Int.J.Curr.Microbiol.App.Sci (2022) *11*(10): 234-238

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 11 Number 10 (2022)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2022.1110.030

Onion (*Allium cepa* L.) Productivity as Affected by Foliar Application of Micronutrients

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Keywords

Benefit cost ratio, Foliar application, Micronutrients, Onion and Yield

Article Info

Received:
08 September 2022
Accepted:
28 September 2022
Available Online:
10 October 2022

A B S T R A C T

Micronutrients are the necessary elements required by onion plant in small quantity to improve the yield of bulbs. It is possible to produce higher yields of good quality bulbs by judicious application of nutrients. A field experiment was conducted during spring summer, 2021-2022 at Vegetable Research Farm of Department of Agriculture, Khalsa College, Amritsar to investigate the effect of foliar application of micronutrients on yield and benefit cost ratio of onion. The experiment was laid out in Randomized Block Design (RBD) with three replications. The seven treatments are applied at 45, 60 and 75 days after transplanting. The result revealed that foliar application of micronutrients mixture outperformed from all other treatments in terms of yield and benefit cost ratio.

Introduction

Onion (*Allium cepa* L.) is a versatile food source that has unique flavour and aroma. It adds taste to many dishes in the form of vegetables as well as spice. Onion is higher in sulphur containing compounds that gives it pungent odour and health promoting effects. It contains anti-inflammatory, anti-cholesterol, anti-cancer and anti-oxidant components, such as quercetin. Onion belongs to family Amaryllidaceae" and locally known as Pyaj. It is old world crop and was domesticated in Iran and Pakistan i.e. Central Asia. This crop can be grown in wide range of Agro-climate condition. Regardless of the price, the demand remain almost constant in the market as it is primarily, used as seasoning for a wide variety of dishes in almost every home, widely consumed as salad as culinary purpose for flavoring as spice in pickles and sauce. The green leaves, immature and mature bulbs are eaten raw or used in vegetable preparations (Lal *et al.,* 2018).

Micronutrients are equally important like macronutrients for crop growth and developments. The micronutrients that required by plants are iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B), molybdenum (Mo) and chlorine (Cl). The

availability of these nutrients in soil depends on the nature of soil and the environment. The manures and fertilizers are supplied by vegetable producers, who provide a sufficient amount of key elements. However, micronutrients are generally ignored. The deficiency of any nutrient in the soil and plant causes poor growth and low yield. The micronutrient deficiencies occur especially in older soil, which are under plough from long ago (Biswas *et al.*, 2020).

Micronutrients also help to enhance the efficiency of macronutrients. Unfortunately, micronutrients have received less attention. Vegetable growers should carefully follow recommendations for micronutrients to avoid unnecessary expense and possible toxic impact or adverse interactions with other nutrients. Foliar application of micronutrients helps to improve the productivity of onion.

Bulb size and yield enhanced when micronutrients were applied in combination instead of their single application. Foliar application of micronutrients during the crop growth stage was successfully used for correcting their deficits and also improving the mineral status of the plants and increasing crop yield. Therefore, this present study was conducted to find out the impact of foliar application of micronutrients on yield and benefit cost ratio of onion.

Materials and Methods

The experiment has been carried out at Department of Vegetable Science of Agriculture, Khalsa College, Amritsar during spring summer season 2021-2022 with seven micronutrients treatments consisting T_1 (1% $CuSO_4$), T_2 (1% $MgSO_4$), T_3 (0.5% $ZnSO_4$), T_4 (0.5% $FeSO_4$), T_5 (0.25% Borax), T_6 (Mixture of all micronutrients @ $CuSO_4$ - 1%, $MgSO_4$ - 1%, $ZnSO_4$ - 0.5%, $FeSO_4$ -0.5% and B - 0.25%) and T_7 (Control). The experiment was conducted in Randomized Block Design with three replications and cultivar PRO7 comprised the plant material. Cultural practices by PAU, Ludhiana were followed during crop growth period. The observation were noted on seven plants taken randomly for the characters namely, days taken to harvest, bulb diameter (cm), fresh weight of bulb (g), dry weight of bulb (g), bulb yield (kg $plot^{-1}$ and benefit cost ratio. The mean data was statistically analyzed according to ANOVA of Panse and Sukhatme (1985).

