Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

**E-ISSN:** 2278-4136
**P-ISSN:** 2349-8234
www.phytojournal.com
JPP 2021; 10(1): 1265-1267
Received: 15-11-2020
Accepted: 23-12-2020

**Manish Kumar Singh**
Research Scholar, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

**Anand Kumar Singh**
Professor and Head, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

**Rohit Kumar Singh**
Research Scholar, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

**Diksha Mishra**
Research Scholar, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

**BK Singh**
Professor, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

**AK Pal**
Professor, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

**Bhagat Singh**
Farm Superintendent, Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

**Corresponding Author:**
**Manish Kumar Singh**
Research Scholar, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

# Effect of foliar application of various micronutrients on yield and economics of cabbage (*Brassica oleracea* var. *capitata* L.)

**Manish Kumar Singh, Anand Kumar Singh, Rohit Kumar Singh, Diksha Mishra, BK Singh, AK Pal and Bhagat Singh**

**Abstract**
A field experimented was conducted at Vegetable Research Farm (South Block), Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh during winter season of 2017-2018 and 2018-2019 to study the effect of foliar application of various micronutrients on yield and economics of cabbage. The results reveals that the maximum head yield of cabbage (21.32, 24.16 and 22.74 kg during 2017-18, 2018-19 and pooled analysis, respectively) and maximum gross returns (₹ 221640.00), net returns (₹ 174625.00) and B: C ratio of the magnitude 3.71 was obtained with application of ($T_{13}$) B-20 @ 0.075% + Mo @ 0.45% followed by application of ($T_{16}$) B-20 @ 0.100% + Mo @ 0.45% during both the years as well as pooled analysis. However, least value of head yield, gross returns, net returns and B:C ratio were observed with ($T_1$) control.

**Keywords:** Cabbage, economics, head yield and net returns

## Introduction
Vegetables play a very important role in the human diet. They are valuable roughages, which promote digestion and help to prevent constipation. They supply carbohydrate, fats, protein, vitamins and mineral elements. Cabbage is a leafy green plant grown as vegetable crop for its dense leaved heads. The vegetables have given a push to Indian economy and boosted up her trade. Average productivity of vegetable crops is however, very low and not sufficient to meet the need of local consumption. Among the several constraints, improper nutritional management is an important impediment for increasing the productivity of cabbage. Vegetable crops have a high micronutrients requirement due to its many functions in plant growth. Application of micronutrients is less expensive but can give higher profits than other nutrients (Solanki *et al.,* 2010) [10]. Micronutrients, has the strongest impact on yield and quality of vegetable crops. In recent years, an increased frequency of micronutrients especially Zn, B and Mo deficiency has been observed in crops may become a factor limiting yield and quality of crops. The farmers of the area, by and large, use N, P and K fertilizers in vegetable crops and as a consequence, deficiency of micronutrients is increasing. About 50% soils of India are deficient in micronutrients and these soils are under intensive cultivation with no or little application of micronutrients (Shukla, 2011) [9]. The information regarding the response of cabbage to micronutrients application under identical soil and weather conditions was considered to be of interest. It was felt imperative to find out the response of cabbage to micronutrients application for higher production and quality. Foliar application of micronutrients can be considered one of the easier and effective methods, to deliver the needed nutrients to plants in adequate concentrations. However, the information pertaining to response of cabbage crop to micronutrients application in sandy clay loam textured soil is limited. Therefore, the present study was planned to assess the effect of foliar application of various micronutrients on yield and economics of cabbage crop in sandy clay loam soil of Varanasi district of Uttar Pradesh.

## Materials and Methods
An experiment was conducted during two successive winter season of 2017-18 and 2018-19, at Vegetable Research Farm (South Block), Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh (situated at 25º10' N latitude and 83º03' E longitude with an altitude of 128.93 m above mean sea level). The soil was sandy clay loam in texture having a pH of 7.36, EC 0.28 ($dSm^{-1}$) organic Carbon 0.42%, available boron 0.31 mg $kg^{-1}$, available zinc 0.57 mg $kg^{-1}$ and available molybdenum 0.26ppm.

