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Impact of Spraying with some Micronutrients on onion (*Allium Cepa* L.) Yield and Economics of Onion

Om Parkash[1], Annu Verma[*1], S.K Singh[1], Amit Kumar[3], Vinita Rajput[2], Sushil Kumar[1]

[1]Krishi Vigyan Kendra, Fatehabad,
[2]Krishi Vigyan Kendra, Sirsa
[3]Department of Vegetable Science
CCS Haryana Agricultural University, Hisar- 125 004, India
*Corresponding author of Email: vermaannu06@gmail.com

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Abstract— *Micronutrients are essentially as important as macronutrients to improve growth, yield and quality in plants. Present experiment was conducted as on-farm testing at farmers' field during Rabi season of 2021-22, 2022-23 and 2023-24 to assess the impact of essential micronutrients like zinc, magnesium, copper, manganese, iron, molybdenum and boron 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 ready-mix containing (Zn, Mg, Fe, Mn, Cu, Mo and Bo 0.25%) @ 2.5 ml/ litre at 30 and 45 days after transplanting of onion seedlings replicated at ten farmers field of Fatehabad district. The use of micronutrients as foliar spray was found effective in treatment T_2 with the significantly highest bulb weight (54.48, 55.60 & 57.20g), bulb yield (198, 265 & 300 q/ha) during 2021-22, 2022-23 and 2023-24, respectively. Maximum net return (₹ 104400, 323000 & 98000/ ha) and benefit cost ratio (2.93, 4.19 & 2.89) were recorded in the treatment T_2 whereas, in treatment T_1 (farmers' practices) net return were (₹ 91000, 292000 & 86500/ ha) and BC ratio (2.71, 3.92 & 2.69), respectively during 2021-22, 2022-23 and 2023-24. 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

Among alliums, onion (*Allium cepa* L.) is one of the most widely grown commercial vegetable crop in India that belongs to family Amaryllidaceae [11]. It is mainly grown for bulb production and used as salad, spice in soups, curries, condiment or cooked with other vegetables, such as boiled or baked and also used in processed form (powder, pickles, paste and flakes). Onion or its product consumption has been found to be beneficial in several diseases such as cancer, cardiac, diabetes and respiratory diseases *etc*. [10]. Due to its highly valued flavor, aroma, unique taste and medicinal properties of its flavour compounds onion commonly known as "Queen of the kitchen" [14,8]. India is a major exporter of onion and is second largest producer in the world next to China. In India, the area under onion is 17.9 lakh ha with production of 302.08 lakh mt per annum with average productivity of 16.87 t/ha. In Haryana, the area under onion is 2.28 lakh ha with production of 5.43 lakh mt per annum with 23.79 t/ha productivity [3]. In India, major onion producing states 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). Indian soils are exposed to Multi-micronutrient deficiencies are closely associated with the yield and quality of crops, as proper plant nutrition is one of the most important factors in improving both the quality and quantity of plant products. Although micronutrients are required by plants in minor quantities, they are involved in a wide range of metabolic processes and cellular functions within plants. In addition, they play an essential role in improving crop growth and yield, as reported by various studies.

EI-Tohamyetal., 2009 and Alam et al., 20Intensive cropping, imbalanced fertilization and no use of micronutrients, less or no use of organic manures have resulted the depletion of soil fertility. Consequently, micronutrients statuses have been decreasing day by day and finally fertility status of soils have been declining. In India, soils are exposed to multi-micronutrient deficiencies that closely associated with the growth of crop and yield. Proper plant nutrition is one of the most important factors in improving the quality as well as quantity of plant products. The use of micronutrients by farmers is limited. Although, the micronutrients are required in very few quantity but play an active role in cell division and carbohydrates metabolism in plant growth and better crop yield (Kumar *et al.,* 2021).Smriti et al., 2002; Shinde et al., 2016 reported that micronutrients such as zinc, boron and ferrous increase the bulb size, highest plant height, bulb diameter, bulb fresh weight and yield of onion.

