is determined by the soil and the surrounding environment. Cool temperatures and damp soil conditions, for example, restrict the availability of Zn, resulting in a Zn shortage. Micronutrient availability (with the exception of Mo) normally declines when soil pH rises. The availability of Zn, Mn, and Cu decreases fast as soil pH rises; sandy soils have higher micronutrient shortages than clay soils.

Micronutrients also assist macronutrients work more efficiently. Micronutrients, however, have received less attention in fertilizer research, development, and extension. To minimize excessive expenses, harmful effects, or negative interactions with other nutrients, growers should carefully follow micronutrient guidelines. The best application strategy is determined by the micronutrient need, local soil conditions, and the stage of crop development and growing season in which a shortage is discovered. Fertilizers can help boost crop output and quality. Keeping in view the above, an experiment was prepared and executed on the "Effect of Micronutrient Treatment on Growth and Production of Kharif Onion (*Allium cepa* L.)," which investigated the importance of micronutrient application in onion to boost yield.

Materials and Method

The Experiment was conducted in Randomized Block Design (RBD) with 11+1 treatment replicated thrice at the Central Research Farm of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences Prayagraj during Kharif season of 2019-2020. The total treatments were as T_0 Control, T_1 10 Kg/ ha $ZnSo_4$, T_2 10 Kg/ha $FeSo_4$, T_3 10 Kg/ha Borax, T_4 10 Kg/ha $CuSo_4$, T_5 5 Kg/ha $ZnSo_4$ + 5 Kg/ha FeSo4, T_6 5 Kg/ha FeSo4 + 5 Kg/ha Borax, T_7 5 Kg/ha Borax + 5 Kg/h $ZnSo_4$, T_8 5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax, T_9 5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ ha $ZnSo_4$, T_{10} 5 Kg/ha Borax + 2.5 Kg/ ha $ZnSo_4$+ 2.5 Kg/ha $CuSo_4$, T_{10} 30 Kg $ZnSo_4$ + 10 Kg $FeSo_4$ + 10 Kg $CuSo_4$.

Climatic condition in the experimental site:

The Prayagraj district comes under subtropical belt in the south-east of Uttar Pradesh, which experiences extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46 ºC- 48 ºC and seldom falls as low as 4 ºC- 5 ºC. The relative humidity ranges between 20 to 94%. The average rainfall in this area is around 1013.4 mm.

Results and Discussion

The plant height was observed during the vegetative growth of plant at 30DAS, 60DAS and 90DAS as influenced by different levels of micronutrients. The maximum plant height was observed in treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax) with 63.8 cm height followed by T_9 (5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ ha $ZnSo_4$) with 62.50 which was significantly superior over T_0 (control) with 55.60 cm plant height.

The maximum number of leaves was observed in treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax) with 11.2 followed by T_9 (5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ha $ZnSo_4$) with 10.87 which was significantly superior over T_0 (control) with 8.52 number of leaves.

The maximum bulb size was found in treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax) with 7.20 cm which is followed by T_9 (5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ha $ZnSo_4$) with 6.50 cm and the minimum bulb size was found in T_0 (control) with 2.50 cm.

The minimum bolting percentage was found in treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax) with 15.50% which is followed by T_9 (5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ ha $ZnSo_4$) with 20.40% and the maximum bolting percentage was found in T_0 (control) with 35.80%.

The maximum weight of fresh bulb was found in treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax) with 65.89 g which is followed by T_9 (5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ ha $ZnSo_4$) with 60.54 g and the minimum weight of fresh bulb was found in T_0 (control) with 42.50 g.

The maximum weight of cured bulb was found in treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5Kg/ha Borax) with 58.60 g which is followed by T_9 (5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ha $ZnSo_4$) with 56.52 g and the minimum weight of cured bulb was found in T_0 (control) with 38.50 g.

The maximum bulb diameter was found in treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax) with 5.80 cm which is followed by T_9 (5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ ha $ZnSo_4$) with 5.20 cm and the minimum bulb diameter was found in T_0 (control) with 3.52 cm.

The maximum yield per plot was found in treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax) with 3.20 kg which is followed by T_9 (5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ ha $ZnSo_4$) with 3.00 kg and the minimum yield per plot was found in T_0 (control) with 1.20 kg.

The maximum yield per hectare was found in treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax) with 205.75 qt/ha which is followed by T_9 (5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ ha $ZnSo_4$) with 198.50 qt/ha and the minimum yield per hectare was found in T_0 (control) with 178.55 qt/ha.

The maximum total soluble solid was found in treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax) with 10.89 ^{0}B which is followed by T_9 (5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ ha $ZnSo_4$) with 10.21 ^{0}B and the minimum total soluble solid was found in T_0 (control) with 7.45 ^{0}B

The maximum ascorbic acid was found in treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax) with 10.12 mg/100 g which is followed by T_9 (5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ha $ZnSo_4$) with 9.75 mg/100 g and the minimum ascorbic acid was found in T_0 (control) with 7.02.

Table 1: Effect of different levels of Treatment on different parameter of the Onion (*Allium cepa*.)

