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**Chandni V Mori**

P.G. Scholar, College of Horticulture, S. D. Agricultural University, Jagudan, Mehsana, Gujarat, India

**AR Patel**

P.G. Scholar, College of Horticulture, S. D. Agricultural University, Jagudan, Mehsana, Gujarat, India

**RC Patel**

P.G. Scholar, College of Horticulture, S. D. Agricultural University, Jagudan, Mehsana, Gujarat, India

**AJ Patel**

P.G. Scholar, College of Horticulture, S. D. Agricultural University, Jagudan, Mehsana, Gujarat, India

**Darshna S Patel**

P.G. Scholar, College of Horticulture, S. D. Agricultural University, Jagudan, Mehsana, Gujarat, India

**Corresponding Author:****Chandni V Mori**

P.G. Scholar, College of Horticulture, S. D. Agricultural University, Jagudan, Mehsana, Gujarat, India

## Effect of different micronutrients and stage of their application on yield and quality of cauliflower (*Brassica oleracea* var. *botrytis*)

Chandni V Mori, AR Patel, RC Patel, AJ Patel and Darshna S Patel

DOI: <https://doi.org/10.22271/chemi.2020.v8.i4au.10222>**Abstract**

An investigation was conducted on cauliflower cv. Pusa Snowball K 1 during *Rabi* season of the year, 2017-18 at College Farm, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Gujarat. In order to find out the effect of different micronutrients and stage of their application on growth, yield and quality of cauliflower. The experiment was laid out in Randomized Block Design with factorial concept (FRBD) keeping two factor *viz.*, stage of application of micronutrients and micronutrients, the first factor with three stage of application of micronutrients *i.e.* at seedling stage (15 DAS), after transplanting (20 & 35 DAT), at seedling stage (15 DAS) and after transplanting (20 & 35 DAT) while second factor *i.e.* micronutrients with eight levels thus, making twenty four treatment combinations. Zinc, Boron and Molybdenum were applied as foliar sprays indifferent concentrations of Zn(0, 1000 ppm), B(0, 200 ppm) and Mo(0,50 ppm) at three different stages. The individual effect of micronutrient application at different stages as well as their interaction effect on yield and quality of cauliflower cv. 'Pusa Snowball K 1' was recorded. The results indicate that micronutrient application at seedling stage (15 DAS) and after transplanting (20 & 35 DAT) gave maximum average weight of curd, yield per plot, yield per hectare and B content were found better with this treatment. Higher dose of micronutrient application was found *i.e.* @ Zn 1000 ppm + B 200 ppm + Mo 50 ppm superior for yield as well as quality parameters *i.e.* average weight of curd, yield per plot and per hectare and B content. The interaction effect of stage of micronutrient application and micronutrients were found not significant for all yield and quality parameters. Thus from the present investigation it could be concluded that for successful cultivation of cauliflower, micronutrient should spray at seedling stage (15 DAS) and 20 & 35 DAT for getting better yield and quality. Micronutrients should apply @ Zn 1000 ppm + B 200 ppm + Mo 50 ppm for same.

**Keywords:** Cauliflower, micronutrients, yield, quality**Introduction**

Cauliflower (*Brassica oleracea* L. var. *botrytis*) is an important winter vegetable crop grown in India. It is an annual plant that reproduces by seed. The edible part, *i.e.* curd is a 'prefloral fleshy apical meristem' and it is generally white in colour and may be enclosed by inner leaves before its exposure (Sitapara *et al.* 2011) [13]. Typically, only the white curd of aborted floral meristem is eaten, while the stalk and surrounding thick, green leaves are used in vegetable broth or discarded. Its name is from Latin *caulis* (cabbage) and flower, an acknowledgment of its unusual place among a family of food plants which normally produce only leafy greens for eating. Its late group variety Pusa Snowball K1 is highly valued for its medium size, compact and snow-white curd. Cauliflower in general and particularly variety Pusa Snowball K1 is heavy feeder of nutrients (Welch *et al.*, 1985) [14]. The nutrient elements which are required comparatively in small quantities are called as micro or minor nutrients or trace elements. Micronutrients are essentially as important as macronutrients to have better growth, yield and quality in plants. The requirements of micronutrients (boron, iron, copper, zinc, manganese, chloride and molybdenum) are only in traces, which are partly met from the soil or through chemical fertilizer or through other sources (Chaudhari *et al.* 2017) [1].

Cauliflower suffers widely by Boron and Molybdenum deficiency followed by Zinc, Manganese, Copper and Iron deficiencies. Cl, Cu, Fe and Mn are involved in various processes related to photosynthesis and Zn, Cu, Fe, and Mn are associated with various enzyme systems; Mo is specific for nitrate reductase only.

