RESEARCH ARTICLE

EFFECT OF FOLIAR APPLICATION OF MICRONUTRIENTS ON GROWTH, YIELD AND QUALITY OF ONION (*ALLIUM CEPA* L.)

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Abstract: A field experiment was conducted as "On-Farm-Trial" on farmers'fields by CCSHAU, Krishi Vigyan Kendra, Rohtak, Haryana during *Rabi*season of 2018-19 and 2019-20. Trial was conducted at ten farmers' field at different locations of district Rohtak.The *Rabi* onion variety Hisar Onion 4 was used for experimentation. The micronutrients were applied to the onion crop through foliar spray of "Multiplex General" which contains Zinc 3.0%, Boron 0.5%, Iron 1.5% and Copper 0.5%. Foliar spray above micronutrients mixture @ 250 ml in 100 litres of water per acre was done at 45 & 60 days after transplanting of the cropalongwith control treatments. Foliar application of micronutrients significantly increased the plant height (66.23cm) over control. In case of yield and its attributes, micronutrients application produced bigger size bulb which reflected in increased bulb diameter (6.17 cm) and weight (53.32 g) than that of untreated control and likewise the maximum and significantly higher yield *i.e*., 302.7 q/ha was reported in the treatment where micronutrients were applied at 45 and 60 days after planting (T_2). The quality parameters such as total soluble solids (TSS)13.92^{0}Brix and 11.60^{0}Brix, dry matter 14.44% and 13.21%, have been reported in treated and control plots, respectively in onion variety HO-4.

Keywords: Foliar application, Onion, micronutrients, TSS

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops grown in India. It is widely grown in most of the countries of the world. It ismainly grown for bulb and an inevitable item of kitchen for every household. In India, onion is consumed as avegetable and condiment. The edible part of onion is greenleaves, immature and mature bulbs. It is used in salad, as spice in soups and many other dishes and is cooked alone as a vegetable. The pungency in onion is due to the presence of Allylpropyle disulfide (Malik, 1994). In addition to its medicinal properties, it is a good source of carbohydrates, vitamin-A, protein, riboflavin *etc*.

Globally, an increase in 53.49% area, 72.87% in production and 12.63% in productivity of onion in last decade indicates its scope and growth. InIndia, it helps in earning of foreign exchange through export. India is the largest producer of onion next toChina in the world and the major exporter across the globe.Due to intensive cropping, less or no use of organic manures, no use of micro nutrients and imbalanced use of fertilizers,soil health is deteriorating day by day. Plant requires 17 nutrient elements to complete its lifecycle. Among these, the nine nutrient elements, which are required by the plants in large amount and are measured in kilogram per hectare are macro nutrients e.g. C, H, O, N, P, K, Ca, Mg, S and other which are required in very less quantity and measured in parts per million (ppm) are micronutrients e.g. iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B), molybdenum (Mo), chlorine (Cl) and nickel (Ni).

The soil and the environment affect availability of these nutrients in soil. Cool weather and wet soil conditions reduce the availability of Zn, resulting in its deficiency. Micronutrient availability (except Mo) generally decreases as soil pH increases. Availability of Zn, Mn and Cu declines rapidly as soil pH increases, also, sandy soils are more likely to exhibits micronutrient deficiencies than clay soils. No doubt, the requirement of micronutrients is less as compared to macronutrients but their deficiency can limit the crop growth and production. Moreover, micronutrients help in increasing the efficiency of macronutrients in vegetable production. Micronutrients have a great role in the fertilizer programmeto achieve higher and sustainable crop yields. Unfortunately, micronutrients have received less attention in fertilizer management research, development and extension.Growers should carefully follow recommendations for micronutrients to avoid unnecessary costs and possible toxic effects or deleterious interactions with other nutrients. Maximizing yield without application of required fertilizers is not possible. Fertilizers can increase yield andquality of crop produce. For maximization of crop yield, all the nutrients whether macronutrients or micronutrients that are deficient in soils must be added in the form of fertilizers, either chemical, organic or both. In the state of Haryana (India), most of the farmer use macronutrients especially nitrogen, phosphorus and potassium for vegetable production. Use of micronutrients is limited. Although, the micronutrients are required in