Treatment	Treatment Combination	Plant Height			Number of Leaves			Bulb Size	Bolting %	Weight of Fresh bulb	Weight of Cured Bulb
		30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS				
T_0	Control	19.5	39.8	55.6	3.6	6.66	8.52	2.50	35.8	42.5	38.50
T_1	10 Kg/ ha $ZnSo_4$	20.4	40.2	60.2	3.87	7.1	8.73	4.00	28.9	45.6	39.56
T_2	10 Kg/ha $FeSo_4$	19.9	40.3	58.6	4.1	7.35	8.83	3.50	26.7	50.2	40.25
T_3	10 Kg/ha Borax	20.9	41.6	61.2	3.97	6.83	9.87	4.80	22.8	52.8	41.50
T_4	10 Kg/ha $CuSo_4$	21.3	43.5	60.8	4.2	7.432	9.13	4.30	32.8	58.6	47.60
T_5	5 Kg/ha $ZnSo_4$ + 5 Kg/ha $FeSo_4$	21.8	43.5	59.4	4.47	7.57	10.26	4.60	27.9	60.5	50.25
T_6	5Kg/ha $FeSo_4$ + 5 Kg/ha Borax	20.8	41.8	58	4.03	7.23	10	3.90	25.6	48.57	40.25
T_7	5 Kg/ha Borax + 5 Kg/h $ZnSo_4$	21.4	42.8	57.8	4.4	7.93	9.97	5.50	23.5	51.6	42.65
T_8	5 Kg/h $ZnSo_4$ + 2.5Kg/ha $FeSo_4$ + 2.5Kg/ha Borax	23.5	44.5	63.8	4.77	8.3	11.2	7.20	15.5	65.89	58.56
T_9	5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ ha $ZnSo_4$	22.8	43.2	62.5	4.57	8.13	10.87	6.50	20.4	60.54	56.52
T_{10}	5Kg/ha Borax + 2.5 Kg/ ha $ZnSo_4$+ 2.5Kg/ha $CuSo_4$	22.4	42.5	61.9	4.1	6.5	8.8	5.20	31.2	54.25	46.52
T_{11}	30 Kg $ZnSo_4$ + 10 Kg $FeSo_4$ + 10 Kg $CuSo_4$	21.8	42.1	61.2	3.9	6.8	8.62	5.80	29.5	42.5	45.56
	S.Ed. (±)	2.11	1.24	0.49	0.97	0.24	0.54	1.56	0.25	2.13	1.14
	C.D. At 5%	4.21	2.53	1.02	1.91	0.52	1.18	3.21	0.63	4.54	3.02

Table 2: Effect of different levels of Treatment on different parameter of the Onion (*Allium cepa*.)

Treatment	Treatment Combination	Bulb Diameter (cm)	Yield per plot (kg)	Yield per ha (qt/ha)	T.S.S. (^{O}B)	Ascorbic Acid
T_0	Control	3.52	1.20	178.55	7.45	7.02
T_1	10 Kg/ha $ZnSo_4$	4.01	1.56	188.56	8.25	8.01
T_2	10 Kg/ha $FeSo_4$	4.23	1.64	180.34	7.95	7.35
T_3	10 Kg/ha Borax	3.84	2.20	185.62	8.35	8.10
T_4	10 Kg/ha $CuSo_4$	3.95	2.45	179.98	9.85	9.54
T_5	5 Kg/ha $ZnSo_4$ + 5 Kg/ha $FeSo_4$	4.50	1.98	190.54	8.95	8.55
T_6	5 Kg/ha $FeSo_4$ + 5 Kg/ha Borax	5.01	1.56	192.56	10.02	9.64
T_7	5 Kg/ha Borax + 5 Kg/h $ZnSo_4$	4.95	1.80	196.56	9.56	9.10
T_8	5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5Kg/ha Borax	5.80	3.20	205.75	10.89	10.12
T_9	5 Kg $FeSo_4$ + 2.5 Kg Borax +2.5 Kg/ ha $ZnSo_4$	5.20	3.00	198.5	10.21	9.75
T_{10}	5 Kg/ha Borax + 2.5 Kg/ ha $ZnSo_4$+ 2.5Kg/ha $CuSo_4$	4.64	2.80	186.59	8.37	8.05
T_{11}	30 Kg $ZnSo_4$ + 10 Kg $FeSo_4$ + 10 Kg $CuSo_4$	4.25	2.50	189.54	7.88	7.51
	S.Ed. (±)	2.11	0.57	8.26	1.23	2.18
	C.D. At 5%	4.21	1.12	17.56	2.98	4.32

Conclusion

On the basis of the experimental finding it is concluded that the treatment T_8 (5 Kg/h $ZnSo_4$ + 2.5 Kg/ha $FeSo_4$ + 2.5 Kg/ha Borax) was found superior in terms of Height of plant (cm), No. of leaves/plant, Bulb size(cm), Bolting (percent), weight of fresh bulb (g), Weight of cured bulb (g), Bulb diameter (cm), Number of bulbs per kg, Yield per plot (kg), Yield per hectare (q), Total Soluble Solids content of bulb (°Brix), Ascorbic acid (mg/100 g).

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