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Impact of micronutrient spray on growth, bulb yield and economics of onion

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Abstract— *Present experiment was conducted as on-farm testing at farmers' field during Rabi season of 2022-23 and 2023-24 to assess the impact of micronutrient spray on growth, bulb yield and economics of onion crop. Two treatments i.e. T_1- Farmers' practice (without spray) and T_2- foliar spray of micronutrient replicated at five farmers field of Jhajjar district. Micronutrients were applied through foliar spray of multiplex general liquid 2.5 ml/ litre (625 ml/ ha) which contains Zn 9%, Fe 8%, Mn 0.50%, Cu 0.50% and Bo 0.25% after one month of transplanting and at bulb formation stage of the onion. The use of micronutrient as foliar spray was found effective in T2 treatment the significantly highest plant height (68.35 & 69.10 cm), number of leaves (6.80 & 6.95), bulb weight (55.38 & 58.80 g) and bulb yield (307.90 & 311.80 q/ha) during 2022-23 and 2023-24, respectively. Maximum net return (₹ 110367 & 211270/ ha) and benefit cost ratio (1.96 & 2.82) were recorded in the treatment T2 whereas, in farmers' practices were found net return (₹ 88428 & 176530/ ha) and BC ratio (1.79 & 2.55), respectively during both the year of study. Therefore, the use of micronutrient application to be increases the production and recommended for onion cultivation.*

Keywords— ***Bulb yield, Economics, Foliar spray, Micronutrient, Onion***

I. INTRODUCTION

Onion (*Allium cepa* L.) is an important bulb crop growing the global. In India, it is consumed as vegetable and condiment since ancient times. It is a short duration vegetable crop (Brewster, 1990) grown at low latitudes. It is commonly known as "Queen of the kitchen" due to its highly valued flavor, aroma, unique taste and the medicinal properties of its flavour compounds (Selvaraj, 1976; Griffiths *et al*., 2002). Its distinctive flavour and pungency, which is the due to sulphur containing compounds Allyl-propyl-disulphide. The bio-flavonoid present in the yellow colour of the outer skin of onion bulb is due to Quercetin. It contains anti-fungal property *viz*. catechol. Onion is used throughout the year in salad, as spice in soups, curries, condiment or cooked with other vegetables, such as boiled or baked and also used in processed foods like pickles, powder, paste and flakes. India is major exporter of onion and the second largest producer in the world next to China with an area of 17.9 lakh ha with production of 302.08 lakh MT per annum with average productivity of 16.87 t/ha (Anonymous, 2023). At present, In Haryana state having an area of 2.28 lakh ha with production of 5.43 lakh MT per annum with 23.79 t/ha productivity. In the Jhajjar district, an area of 334.8 ha with production of 3000 MT and 8.96 t/ha average productivity (Anonymous, 2023). The major onion producing states in India are Maharashtra, Madhya Pradesh, Gujarat, Karnataka, Rajasthan, Bihar, West Bengal, Uttar Pradesh, Haryana, Andhra Pradesh, Tamil Nadu, Odisha, Punjab and Telangana.

Due to intensive cropping, a smaller amount of manures, micronutrients and unfair use of fertilizers so soil health is deteriorating continuously. All the essential nutrient elements are most important factors which govern the onion growth and yield. Macro and micronutrients help in increasing the yield, storage quality and fertility status of soil in onion. The macronutrient such as N, P, K, Ca, Mg, S and micronutrients such as Fe, Zn, Cu, B, Mo and Mn are beneficial in enhancing the growth, bulb yield, storage quality and fertility status of soil in onion (Singh, 2005). The soil and environment have an effect on availability of these nutrients in soil. The use of micronutrients is limited. Although, the micronutrients are required in very few quantity but important role in cell division and carbohydrates metabolism in plant growth and high crop yield (Kumar *et al*., 2021). There were evidences that micronutrients such as zinc, ferrous and boron increase the bulb size, highest plant height, bulb fresh weight, bulb diameter and yield of onion (Smriti *et al*., 2002; Shinde *et al*., 2016). In Haryana, most of the farmers use macronutrients especially nitrogen, phosphorus and potassium for more yield and quality of vegetables. The vegetable growers should carefully follow recommendations for micronutrients to avoid unnecessary costs and their toxic effects. In consideration with the above situations, an attempt has been made to study on efficacy of micronutrient spray on growth, bulb yield and economics of onion.

II. MATERIALS AND METHODS

A field experiment was conducted during *Rabi* season of 2022-23 & 2023-24 at farmer's fields in Dulina village, Jhajjar district of Haryana. Sandy loam soil was in the experiment area having pH of 7.0 and 0.35% organic carbon. Onion seed was treated with Carbendazim 2.5 g/kg seed as per package of practices. The treated seed was sown in lines in well-prepared nursery beds (3.0 x 1.0 x 0.15 m size) on 06th November during the both of experiments. Nursery management operations (Thinning, weeding, irrigation) were carried out till the seedling transplant in field. Nursery was raised commonly for both the treatments and micronutrients were applied as per treatment in the main field. About 60 days old seedling of 15 cm height were transplanted in the field on 05th January at a spacing of 15 x 10 cm. The recommended dose of fertilizer used for onion crop was 125:50:25 kg/ha NPK along with FYM 20 tonnes applied uniformly in all the treatments.

There were two treatments *i.e*., Farmer's practices (T_1) = control (without spray of micronutrients) and Assessed technology (T_2) = Use of RDF with foliar spray of micronutrients after one month of transplanting and at bulb formation stage. Micronutrients were applied through foliar spray 625 ml of multiplex in 250 litres of water/ ha which contains Zn 9%, Fe 8%, Mn 0.50%, Cu 0.50% and Bo 0.25%. Trial was conducted at five farmers' field comprising of 1.0 acre area as plot size. Ten plants were selected randomly from each treatment for recording all observations on growth and yield. Economics of onion production was calculated by keeping a record on each operation during cultivation. The t-test is statistical analysis was done using standard procedure.