B is the only micronutrient not specifically associated with either photosynthesis or enzyme function, but it is associated with the carbohydrate chemistry and reproductive system of the plant. The cauliflower crop often shows the deficiency symptoms of boron and molybdenum as browning of curd and whiptail formation of leaves respectively. These disorders render curds unfit for human consumption and reduce the curd yield considerably (Singh and Thakur 1991) <sup>[11]</sup>.

Zinc is essential component of many enzymes such as carbonic anhydrase, alcohol dehydrogenase, superoxide dismutase and RNA polymerase etc. and also involved in nitrogen metabolism. It plays role in synthesis of plant growth substances and enzyme systems and is essential for promoting certain metabolic reactions. It is necessary for production of chlorophyll and carbohydrates. In cauliflower boron deficiency has been reported very frequently. Till the curd start developing, external symptoms of boron deficiency are not very apparent in most cases. In more advanced stages, pinkish or rusty brown areas develop on the surface of curd and hence, it is called brown rot or red rot and these types of curds develop bitter taste, which reduces the marketable quality of curd. Molybdenum is also very essential micronutrient for the better growth and development. It is an essential component of major enzyme nitrate reductase in the plant. It occurs in envelopes of chloroplast in leaves. As a result the leaf blade fails to develop properly and only the midrib portions develop resulting sword like appearance of leaves giving whiptail symptom. (Singh *et al.* 2017) <sup>[12]</sup>.

### Materials and Methods

The field trial was carried out in open field condition during *rabi* season of the year, 2017-18 at field of College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Dist. - Mehsana (Gujarat). The experiment was laid out in Randomized Block Design with factorial concept (FRBD) keeping two factor *viz.*, stage of application of micronutrients and micronutrients, the first factor with three stage of application of micronutrients *i.e.* at seedling stage (15 DAS), after transplanting (20 & 35 DAT), at seedling stage (15 DAS) and after transplanting (20 & 35 DAT) while second factor *i.e.* micronutrients with eight levels thus, making twenty four treatment combinations. Zinc, Boron and Molybdenum were applied in the form of zinc sulphate hepta hydrate, borex and ammonium molybdate, respectively. Spraying was done with micro sprayer and the leaves were wetted thoroughly with a fine mist. The variety Pusa Snowball k 1 of cauliflower was taken under investigation, the seeds of this variety were procured from IARI, Regional Station, Katrain (KulluValley). The seedlings of cauliflower cv. Pusa Snowball K 1 were transplanted after four weeks of seed sowing at 45×30 cm spacing. All the experiment plots received recommended dose of nitrogen (125 kg/ ha), phosphorus (50 kg/ha) and potassium (50 kg/ha) along with F.Y.M. (20 tones/ha). Full dose of phosphorus, potash and 50% of nitrogen were applied as basal dose. Rest of nitrogen was top dressed in two equal splits doses at 30 days intervals. Common cultural practices were used for the cauliflower production such as irrigation, weeding, blanching, fertilization...etc, according to recommended practices for cauliflower in the commercial fields. Five randomly selected plants were tagged in each plot and used for recording the observations of yield and quality attributes.

## Results and Discussion

### Yield Parameters

#### Effect of stage of micronutrient application and micronutrients on average weight of curd (kg)

The data pertaining to average weight of curd (kg) as influenced by different stage of micronutrient application and micronutrients are presented in Table 1. Data showed that the influence of different stage of micronutrient application and micronutrients on average weight of curd was found significant. The significantly maximum average weight of curd (0.75 kg) was recorded with micronutrient application at seedling stage and after transplanting stage ( $s_3$ ), which was statistically at par with  $s_2$ . Whereas minimum average weight of curd (0.70 kg) was recorded with micronutrient application at seedling stage ( $s_1$ ).

Inspection of data disclosed significant difference for average weight of curd with different levels of micronutrients application. Significantly maximum average weight of curd (1.01 kg) was recorded with application of Zn 1000 ppm + B 200 ppm + Mo 50 ppm treatment ( $m_7$ ). While minimum average weight of curd (0.52 kg) was found in no application of micronutrients. According to Lashkari *et al.* (2008) <sup>[4]</sup> zinc increases curd weight due to the improved physiological activities like photosynthesis, translocation of assimilates from leaves to curd and their storage in curd for which zinc was a responsible factor.

Perusal of data presented in Table 1 exhibited the not significant effect of interaction effect between different stage of micronutrient application and micronutrients with respect to average weight of curd.