Indian soils are exposed to multi-micronutrient deficiencies that are closely associated with crop yield and quality. Proper plant nutrition is one of the most important factors in improving both the quality and quantity of plant products. Although micronutrients are required by plants in minor quantities, they are involved in a wide range of metabolic processes and cellular functions and play an essential role in enhancing crop growth and yield, as reported by El-Tohamy et al. (2009) and Alam et al. (2010). The production of good-quality onion bulbs is an important goal for onion growers, many of whom have inadequate knowledge about the beneficial role of micronutrients in increasing onion yield and quality for local and foreign markets. Bulb size and yield are enhanced when micronutrients are applied in combination rather than individually. Consequently, onion cultivation has expanded into newly reclaimed areas characterized by low fertility, high pH, and low organic matter content, leading to poor availability of micronutrients in the soil. Keeping this in view, a field experiment was conducted at the College of Horticulture (OUAT), Sambalpur, Odisha, India, during the Rabi season of 2014–15 to study the effect of micronutrients on onion growth and total bulb yield, with the primary objective of evaluating their efficacy on vegetative growth parameters and total bulb yield.

Soil health is continuously deteriorating due to intensive cropping system, less use of manures, micronutrients and injudicious use of fertilizers. All essential nutrient elements are most important factors which govern the onion growth, yield and its quality production. Macro and micronutrients help in improving the yield, storage quality and fertility status of soil in onion crop cultivation. The macronutrient such as N, P, K, Ca, Mg, S and micronutrients such as Fe, Zn, Cu, B, Mo and Mn enhance the growth, bulb yield, storage quality and fertility status of soil in onion [16,7]. The use of micronutrients is limited. Although, the micronutrients are required in very less quantity but have important role in cell division and carbohydrates metabolism in plant growth and high crop yield [10]. There were several evidences that micronutrients such as zinc, ferrous and boron increases bulb size, highest plant height, bulb fresh weight, bulb diameter and yield of onion [17,15]. In Haryana, most of the farmers use macronutrients especially nitrogen, phosphorus and potassium in vegetable crops. The farmers should carefully follow recommendations for micronutrients to avoid unnecessary costs and their toxic effects. Looking to the importance of micronutrient application, an attempt has been made to study on efficacy of micronutrient spray on growth, bulb yield and economics of onion.

II. MATERIALS AND METHODS

Present experiment was conducted as on-farm testing at farmers' field of Fatehabad district during *Rabi* season of 2021-22, 2022-23 and 2023-24 to assess the impact of foliar spray of essential micronutrients like zinc, magnesium, copper, manganese, iron, molybdenum and boron spray on growth, bulb yield and economics of onion bulb crop. Onion seed was treated with carbendazim 1 g/kg seed as per package of practices. The treated seed was sown in lines in well-prepared nursery beds in the first fortnight of November during every year of experiment. Nursery management operations (Thinning, weeding, irrigation) were carried out till seedling were transplant in field. Nursery was raised commonly for both the treatments and micronutrients were applied as per treatment. About 50-55 days old seedling of about 15 cm height were transplanted during first fortnight of January at a spacing of 15-20 x 10-15 cm. The recommended doses of fertilizer were applied. Two treatments *i.e.* T_1- Farmers' practice (without foliar spray of micronutrients) and T_2-

foliar spray of ready-mix containing (Zn, Mg, Fe, Mn, Cu, Mo and Bo 0.25%) @ 2.5 ml/ litre at 30 and 45 days after transplanting of onion seedlings comprising of 1.0 acre area as plot size of Fatehabad district. Demonstrations were regularly monitored at different stages of crop by a multi-disciplinary team of KVK scientists. Economics of onion crop production was calculated by keeping a record on each operation carried out, number of labour engaged, power and inputs utilized. The gross and net returns (Rupees per hectare) were calculated considering the prevailing market price of input and produce. Benefit cost ratio, represents the returns per rupee invested were worked out for different package of practices under each treatment by dividing gross returns with corresponding cost of cultivation.

Net returns = Gross returns - Cost of cultivation

Benefit to Cost ratio = Gross returns/ Cost of cultivation

III. RESULTS AND DISCUSSION

The effect of micronutrient foliar spray was studied on bulb weight (g), bulb yield and economics of onion. In present experiment use of foliar spray of micronutrients on onion crop was found effective in treatment T_2. This might be due to better efficacy of micronutrient mixture in increasing vegetative growth and bulb yield because micronutrients play a pivotal role in strengthening plant cell walls and translocation of carbohydrates from leaves to other plant parts indicates possibility of increasing dry matter percentage as well as yield [9].