Results and Discussion

Days taken to harvest

Days taken to harvest depend upon the variety of plant material, cultural practices and the micronutrients that is supplied during the cultivation. Treatment T_6 had minimum days taken to harvest which was statistically at par with the treatment T_3. Treatment T_7 was recorded maximum days to harvest (Table. 1).

This might be due the application of micronutrients, increases the nutrients accumulation in plants and also increases the bulb growth which ultimately improves the days taken to harvest. The results related to days taken to harvest are in close with the findings of Rohidas *et al.*, (2010) and Chandan *et al.*, (2021) observed that the minimum days taken to harvest (150 and 149 days), respectively in the application of micronutrient mixture.

Bulb diameter (cm)

Bulb diameter depends upon height and number of leaves due to maximum plant height and more number of leaves the photosynthetic rate increases that improves the accumulation of nutrients and helps to maximize the bulb diameter. Treatment T_6 had the maximum bulb diameter which was significantly higher than all other treatments. Treatment T_7 had the minimum bulb diameter.

This is may be due to the application of minor nutrients, increases the photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin contents in the plants which ultimately improving the diameter of bulb.

The findings of the current inquiry are consistent with the previous investigations of Lal *et al.,* (2017); Maurya *et al.,* (2018) and Biswas *et al.,* (2020) who also reported higher bulb diameter (5.73, 4.05 and 4.68 cm), respectively in combination of micronutrients.

Bulb fresh weight (g)

Average bulb fresh weight is the most significant yield contributing character. The maximum bulb fresh weight has been recorded in treatment T_6 which was statistically at par with the treatment T_3. The minimum fresh weight of bulb was recorded in treatment T_7. Greater results were obtained due to the presences of favourable circumstances in these treatments, which may be related to better absorption of micronutrients. This might be due to the better utilization of photosynthates and increased allocation of photosynthates towards the economic parts, of bulbs in onion. Similar findings were also recorded by Pramanik *et al.,* (2017); Babelehwar *et al.,* (2017) and Sethupathi *et al.,* (2019) who observed the maximum bulb fresh weight (60.55, 78.79 and 89.51 g), respectively with the application of micronutrient mixture.

Bulb dry weight (g)

Bulb dry weight is also most significantly yield contributing character. Bulbs with maximum weight are required by farmers in order to get more marketable yield. The maximum dry weight has been recorded in treatment T_6 which was statistically at par with the treatment T_3. The minimum dry weight was recorded in treatment T_7. Probable reason for increased dry weight of bulb per plant due to humus substances could have mobilized the reserve food material to the sink through increases activity of hydrolyzing and oxidizing. The findings of current inquiry are consistence with those of the previous investigation of Ballabah *et al.,* (2013); Goyal *et al.,* (2017) and Maurya *et al.,* (2018) who also that the micronutrients mixture had maximum bulb dry weight (13.2, 27.44 and 13.60 g), respectively.

Bulb yield (kg plot^{-1})

Yield per plot is one of the key parameters that receive the greatest attention during harvesting. These special characteristic depends on yield and plant population per plot. Among the treatments, maximum yield per plot was recorded in treatment T_6 which was statistically at par with the treatment T_3 whereas, the minimum yield per plot was observed in treatment T_7. The better efficiency of micronutrients might be due to the pivotal role of micronutrients in strengthening the plant cell wall and translocation of carbohydrates from leaves to all other plant parts that would ensure increases bulb weight which is collectively increases the bulb yield. Similar report of increased bulb yield was observed by several workers Acharya *et al.,* (2015) and Chandan *et al.,* (2021) who observed the maximum bulb yield (9.6 and 18.84 kg plot^{-1}), respectively in combination of micronutrients.