#### Effect of stage of micronutrient application and micronutrients on yield per plot (kg)

The data regarding to yield per plot (kg) as influenced by different stage of micronutrient application and micronutrients are presented in Table 1. Data shows that the influence of different stage of micronutrient application on yield per plot was found significant. The significantly maximum yield per plot (10.18 kg) was recorded with micronutrient application at seedling stage and after transplanting stage ( $s_3$ ). Whereas, minimum yield per plot (9.64 kg) was recorded with micronutrient application at seedling stage ( $s_1$ ).

The revealed data disclosed significant difference for yield per plot (kg) with different levels of micronutrients. Significantly maximum yield per plot (12.15 kg) was recorded with application of Zn 1000 ppm + B 200 ppm + Mo 50 ppm treatment ( $m_7$ ). While, minimum yield per plot (8.22 kg) was found with no application of micronutrients ( $m_0$ ).

Further, view of data presented in Table 1. revealed that interaction effect of stage of micronutrient application and micronutrients was unable to exert statistically significant variation among different treatments.

#### Effect of stage of micronutrient application and micronutrients on yield/ hectare (t)

The data pertaining to yield per hectare (t) as influenced by different stage of micronutrient application and micronutrients are presented in Table 1. Data showed that the influences of different stage of micronutrient application on yield per hectare (t) were found significant. The significantly maximum yield per hectare (17.94t) was recorded with micronutrient application at seedling stage and after transplanting stage ( $s_3$ ).

Whereas, minimum yield per hectare (16.97t) was recorded with micronutrient application at seedling stage ( $s_1$ ). The repeated application of micronutrients like zinc increased plant activities in chlorophyll formation, it also influenced the cell division, meristematic activity of plant tissues and expansion of cell and formation of cell wall by active synthesis of aromatic amino acid *i.e.*, tryptophan, which is precursor of IAA and it is responsible to stimulate plant growth by cell elongation and cell division (Choudhary and Mukherjee, 1999) [2].

Inspection of data disclosed significant difference for yield per hectare (t) with different levels of micronutrient application. Significantly maximum yield per hectare (21.42 t) was recorded with application of Zn 1000 ppm + B 200 ppm + Mo 50 ppm treatment ( $m_7$ ). While minimum yield per hectare (14.49 t) was found with treatment of no application of micronutrients ( $m_0$ ). Improvement in yield characters as a result of foliar application of micronutrients might be due to the foliar application of combined nutrients consist Zn, which accelerated and stimulated the physiological forms and

functions of cell, tissue and whole plant resulted in increase the yield parameters of cauliflower. Promotive effects of molybdenum on vegetative growth which ultimately lead to more photosynthesis activities while, application of boron, enhanced carbohydrate and nitrogen metabolism of pectic substances. Molybdenum had significant effect on yield characters may be due to the increase of the estimated attributed in leaves. In addition, the promotion in plant weight reflected in a significant increase of curd yield. Furthermore the stimulatory effect of molybdenum application could be due to the increase of the metabolic pools required for the synthesis of saccharides, along with the enhanced photosynthetic capacity (Mohamed El-Sayed Ahmed *et al.* 2011) [7]. These finding corroborate with the result obtained by Mehrotra and Mishra (1974) [6] in cauliflower. Sharma *et al.* (2005) [10], Nandi and Nayak (2008) [8] in cabbage.

The interaction between different stage of micronutrient application and micronutrients exhibited not significant difference with respect to yield per hectare.

**Table 1:** Effect of stage of micronutrient application and micronutrients on average weight of curd (kg), yield per plot (kg) and yield per hectare (t)