Net returns = Gross returns - Variable cost

$$\text{Benefit cost ratio} = \frac{\text{Gross returns}}{\text{Variable cost}}$$

III. RESULTS AND DISCUSSION

The effect of micronutrient foliar spray was studied on the growth, bulb yield and economics of onion. The results obtained was significant differences in plants height (cm), number of leaves, bulb weight (g) and bulb yield (q/ha) due to foliar spray of micronutrients general liquid (Table 1).

Plant height (cm)

The maximum plant height (68.35 & 69.10 cm) was recorded under T2 with foliar application of micronutrient, where as the minimum plant height (56.15 & 55 cm) was recorded in T1 (control) during 2022-23 and 2023-24, respectively. The increased plant height by use of micronutrient might be due to the cell division and cell enlargement of the protoplast through water uptake. It's important role in many physiological processes and cellular function of the plants. These findings are in agreement with the findings of Abd EI- Samad *et al*. (2011); Dake *et al*. (2011) and Acharya *et al*. (2015) in onion.

Number of leaves

Significantly the maximum number of leaves/ plant (6.80 & 6.95) were recorded in the treatments T_2 (Zn 9%, Fe 8%, Mn 0.50%, Cu 0.50% & Bo 0.25%) followed by T_1 *i.e.*, control (5.11 & 5.30) in 2022-23 and 2023-24, respectively. Invariably, use of micronutrients increased the production of more leaves/ plant than control. It may be due to primitive effects of micronutrients on vegetative growth which ultimately lead to more photosynthetic activities. Similar results finding by Dake *et al*. (2011); Manna *et al*. (2013); Ballabh *et al*. (2013) and Acharya *et al*. (2015).

Bulb weight (g)

Application of micronutrients *i.e.*, T_2 treatment had statistically significant of highest bulb weight (55.38 g & 58.80 g) in onion as compared to without spray of micronutrients (46.25 g & 48.75 g) during both the year of study. This might be due to the better improving of photosynthesis efficacy and increased allocation of photosynthates towards the bulb. Increased bulb weight was also due to enhanced growth and yield traits as a result of positive influence of micronutrients and PGRs. The result of present experiment well corroborates the findings of Abedin *et al*. (2012); De *et al*. (2013) and Pramanik *et al*. (2020).

Bulb yield (q/ha)

Significantly the maximum bulb yield (307.9 & 311.8 q/ha) were recorded in the treatment T2 (Zn 9%, Fe 8%, Mn 0.50%, Cu 0.50% & Bo 0.25%) where micronutrients were applied after one month of transplanting and at bulb formation stage as compared to T1 treatment (274.6 & 276.5 q/ha) *i.e.*, without any micronutrients spray during both the year 2022-23 and 2023-24, respectively. It might be due the crucial role of micronutrients in strengthening the cell wall and translocation of carbohydrates from leaves to other parts of plant. The higher photosynthesis build up in the bulbs would ensure more bulb weight and bulb diameter which collectively increases the total bulb yield in onion. The similar report was observed by Trivedi and Dhamal (2013); Damse *et al*. (2014); Pramanik *et al*. (2020) and Biswas *et al*. (2020).

Economics

It is revealed from (Table 2) that the highest net return of ₹ 110367 & 211270/ ha with benefit cost ratio 1.96 & 2.82 was obtained in treatment T2 ,while the lowest net return of ₹ 88428 & 176530/ha along with benefit cost ratio of 1.79 & 2.55 was obtained in treatment T1 (Control) during 2022-23 and 2023-24, respectively. The foliar spray of micronutrients mixture applied after one month of transplanting and at bulb formation stage increased all economic parameters indicating the feasibility used of micronutrients significantly higher bulb yield and optimum profit of onion. The similar result was also reported by Nasreen *et al*. (2009) and Pramanik *et al*. (2020).

Table 1. Impact of micronutrients foliar spray on growth and bulb yield of onion

Technology	Technical observations							
	Plant height (cm)		No. of leaves		Bulb weight (g)		Bulb yield (q/ha)	
	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24
T_1-P.F. (No Spray)	56.15	55.0	5.11	5.30	46.25	48.75	274.6	276.5
T_2-Foliar application of Micronutrient	68.35	69.10	6.80	6.95	55.38	58.80	307.9	311.8
t-Statistic	22.51	14.78	29.13	6.98	5.43	16.58	20.18	64.09
t-Critical (P=0.05)	4.30							

Table 2. Impact of micronutrients foliar spray on economics of onion

Technology	Economics (₹/ ha)									
	Increase (%)		Variable cost (₹/ha)		Gross return (₹/ha)		Net return (₹/ha)		BC ratio	
	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24
T_1-P.F. (No Spray)	-	-	112030	113795	200458	290325	88428	176530	1.79	2.55
T_2-Foliar application of Micronutrient	10.82	11.32	114400	116120	224767	327390	110367	211270	1.96	2.82

Note: Onion bulbs were sold ₹ 730/ q and ₹ 1050/ q during 2022-23 & 2023-24, respectively.

IV. CONCLUSION

From the above two consecutive year of the research, it is concluded that application of micronutrients mixture (Zn 9%, Fe 8%, Mn 0.50%, Cu 0.50% & Bo 0.25%) @ 2.5 ml per litres of water after one month of transplanting and at bulb formation stage was found to be more vegetative growth, yield traits, bulb yield and economics of onion as over to control treatment.

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