**Influence of Foliar Spray of Micronutrients on Growth and Yield of Cauliflower (*Brassica oleraceae var. botrytis* L.)**

# Abstract

# A field experiment was conducted at Research Farm, Mewar University Gangrar, Chittorgarh (Rajasthan) during Rabi season to check of influence of foliar spray of micronutrients on growth and yield of cauliflower variety “Pusa Snowball K-1‟ was used in this study. The result revealed that the maximum growth parameters like plant height (17.62 and 35.25 cm at 30 and 60 DAS), number of leaves per plant (11.63 and 16.87 at 30 and 60 DAS), stalk length (23.00 cm) and yield parameters like curd depth (9.45), net curd weight (645.58), gross curd weight (1020.63 g) and curd yield (145.36 q/ha) was recorded with T8-Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT). Therefore, application of different micro-nutrients and its combinations were found better for increasing the vegetative characters and yield as correlated to control at all the step of experiment observations. It can be concluded based on the results obtained from the investigation that foliar application of different micronutrients (Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT) was found effective for higher growth and yield of cauliflower return.

**Key words: - Micronutrient Yield, Cauliflower, Foliar spray**

**1. Introduction**

Cauliflower (*Brassica oleracea var. botrytis* L.) is one of the most important vegetables among the all-Cole crops. Eastern Mediterranean region is its centre of origin and probably developed from broccoli. India is the highest producer of cauliflower in the whole world apart from India other major producers of cauliflower are china, France, Italy, UK, USA, Spain, Poland, Germany and Pakistan, Mexico. The crop grown in open fields is often exposed to fluctuating temperature, humidity, unexpected heavy rains and insect pest diseases which ultimately affect the crop productivity adversely. Micronutrient plays an important role in growth and development of plant. Though these are required in small amount but equally indispensable for the normal growth of the plant and in deficient condition these lead to the occurrence of some physiological disorders and ultimately affect the yield and quality of the cauliflower. Micronutrient improves the chemical composition of curd and general condition of the plant. It increases seed germination, macronutrient uptake, production and quality through enhanced photosynthetic activity and increased metabolite content of leaves. They also reduce the incidence of diseases, pests and disorders and improve the postharvest quality of the crop produce. (Hemphill *et al*., 1982). Different micronutrients have specific role in cauliflower production. Among all (Boron, Molybdenum, Iron, Copper, Chlorine, Zinc and Manganese), Boron and Molybdenum are more important than others due to its availability in soil, mobility in plants and soil and more dependency upon pH in soil. (Chaudhari *et al.* 2017). Boron is an essential micronutrient which plays an important role in a diverse range of plant activity including cell wall development and provides the structural stabilities and functional integrity of biological membranes, facilitates the move of sugar or energy into different growing parts of plants. It also helps in pollination and seed set. Adequate amount of boron is the recommended for effective nitrogen fixation in plants. Different micronutrients have specific role in cauliflower production. Among all (Boron, Molybdenum, Iron, Copper, Chlorine, Zinc and Manganese), Boron and Molybdenum are more important than others due to its availability in soil, mobility in plants and soil and more dependency upon pH in soil. (Chaudhari *et al.* 2017). Zinc plays a crucial role in plant nutrition. Zinc acts as a metal activators of enzyme like dehydrogenase, proteinases and peptinases. Tryptophan is essentially synthesized by Zinc, which is a precursor of IAA. These are essentially required for synthesis of chlorophyll and help in the cell division and different metabolic process in plant. Zinc required for transformation of carbohydrates because of its catalytic nature (Singh *et al.* 2018). Zinc required for transformation of carbohydrates because of its catalytic nature. Interveinal chlorosis, decrease root growth blossoming, flowering are caused due to the deficiency of zinc. Its deficiency also causes, shortened internodes and chlorosis of older leaves. (Sabri *et al.* 2021).