Micronutrients (M) (ppm)	Average weight of curd (kg)				Yield per plot (kg)				Yield per hectare (t)			
	Stage of micronutrient application (S)			Mean	Stage of micronutrient application (S)			Mean	Stage of micronutrient application (S)			
	( $s_1$ )	( $s_2$ )	( $s_3$ )		( $s_1$ )	( $s_2$ )	( $s_3$ )		( $s_1$ )	( $s_2$ )	( $s_3$ )	
$m_0$ : Zn 0+ B 0 + Mo 0	0.48	0.50	0.56	0.52	8.56	8.17	7.95	8.22	14.40	15.08	14.01	14.49
$m_1$ : Zn 0 + B 0 + Mo 50	0.56	0.63	0.64	0.61	8.21	8.81	8.56	8.56	15.52	14.48	15.25	15.08
$m_2$ : Zn 0 + B 200 + Mo 0	0.58	0.67	0.66	0.64	8.59	9.27	8.53	8.80	16.34	15.15	15.03	15.51
$m_3$ : Zn 0 + B 200 + Mo 50	0.64	0.69	0.69	0.67	9.37	9.45	9.49	9.44	16.65	16.52	16.72	16.63
$m_4$ : Zn 1000 + B 0 + Mo 0	0.66	0.73	0.72	0.71	9.65	9.78	10.56	10.00	17.24	17.01	18.62	17.62
$m_5$ : Zn 1000 + B 0 + Mo 50	0.73	0.77	0.90	0.80	10.15	9.74	11.07	10.32	17.17	17.90	19.51	18.20
$m_6$ : Zn 1000 + B 200 + Mo 0	0.90	0.88	0.89	0.89	11.01	10.26	11.97	11.08	18.08	19.40	21.11	19.53
$m_7$ : Zn 1000 + B 200 + Mo 50	1.05	1.00	0.97	1.01	11.54	11.72	13.19	12.15	20.34	20.66	23.25	21.42
Mean	0.70	0.73	0.75		9.64	9.65	10.18		16.97	17.03	17.94	
	S	M	Interaction (S x M)		S	M	Interaction (S x M)		S	M	Interaction (S x M)	
S.Em.±	0.02	0.02	0.04		0.16	0.26	0.45		0.29	0.47	0.82	
C.D. at 5%	0.04	0.07	NS		0.45	0.74	NS		0.83	1.35	NS	
C. V. (%)	10.02				7.91				8.20			

S: Stage of application of micronutrients

M: Micronutrients

$s_1$ : At seedling stage (15 DAS)

$s_2$ : After transplanting (20 & 35 DAT)

$s_3$ : At seedling stage (15 DAS) and after transplanting (20 & 35 DAT)

## Quality Parameters

### Effect of stage of micronutrient application and micronutrients on B content (ppm)

Data revealed that the influence of different stage of micronutrient application found significant with respect to B content. Significantly maximum B content (34.12 ppm) was

recorded with micronutrient application at seedling stage and after transplanting stage ( $s_3$ ). Whereas, minimum B content (28.35 ppm) was found with micronutrient application at seedling stage ( $s_1$ ). This result was in conformity with result of Mehraj *et al.* (2015) [5] in okra.

**Table 2:** Effect of stage of micronutrient application and micronutrients on B content (ppm)

Micronutrients (M) (ppm)	B content (ppm)			
	Stage of micronutrient application (S)			Mean
	( $s_1$ )	( $s_2$ )	( $s_3$ )	
$m_0$ : Zn 0+ B 0 + Mo 0	20.64	24.72	30.27	25.21
$m_1$ : Zn 0 + B 0 + Mo 50	22.52	29.80	34.69	29.00
$m_2$ : Zn 0 + B 200 + Mo 0	32.11	34.83	35.70	34.22
$m_3$ : Zn 0 + B 200 + Mo 50	31.93	33.00	33.60	32.84
$m_4$ : Zn 1000 + B 0 + Mo 0	23.89	25.02	24.31	24.40
$m_5$ : Zn 1000 + B 0 + Mo 50	29.46	32.27	29.97	30.56
$m_6$ : Zn 1000 + B 200 + Mo 0	32.06	35.46	43.71	37.10
$m_7$ : Zn 1000 + B 200 + Mo 50	34.15	37.13	40.69	37.32
Mean	28.35	31.53	34.12	
	Stage of application (S)		Micronutrient (M)	Interaction (S x M)
S.Em.±	0.68		1.10	1.91
C.D. at 5%	1.92		3.13	NS
C. V. (%)	10.56			

Data revealed that an influence of micronutrients on B content was found significant. The maximum B (37.32 ppm) was obtained from the application of Zn 1000 ppm + B 200 ppm Mo 50 ppm treatment (m<sub>7</sub>). The treatment m<sub>7</sub> was found statistically at par with treatment m<sub>6</sub>. While minimum B (25.21 ppm) was observed with no application of micronutrients (m<sub>0</sub>). It might be due to interaction effect of micronutrient mixture which enhance the mineral absorption and root growth. These findings corroborate with the result obtained by Shabir (2003) <sup>[9]</sup> and Khadka *et al.* (2005) <sup>[3]</sup> in cauliflower.

Inspection of data showed not significant interaction effect between stage of micronutrient application and micronutrients for B content.

### Conclusion

On the basis of experiment evidences, maximum yield and better quality from cauliflower cultivation during *rabi* season can be harvested with micronutrient application at seedling stage (15 DAS) as well as 20 and 35 DAT and micronutrients Zn 1000 ppm + B 200 ppm + Mo 50 ppm should be applied.

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