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very small quantity but these are important in cell division and carbohydrates metabolism in plant growth. Application of boron increases bulb size and yield of onion (Smriti *et al*., 2002). The research work on the effect of micronutrients on the growth, yield and quality of onion in India and specially Haryana is very limited, although it is needed to determine micronutrient requirement of the onion crop. In consideration with the above situations,an attempt has been made to study the effect of micronutrients on growth, yield & quality of onion in presence of N, P & K.

MATERIALS AND METHODS

The experiment was conducted as "On-farm-Trial" at farmer's fields in district Rohtak of Haryana, India on onion variety Hisar Onion 4 for consecutive two years during 2018-19 and 2019-20 during *Rabi*season *i.e.*, Jan. – May. The seed of Var. HO 4 was procured from department of Vegetable Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar. The seed was treated with carbendazim @ 2.5g/kg seed as dry dressing as per package and practicesadopted forHaryana state. The treated seed was sown in lines in well prepared nursery beds on 10^{th} and $12^{th}$of November during first and second year of experimentation, respectively. Proper thinning, weeding and other nursery care operations were carried out till the transplanting of seedlings in the main field. Nursery was raised commonly for both treatments and micronutrients were applied as per treatment in the main field.Only healthy and vigorous (15cm long) seedling of the crop was transplanted at a spacing of 15 x 10 cmduring first week of January 2019 and 2020, respectively.There were two treatments*i.e.*, T_1 = control (no application of micronutrients) and T_2 = application of micronutrients at 45 and 60 days after transplanting through foliar spray. These micronutrients were applied to the onion crop during *Rabi* season (January to May) through foliar spray of "Multiplex General" which contains zinc 3%, Boron 0.50%, Iron 1.50% and copper 0.50%. Foliar spray @ 250 ml of "Multiplex General" in 100 litres of water per acre was done at 45 & 60 days after transplanting of the crop. Trial was conducted at ten farmers' field in Rohtak district comprising of 0.5-acre area as plot size. Ten plants were selectedrandomly from each treatment as a unit forrecording all observationson growth, yield and yield attributes. Total solublesolids were determined by using hand Refractometer. Statistical analysis was done using standard procedure. Economicsof onion production was calculated by keeping a record on eachoperation carried out, number of labours 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, was 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

$$\text{Benefit to Cost ratio} = \frac{\text{Gross returns}}{\text{Cost of cultivation}}$$

RESULTS AND DISCUSSION

The data on growth parameters such as plant height and number of leaves has been recorded and presented in Table 1, revealed that foliar application of micronutrientssignificantly increased the plant height (66.23cm) over control, whereas non-significant effect of foliar application of micronutrients on number of leaves per plantwasnoticed. The result of the present study is in consonance with the resultsof previous researcher Dake*et al*. (2011) and Abd EI- Samad *et al.* (2011),they reported that growth parameters of onion plant were positively affected by foliar application of micronutrients. The improvement in plant growth might be due to its role in many physiological processes and cellular functions within the plants.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.

The yield attributes *i.e*., bulb diameter, weight and yield as influenced by micronutrients application (Table 1) exhibited that micronutrients'application produced bigger size bulb, which reflected asignificant increase in bulbdiameter (6.17cm) and bulb weight (53.32 g) than that of untreated control and likewise the maximum and significantly higher yield *i.e.*,302.7q/ha was recorded in the treatment where micronutrients were applied at 45 and 60 days after planting (T_2). These results obtained from the present experiment are in close conformity with the result of Pramanik*etal*.,(2020), they observed significantly higher vegetative growth in terms of plant height, number of leaves per plant, collar thickness, average bulb weight, total bulb yield per plot and per hectare was recorded when crop was treated with recommended 150:50:80:30 NPKS kg ha^{-1} +20 t ha^{-1} FYM + micronutrient mixture *i.e.*, Fe-2.5 %, B-0.5%, Zn -3%, Cu -1% and Mn-1% @ 0.5% as foliar application at 30 and 45 DAP. 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.