# 2. Materials and Methods

A field experiment was conducted during Rabi season of 2024-25 at research farm, Department of Agriculture (Horticulture), Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan). Soil of the experimental field was sandy loam in texture, saline in reaction with a pH value of 7.6, poor in organic carbon (0.16%), deficient in available zinc (0.48 ppm) and iron (1.2 ppm) low in available nitrogen (176 kg/ha) and phosphorus (20.2 kg/ha) but medium in available potassium (320 kg/ha). The experiment was laid out in randomized block design with three replications – Control (only RDF), Borax @ 0.2% (Foliar spray at 30, 45 and 60 DAT), FeSO4 @ 0.5% (Foliar spray at 30, 45 and 60 DAT), ZnSO4 @ 0.5% (Foliar spray at 30, 45 and 60 DAT), Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT), FeSO4 @ 0.5% + ZnSO4 @ 0.5% (Foliar spray at 30, 45 and 60 DAT), Borax @ 0.2% + FeSO4 @ 0.5% (Foliar spray at 30, 45 and 60 DAT), Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT) and Borax @ 0.2% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT). Total treatment combination is 9 and three replications than total number of plots is 27.

**3. Results and Discussion**

The purpose of this study was to determine the extent of performance for growth and yield parameters.

**3.1 growth parameters**

The data were showed significant in respect of plant height at 30 days after transplanting. At 30 days after transplanting maximum plant height (17.62 cm) was observed in T8-Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT). The minimum plant height (11.26 cm) was recorded in treatment T1-Control (only RDF). The data were showed significant in respect of plant height at 60 days after transplanting. At 60 days after transplanting maximum plant height (35.25 cm) was observed in T8-Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT). The minimum plant height (22.56 cm) was recorded in treatment T1-Control (only RDF). The data were showed significant in respect of number of leaves per plant at 30 days after transplanting. At 30 days after transplanting maximum number of leaves per plant (11.63) was observed in T8-Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT). The minimum number of leaves per plant (7.22) was recorded in treatment T1-Control (only RDF). The data were showed significant in respect of number of leaves per plant at 60 days after transplanting. At 60 days after transplanting maximum number of leaves per plant (16.87) was observed in T8-Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT). The minimum number of leaves per plant (12.44) was recorded in treatment T1-Control (only RDF). The data were showed significant in respect of stalk length. The maximum stalk length (23.00 cm) was observed in T8-Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT). The minimum stalk length (36.12 cm) was recorded in treatment T1-Control (only RDF). Similar result also reported by Kotecha *et al.* (2011), Kumar *et al.* (2012), Trivedi and Dhumal (2013), Hassan *et al.* (2013), Ballabh *et al.* (2013), Kumar *et al.* (2014), Bairwa *et al.* (2024) and Kumar *et al.* (2024).

* 1. **Yield attributes**

The data were showed significant in respect of curd diameter. The maximum curd diameter (31.15 cm) was observed in T8-Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT). The minimum curd diameter (26.85 cm) was recorded in treatment T1-Control (only RDF). The data were showed significant in respect of curd depth. The maximum curd depth (9.45 cm) was observed in T8-Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT). The minimum curd depth (8.00 cm) was recorded in treatment T1-Control (only RDF). The data were showed significant in respect of net curd weight. The maximum net curd weight (645.58 g) was observed in T8-Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT. The minimum net curd weight (430.02 g) was recorded in treatment T1-Control (only RDF). The data were showed significant in respect of gross curd weight. The maximum gross curd weight (1020.63 g) was observed in T8-Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT). The minimum gross curd weight (800.22 g) was recorded in treatment T1-Control (only RDF). The data were showed significant in respect of curd yield. The maximum curd yield (145.36 q/ha) was observed in T8-Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT). The minimum curd yield (102.52 q/ha) was recorded in treatment T1-Control (only RDF). Similar concluded by Sitapara *et al. (*2011), Singh *et al.* (2011), Naher (2014), Sathiyamurthy *et al.* (2017), Singh *et al.* (2018), Ranjan *et al*. (2019) and Saurabh *et al.* (2024).