3.1 BULB WEIGHT (G)

Application of micronutrients *i.e.,* treatment T_2- foliar spray of ready-mix containing (Zn, Mg, Fe, Mn, Cu, Mo and Bo 0.25%) (Table 1) had highest bulb weight (54.48, 55.60 & 57.20g) as compared to treatment T_1 (without spray of micronutrients) bulb weight (45.30, 47.50 & 48.40 g) during 2021-22, 2022-23 and 2023-24, respectively. Increased bulb weight was also due to enhanced growth and yield traits as a result of micronutrients applications. The result of present experiment well corroborates the findings of Abedin *et al*. (2012); De *et al*. (2013) and Pramanik *et al.* (2020) [1,6,13]. Pramanik *et al*. (2020) [13] observed significantly higher average bulb weight and total bulb yield per plot. This might be due to the active role of micronutrients in the plant metabolic process starting from cell wall development to respiration, photosynthesis, chlorophyll formation, enzyme activity and nitrogen fixation.

3.2 BULB YIELD (Q/HA)

Application of micronutrients *i.e.,*treatment T_2- foliar spray of ready-mix containing (Zn, Mg, Fe, Mn, Cu, Mo and Bo 0.25%) (Table 1) had highest bulb yield (198, 265 & 300 q/ha) whereas, in T_1 (without spray of micronutrients) bulb yield (180, 245 & 275q/ha) during 2021-22, 2022-23 and 2023-24, respectively. It might be due the crucial role of micronutrients in strengthening the crop.

3.3 ECONOMICS

It is revealed from (Table 2) that maximum net return (₹ 104400, 323000& 98000/ ha) and benefit cost ratio (2.93, 4.19 & 2.89) were recorded in the treatment T_2- foliar spray of ready-mix containing (Zn, Mg, Fe, Mn, Cu, Mo and Bo 0.25%) (Table 2) whereas, T_1 (without spray of micronutrients) net return were (₹ 91000, 292000 & 86500/ ha) and BC ratio (2.71, 3.92 & 2.69) during 2021-22, 2022-23 and 2023-24, respectively. The present results corroborate the findings of Smiriti *et al.* (2002) [17] for boron while Nasreen *et al.* (2009) [12] and Pramanik *et. al.,* (2020) [13] for zinc as a source of micronutrients towards increased benefit cost ratio in onion production.

Table 1: Impact of micronutrients foliar spray on Bulb weight and bulb yield of onion.

	Bulb weight (g)	Bulb Yield (q/ha)	Increase (%)
Rabi 2021-22			
T_1- FP (No Spray)	45.30	180	-
T_2-Foliar application of Micronutrient	54.48	198	8.33
Rabi 2022-23			
T_1- FP (No Spray)	47.50	245	-
T_2-Foliar application of Micronutrient	55.60	265	8.1
Rabi 2023-24			
T_1- FP (No Spray)	48.40	275	-
T_2-Foliar application of Micronutrient	57.20	300	9.09

Increase in production was found 8.33 %, 8.1 % and 9.09 % during 2021-22, 2022-23 and 2023-24, respectively in treatment T_2 as compared to treatment T_1. Dake *et al.* (2011) [5] and Abd EI- Samad *et al.* (2011) [2], they reported that growth parameters of onion plant were positively affected by foliar application of micronutrients. In addition, zinc and boron play an essential role in improving plant growth, through the biosynthesis of endogenous hormones, which is responsible for promotion of plant growth. Therefore, the use of micronutrient application to be increases the production, improve economics and beneficial for onion cultivation.

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

	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs./ha)	B:C ratio	Sale price (Rs./q)
Rabi 2021-22					
T_1- FP (No Spray)	53000	144000	91000	2.71	800
T_2-Foliar application of Micronutrient	54000	158400	104400	2.93	
Rabi 2022-23					
T_1- FP (No Spray)	100100	392000	292000	3.92	1600
T_2-Foliar application of Micronutrient	101000	424000	323000	4.19	
Rabi 2023-24					
T_1- FP (No Spray)	51000	137500	86500	2.69	500
T_2-Foliar application of Micronutrient	52000	150000	98000	2.89	

IV. CONCLUSION

From the above three consecutive year of research, it is concluded that application of ready-mix containing (Zn, Mg, Fe, Mn, Cu, Mo and Bo 0.25%) @ 2.5 ml/ litre at 30 and 45 days after transplanting of onion seedlings was found better for higher yield and parameters of economics of onion as over to control treatment. Hence may be recommended that application of ready-mix consists of all essential micronutrients gives better vegetative growth in term of growth, bulb weight and bulb production along with higher BC ratio as compared to control treatment.

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