Application of micronutrients had significant impact on dry matter of onion and total soluble solids (TSS). Significantly higher dry matter content of 14.44 % and TSS 13.92^0Brixwere recorded when crop was sprayed micronutrients, these figures differ significantlyover control as depicted in Table 2. The bulb weight and bulb diameter of onion were

increased due to higher photosynthate accumulation in the bulband higher number of leaves per plant. Foliar application of micronutrients significantly affected quality parameters of onion variety HO-4 in terms of total soluble solids. This might be due to better efficacy of micronutrient mixture in increasing vegetative growth and bulb yield attributing parameters as observed in the present study as 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 (Hanch and Mendel, 2009). Whereas, Alam *et al*. and Acharya *et al*. (2015) stated a significant effect of zinc and boron application on dry matter production of onion.

The data pertaining to the results on production economics (Gross return, Net return and BCR) of onion as influenced by micronutrients revealed a significant variationbetween treatments (Table 2). The foliar application of micronutrient (Zinc 3%, Boron 0.5%, Iron 1.5% and copper 0.5%.) @ 2.5% at 45 and 60 DAP recorded significantly highest gross return (2.26 lakh/ha) as well as net income (1.58 lakh/ha) as compared tocontrol treatment (1.41 lakh/ha). This higher gross return was obviously due to the higher total bulb yield with application of micronutrients, as revealed in the present study. Similar trend was also observed for Benefit Cost Ratio (BCR), highest being calculated in T_2(2.81) followed by T_1 (2.65). This was obviously due to significantly higher total bulb yield. Thus, in general, it may be concluded that application of micronutrients mixture, preferably as foliar spray at 45 and 60 DAP increased all the economic parameters of gross and net returns as well as benefit cost ratio indicating the feasibility of use of micronutrients for optimum profit in commercial cultivation of onion. The present results corroborate the findings of Smiriti *et al*. (2002) for boron while Nasreen *et al*. (2009) and Pramanik *et.al*., (2020) for zinc as a source of micronutrients towards increased benefit cost ratio in onion production.

Table1. Effect of foliar spraying of micronutrients on growth, yield and quality of onion (Pooled data of two years)

Treatment	Plant height (cm)	No. of leaves / Plant	Bulb diameter (cm)	Bulb Weight (g)	Yield (q/ha)	TSS (^{O}B)	Dry Matter of bulb (%)
T_1: No Spray of Micro nutrients	58.41	5.24	4.45	47.81	279.2	11.60	13.21
T_2: Foliar application of Micronutrients	66.23	6.56	6.17	53.32	302.7	13.92	14.44
CD at 5%	5.61	NS	0.38	5.42	21.9	1.89	0.43

NS : Non significant (P > 0.05).

Table2. Effect of foliar spraying of micronutrients on Economics of onion crop (Pooled data for two years)

Treatments	Economics (Rs. / ha)			
	Gross Cost	Gross Return	Net Returns	B:C ratio
T_1: No Spray of Micronutrients	85450	2,26,152	1,40,702	2.65
T_2: Foliar application of Micronutrient	87390	2,45,187	1,57,797	2.81

*onion bulbs were sold @ Rs.810/q

CONCLUSION

Based on two consecutive year findings of the experiment, it may be concluded that combined application of micronutrients mixture (Zinc 3.0%, Boron 0.5%, Iron 1.5% and Copper 0.5%) @ 250ml per 100 litres of water at 45 and 60 days after transplanting was found to be better for higher growth, yield and economic parameters of onion, hence may be recommended that application micronutrients gives better vegetative growth in term of number of leaves, bulb weight and bulb production along with higher BC ratio in onion as compare to control treatment.

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