Net returns (Rs. Plot^{-1})

The adoption of technology in modern agriculture can only be feasible and acceptable to the farmer if it is economically viable. Treatment T_6 had the maximum net return (kg plot^{-1}) which was significantly higher from all other treatments whereas, treatment T_7 had the minimum net returns (kg plot^{-1}). The higher photosynthetic accumulation in bulbs would ensure higher bulb weight that increase bulb yield and net returns also by marketed the onions. Similar findings were also reported by Bose *et al.,* (2009) and Goyal *et al.,* (2017) who observed the maximum net returns (Rs. 66099 and 3, 45,355 ha^{-1}), respectively.

Benefit cost ratio

The results of economics production of onion as influenced by micronutrients revealed significant variation among various treatments. It is apparent from the data the maximum benefit cost ratio was observed in treatment T_6 which was statistically at par with the treatment T_3. Beside, minimum benefit cost ratio was found in treatment T_7.

Table.1 Impact of foliar application of micronutrients on yield and benefit cost ratio of onion.

Treatments	Days taken to harvest	Bulb diameter (cm)	Fresh weight of bulb (g)	Dry weight of bulb (g)	Bulb yield (kg plot^{-1})	Net returns (Rs. plot^{-1})	Benefit cost ratio
T_1-1% Copper sulphate	118.73	4.00	72.30	9.83	30.60	538.37	2.37
T_2-1% Magnesium sulphate	119.0	4.73	76.60	11.27	32.43	578.62	2.49
T_3-0.5% Zinc sulphate	115.0	5.30	79.27	12.50	34.90	634.23	2.66
T_4-0.5% Ferrous sulphate	117.67	4.40	74.80	10.80	31.60	561.60	2.45
T_5-0.25% Borax	116.33	5.00	77.57	11.90	33.90	611.73	2.59
***T_6- Mixture of all the micronutrients**	114.33	5.87	81.23	13.13	35.80	654.87	2.72
T_7- Control	120.0	3.60	70.80	8.30	28.00	477.37	2.14
Mean	117.3	4.7	76.1	11.1	32.5	580	2.5
CD ($p \leq 0.05$)	0.88	0.30	1.87	0.7	0.92	16.62	0.11

(*Treatment 6- mixture of all the micronutrients @ $CuSO_4$ - 1%, $MgSO_4$ - 1%, $ZnSO_4$ - 0.5%, $FeSO_4$ - 0.5% and B - 0.25%)

The probable reason of maximum benefit cost ratio in treatment T_6 due to high bulb yield by using foliar application of micronutrient mixture and suitable environment conditions.

The results related to benefit cost ratio are close with the findings of Yadav *et al.*, (2018); Biswas *et al.*, (2020) and Pramanik *et al.*, (2020) who reported the maximum benefit cost ratio (2.37, 4.61 and 2.26), respectively with the application of micronutrient mixture.

The combined foliar application of micronutrient best for getting better yield and benefit cost ratio. Hence, application of treatment T_6 (Mixture of all the micronutrients @ $CuSO_4$ - 1%, $MgSO_4$ - 1%, $ZnSO_4$ - 0.5%, $FeSO_4$ - 0.5% and B - 0.25%) at 45, 60 and 75 days after transplanting was beneficial for onion production.

Acknowledgement

The Department of Horticulture at Khalsa College in Amritsar provided the essential equipments for this research, for which the authors are grateful.

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How to cite this article:

Manpreet Kaur and Navjot Singh Dhillon. 2022. Onion (*Allium cepa* L.) Productivity as Affected by Foliar Application of Micronutrients. *Int.J.Curr.Microbiol.App.Sci.* 11(10): 234-238.
doi: https://doi.org/10.20546/ijcmas.2022.1110.030