The experiment was conducted in randomized block design with replicate thrice consisted of sixteen micronutrient treatments *viz.* ($T_1$) control, ($T_2$) B-20 (Boron) @ 0.050%, ($T_3$) B-20 (Boron) @ 0.075%, ($T_4$) B-20 (Boron) @ 0.100%, ($T_5$) Ammonium Molybdate (Mo) @ 0.15%, ($T_6$) Ammonium Molybdate (Mo) @ 0.30%, ($T_7$) Ammonium Molybdate (Mo) @ 0.45%, ($T_8$) B-20 @ 0.050% + Mo @ 0.15%, ($T_9$) B-20 @ 0.050% + Mo @ 0.30%, ($T_{10}$) B-20 @ 0.050% + Mo @ 0.45%, ($T_{11}$) B-20 @ 0.075% + Mo @ 0.15%, ($T_{12}$) B-20 @ 0.075% + Mo @ 0.30%, ($T_{13}$) B-20 @ 0.075% + Mo @ 0.45%, ($T_{14}$) B-20 @ 0.100% + Mo @ 0.15%, ($T_{15}$) B-20 @ 0.100% + Mo @ 0.30% and ($T_{16}$) B-20 @ 0.100% + Mo @ 0.45%. Application of Zn 0.5 g $l^{-1}$ was also applied equal in all the treatments involving Goldean Acre variety of cabbage. The crop was transplanted in the 2nd week of October in main field during both the years. The foliar spray was applied at 15, 30 and 45 days after transplanting. The crop was raised with recommended agronomic practices. The crop was harvested at physiological maturity and cabbage head yields were recorded.

**Statistical analysis and interpretation of data**

Data recorded on various parameters of the experiment was subjected to analysis by using Fisher's method of analysis of variance (ANOVA) and interpreted as outlined by Gomez and Gomez (1984) [1]. The levels of significance used in 'F' and 't' test was *p*=0.05. Critical difference values were calculated where F test was found significant.

**Results and Discussions**

The outcomes of the study (Table 1) showed that different micronutrients significantly influence the yield of cabbage is presented in Table 1. Data indicated that among the treatments, highest cabbage head yield plot$^{-1}$ (21.32, 24.16 and 22.74 kg during 2017-18, 2018-19 and pooled analysis, respectively) was observed with application of ($T_{13}$) B-20 @ 0.075% + Mo @ 0.45% which was statistically at par with ($T_{16}$) B-20 @ 0.100% + Mo @ 0.45%, ($T_{15}$) B-20 @ 0.100% + Mo @ 0.30%, ($T_{12}$) B-20 @ 0.075% + Mo @ 0.30% and ($T_{14}$) B-20 @ 0.100% + Mo @ 0.15% during both the years as well as pooled analysis. However, least cabbage yield was observed with ($T_1$) control. The contribution of foliar application of different micronutrient combinations to increase in yields can be attributed to enhance availability of essential plant nutrients at the required growth stages. Hence, increased rate and efficiency of metabolic activities resulting in high assimilation of proteins and carbohydrates which in turn helps in better nutrient absorption by plants resulting in better yields. The results obtained corroborated with the reports of Sarma *et al.* (2005) [8], Kanujia *et al.* (2006) [3], Narayanamma *et al.* (2007) [6], Lashkari *et al.* (2008) [4], Nandi and Nayak (2008) [5] and Yadav *et al.* (2009) [12].

**Table 1:** Effect of micronutrients on plot$^{-1}$ yield (kg) of cabbage

| Notation | Treatments | Yield plot$^{-1}$ (kg) | | |
|---|---|---|---|---|
| | | 2017-18 | 2018-19 | Pooled |
| $T_1$ | Control | 15.00 | 17.33 | 16.17 |
| $T_2$ | B-20 (Boron) @ 0.050% | 15.88 | 18.40 | 17.14 |
| $T_3$ | B-20 (Boron) @ 0.075% | 16.79 | 19.31 | 18.05 |
| $T_4$ | B-20 (Boron) @ 0.100% | 17.11 | 19.62 | 18.36 |
| $T_5$ | Ammonium Molybdate (Mo) @ 0.15% | 15.29 | 17.80 | 16.54 |
| $T_6$ | Ammonium Molybdate (Mo) @ 0.30% | 15.30 | 17.82 | 16.56 |
| $T_7$ | Ammonium Molybdate (Mo) @ 0.45% | 16.00 | 18.51 | 17.25 |
| $T_8$ | B-20 @ 0.050% + Mo @ 0.15% | 18.19 | 20.70 | 19.44 |
| $T_9$ | B-20 @ 0.050%+ Mo @ 0.30% | 18.51 | 21.02 | 19.77 |
| $T_{10}$ | B-20 @ 0.050%+ Mo @ 0.45% | 19.51 | 22.03 | 20.77 |
| $T_{11}$ | B-20 @ 0.075% + Mo @ 0.15% | 19.64 | 22.15 | 20.89 |
| $T_{12}$ | B-20 @ 0.075% + Mo @ 0.30% | 20.47 | 22.99 | 21.73 |
| $T_{13}$ | B-20 @ 0.075% + Mo @ 0.45% | 21.32 | 24.16 | 22.74 |
| $T_{14}$ | B-20 @ 0.100% + Mo @ 0.15% | 20.02 | 22.54 | 21.28 |
| $T_{15}$ | B-20 @ 0.100% + Mo @ 0.30% | 20.66 | 23.17 | 21.91 |
| $T_{16}$ | B-20 @ 0.100% + Mo @ 0.45% | 20.85 | 23.36 | 22.11 |
| S.Em± | | 0.51 | 0.62 | 0.56 |
| *LSD* (*P*=0.05) | | 1.47 | 1.79 | 1.61 |