# Conclusion

# Apply of different micro-nutrients and its combinations were found better for increasing the vegetative characters and yield as correlated to control at all the step of experiment observations. It can be concluded based on the results obtained from the investigation that foliar application of different micronutrients (Borax @ 0.2% + FeSO4 @ 0.5% + ZnSO4 @ 0.5% + Ammonium molybdate @ 0.2% (Foliar spray at 30, 45 and 60 DAT) was found effective for higher growth and yield of cauliflower return.

**Table 1 Effect of foliar spray of micronutrients on growth attributes of cauliflower**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Plant height (cm)** | | **Number of leaves per plant** | | **Stalk length**  **(cm)** |
| **30 DAT** | **30 DAT** | **30 DAT** | **60 DAT** |
| T1 | 11.26 | 22.56 | 7.22 | 12.44 | 20.00 |
| T2 | 15.725 | 31.44 | 9.80 | 15.04 | 21.82 |
| T3 | 16.00 | 32.05 | 10.33 | 15.57 | 21.95 |
| T4 | 16.12 | 32.28 | 10.48 | 15.72 | 22.05 |
| T5 | 14.68 | 29.36 | 9.48 | 14.72 | 21.58 |
| T6 | 16.82 | 33.65 | 11.03 | 16.27 | 22.55 |
| T7 | 16.52 | 33.05 | 10.78 | 16.02 | 22.30 |
| T8 | 17.62 | 35.25 | 11.63 | 16.87 | 23.00 |
| T9 | 17.06 | 34.15 | 11.33 | 16.57 | 22.65 |
| S. Em. ± | 0.41 | 0.55 | 0.41 | 0.55 | 0.52 |
| CD at 5% | 1.23 | 1.63 | 1.23 | 1.63 | 1.56 |

**Table 2 Effect of foliar spray of micronutrients on yield parameters and yield of cauliflower**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Curd diameter**  **(cm)** | **Curd depth (cm)** | **Net curd weight (g)** | **Gross curd weight**  **(g)** | **Curd yield**  **(q/ha)** |
| T1 | 36.85 | 8.00 | 430.02 | 800.22 | 102.52 |
| T2 | 39.45 | 8.89 | 562.25 | 885.02 | 130.78 |
| T3 | 40.00 | 9.00 | 580.44 | 900.45 | 133.63 |
| T4 | 40.32 | 9.05 | 589.36 | 920.36 | 136.20 |
| T5 | 39.78 | 8.78 | 538.78 | 848.25 | 127.45 |
| T6 | 40.85 | 9.30 | 612.25 | 962.85 | 140.56 |
| T7 | 40.65 | 9.20 | 600.52 | 940.15 | 138.45 |
| T8 | 41.15 | 9.45 | 645.68 | 1020.63 | 145.36 |
| T9 | 41.00 | 9.38 | 628.47 | 985.36 | 142.52 |
| S. Em. ± | 0.58 | 0.09 | 13.92 | 27.73 | 2.91 |
| CD at 5% | 1.73 | 0.28 | 41.74 | 83.14 | 8.73 |

**References**

Bairwa, P. L., Dixit, A., Bala, J., & Singh, V. (2024). Effect of Different Macro and Micro Nutrient Uptake on Soil and Plant in Cauliflower (*Brassica oleracea* var. botrytis L.) cv. Pusa Sharad. *Journal of Advances in Biology & Biotechnology*, **27**(6), 878-895.

Ballabh K., D.K. Ram and S.S. Rawat (2013). Effects of foliar application of micronutrients on growth, yield and quality of onion. *Indian Journal Hort,* **70** (2) : 260-265.

Chaudhari VJ, Patel NK, Tandel BM and Chaudhari V. (2017). Effect of foliar spray of micronutrients on growth and yield of cauliflower (*Brassica oleracea* L. var. botrytis). *International Journal of Chemical Studies*. **5** (6):1133-1135.