**Chelated Zn @ 0.5 g $l^{-1}$ was applied in all the treatments

A cursory glance of Table 2 revealed that micronutrients had effect on relative economics of cabbage during both the years of study. The maximum gross returns (₹ 221640.00), net returns (₹ 174625.00) and B: C ratio of the magnitude 3.71 was obtained with application of ($T_{13}$) B-20 @ 0.075% + Mo @ 0.45% followed by application of ($T_{16}$) B-20 @ 0.100% + Mo @ 0.45%. However, maximum cost of cultivation (₹ 47155.00) was recorded with application of ($T_{16}$) B-20 @ 0.100% + Mo @ 0.45% followed by ($T_{13}$) B-20 @ 0.075% + Mo @ 0.45% (₹ 47015.00) during in the investigation. While, minimum values of cost of cultivation (₹ 45860.00), gross returns (₹ 160020.00) and net returns (₹ 114160.00) was recorded with ($T_1$) control. This is due to the higher head yield of cabbage in ($T_{13}$) B-20 @ 0.075% + Mo @ 0.45% treatment. Similar findings were also reported by Taheri *et al.* (2020) [11]. The results are in agreement with the findings of Jamre *et al.* (2010) [2] in cauliflower and Patil *et al.* (2013) [7] in bitter gourd.

**Table 2:** Effect of micronutrients on economics (₹ ha$^{-1}$) of cabbage

| Treatments | Cost of cultivation (₹ha$^{-1}$) | | | Gross return (₹ha$^{-1}$) | Net returns (₹ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|---|
| | Fixed | Variable | Total | | | |
| $T_1$ | 45860.00 | 00.00 | 45860.00 | 160020.00 | 114160.00 | 2.49 |
| $T_2$ | 45860.00 | 280.00 | 46140.00 | 165600.00 | 119460.00 | 2.59 |
| $T_3$ | 45860.00 | 420.00 | 46280.00 | 174540.00 | 128260.00 | 2.77 |

| | | | | | | |
|---|---|---|---|---|---|---|
| $T_4$ | 45860.00 | 560.00 | 46420.00 | 178620.00 | 132200.00 | 2.85 |
| $T_5$ | 45860.00 | 245.00 | 46105.00 | 165000.00 | 118895.00 | 2.58 |
| $T_6$ | 45860.00 | 490.00 | 46350.00 | 160560.00 | 114210.00 | 2.46 |
| $T_7$ | 45860.00 | 735.00 | 46595.00 | 167520.00 | 120925.00 | 2.60 |
| $T_8$ | 45860.00 | 525.00 | 46385.00 | 189420.00 | 143035.00 | 3.08 |
| $T_9$ | 45860.00 | 770.00 | 46630.00 | 192660.00 | 146030.00 | 3.13 |
| $T_{10}$ | 45860.00 | 1015.00 | 46875.00 | 202680.00 | 155805.00 | 3.32 |
| $T_{11}$ | 45860.00 | 665.00 | 46525.00 | 203940.00 | 157415.00 | 3.38 |
| $T_{12}$ | 45860.00 | 910.00 | 46770.00 | 212280.00 | 165510.00 | 3.54 |
| $T_{13}$ | 45860.00 | 1155.00 | 47015.00 | 221640.00 | 174625.00 | 3.71 |
| $T_{14}$ | 45860.00 | 805.00 | 46665.00 | 207780.00 | 161115.00 | 3.45 |
| $T_{15}$ | 45860.00 | 1050.00 | 46910.00 | 214140.00 | 167230.00 | 3.56 |
| $T_{16}$ | 45860.00 | 1295.00 | 47155.00 | 216060.00 | 168905.00 | 3.58 |

**Chelated Zn @ 0.5 g $l^{-1}$ was applied in all the treatments

## Conclusion

From data presented it might reasonably be argued that the highest yield of cabbage head, gross returns, net returns and B:C ratio was recorded with application of ($T_{13}$) B-20 @ 0.075% + Mo @ 0.45% followed by ($T_{16}$) B-20 @ 0.100% + Mo @ 0.45% than rest of the treatments during both the years as well as pooled analysis.

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