Hassan H.A, Ahmed M.Y. Aboull EI-magd M.M. and Anwar M.T. (2013). Effect of different phosphorous fertilizer rates and foliar spray with some commercial nutrients on growth and yield of broccoli grown in sandy soils*. J. of applied sci*. **9** (3): 2052-2062.

Hemphill, D. D. (1982). Anticrustant Effects on Soil Mechanical Resistance and Seedling Emergence1. *Hort. Science*, **17**(3), 391-393.

Kotecha A.V., JJ. Dharuve and N.J. Vihol (2011). Effect of foliar application of micronutrients and growth regulators on growth and yield of cabbage *{Brassica oleracea L. var.capitata)* cv. Golden Acre. *The Asian journal of Horticulture,* 6 : 381-384.

Kumar Anil D.K. Parmar and V.K. Suri (2012). Effect of boron fertilizers and organic manure on Autumn cauliflower in western Himalayas. *Annals of Horticulture,* **5** (1) : 17-24.

Kumar Santosh, S.S. Singh, Singh Pradeep Kumar and Singh Vivekanand (2014). Response of cauliflower (*Brassica oleracea L. var. botrytis)* to Boron and Molybdenum application. *Vegetable science,* **37** (1) : 40-43.

Kumar, V. V., Ramesh, E., Triveni, V., & Dash, B. (2024). Enhancement of Growth and Yield of Valentena (Purple Cauliflower) through Different Micronutrient Optimization. *Environment and Ecology*, **42**(3B), 1369-1374.

Naher M.N.A., M.N. Alami and N. Jahan (2014). Effect of nutrient management on the growth and yield of cabbage *(Brassica oleracea var. capitate L.) in calcareous soil of Bangladesh- The Agriculturists,* **12**(2) : 24-33.

Ranjan S, Misra S, Sengupta S, Parween S and Kumari U. (2019). Influence of micronutrients on growth and yield of cauliflower. *Journal of Pharmacognosy and Phytochemistry*. **9** (1):238-240.

Sabri ZN, Mujawal AK and Kshash BH. (2021). Effect of ethephone, zinc and boron on growth and yield of cucumber (*Cucumis melo* var. flexuosus) cultivated in plastic houses. *Earth and Environmental Science*. 910:1-6.

Sathiyamurthy VA, Shanmugasundaram T, Rajasree V and Arumugam T. (2017). Effect of foliar application of micronutrients on growth, yield and economics of tomato (*Lycopersicon esculentum* L.). *Madras Agricultural Journal*. 104:88-193.

Saurabh, A., Kaur, M., Khan, R., Guleria, G., Shandilya, M., & Thakur, S. (2024). Foliar application of Fe2O3 nano fertilizer on growth and yield of cauliflower (*Brassica oleracea* var. Botrytis L.) cv. Pusa Snowball K-1. *International Journal of Phytoremediation*, **26**(7), 993-1002.

Singh K.P., V.K. Singh Kamalkant and R.K. Roy (2011). Effect of different levels of boron and its methods of application on growth and yield of cauliflower *{Brassica oleracea L. var. botrytis). Vegetable science,* **38** (1) : 76-78.

Singh, V., Singh, A. K., Raghuvanshi, T., Singh, M. K., Singh, V. and Singh, U. (2018). Influence of Boron and Molybdenum on Growth, Yield and Quality Of Cauliflower (*Brassica oleracea* L. var. *botrytis*). *Int. J. Curr. Microbiol. App. Sci* **6** (10): 3408-3414.

Singh, V., Singh, A. K., Singh, S., Kumar A., and Kumar, S. (2018). Assessment of effect of foliar spray of micronutrients on quantitative and qualitative attributes of broccoli (*Brassica oleracea* var. *italica*) cv. Pusa KTS-1. *Journal of Pharmacognosy and Phytochemistry*, **7**(4): 3189-3192.

Trivedi A.P. and K.N. Dhumal (2013). Effect of soil and foliar application of zinc and iron on the yield and quality of onion *{Allium cepa* L.) *Bangladeshi. Agril. Res.,* **38** (1) : 41-48.