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Influence of micronutrients on growth and yield of cauliflower

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Abstract
An experiment was conducted in the Department of Horticulture, Birsa Agricultural University, Ranchi, during 2018. The soil of the experimental site was sandy loam with pH 6.2. The treatments comprised of foliar application of individual and combined nutrients *viz.* Boron, Molybdenum, Manganese and Zinc. The experiment was laid out in Randomized Block Design and replicated thrice. The variety used was "Hajipur Early". All the treatments uniformly received 120 kg N, 80 kg P_2O_5 and 50 kg K_2O per hectare. Results revealed that plant height, number of leaves per plant, stem length, stem diameter, plant spread, leaf area index and marketable yield of cauliflower, all were found significantly higher in the combined foliar application of 0.2% Borax + 0.5% Manganese sulphate + 0.1% Ammonium molybdate.

Keywords: Borax, manganese sulphate, ammonium molybdate, hajipur early

Introduction
Cauliflower (*Brassica oleracea* L. var. *botrytis*) represents Cruciferae family is one of the important vegetable among cole crops grown in India. It is highly valued for its compact and white curds. Cauliflower in general and variety "Hajipur early" particularly is heavy a feeder of nutrients. In Jharkhand, the soil of Ranchi district is acidic in nature with pH ranging 6.2. The cultivated area of cauliflower under Indian region is 452 thousand hectare with total production of 8499 thousand MT in 2016-17 (Anonymous, 2017) [1].
Although micronutrient is required in very less amount but it is as important as macronutrients, the micronutrients play important role in growth and yield of cauliflower, required in trace amount still plays important role.
Boron is essential in cell division since it is the constituent of cell membrane. In case of boron deficiency in cauliflower the process of cell division get ceased at the growing point of the plant which leads to many disorders like hollow stem and browning (Singh, 1991) [13]. It is also related to buffer action, precipitation of cation and maintenance of conductivity in cell of the plant system, it also influence the absorption of nitrogen (Singh, 1991) [13], regulates metabolism intricate in translocation of carbohydrates, cell wall development and synthesis of RNA. (Narayanamma *et al.*, 2007) [11]. Manganese is in conjunction with Fe metabolism, plays significant roles in respiration and chloroplast structure (Singh *et al.*, 2018) [14]. Manganese is also crucial for chlorophyll formation in photosynthesis, nitrate assimilation and various enzymatic activities. Elkhatib (2009) [3] and Chahal and Chahal (1991) [2] claimed that foliar applications of molybdenum stimulated nodulation and biological nitrogen fixation, thus improving the plant growth. (Ahmed *et al.* 2011) [9]. Therefore, the present investigation was conducted with a view to study the effect of boron, manganese and molybdenum individually and in their combinations on the growth and yield of cauliflower.

Materials and method
A field experiment was conducted during summer season in 2018 in the Deptartment of Horticulture, Birsa Agricultural University, Kanke, Ranchi. The experiment was carried out from the first week of March to second week of June in a randomized block design having cultivar "Hajipur Early" with three replications, in a plot size of 3m X 3m. The crop was raised with a spacing of 40cm X 40cm by following all recommended package of practices except the foliar application of micronutrients. The soil of the experimental plot was sandy loam with pH 6.2 The observations on growth was recorded at 30 days interval and yield observations were recorded at harvest of the crop. The experimental plots were irrigated at regular interval, weeds were kept at check and the seedlings were kept healthy by spraying pesticides as and when required.

In the present investigation the micronutrients *viz.* boron, manganese and molybdenum were applied in the form of 0.2% Borax, 0.5% Manganese sulphate and 0.1% Ammonium molybdate respectively individually and in combinations. Hence the experiment was laid out in randomized block design replicated thrice. The data collected was analysed by statistical method suggested by Gomez and Gomez (1984) [4].

Result and discussion

Effect of micronutrients on growth

The foliar application of micronutrients on 15, 45 and 75 days have positive effect on plant growth like number of leaves, plant height, stem length, stem diameter, plant spread and leaf area index of cauliflower. The result showed that there is significant increase in number of leaves per plants, stem length, stem diameter and leaf area index. The maximum number of leaves recorded was 19.10 leaves, maximum plant height was 31.16 cm, maximum stem length and stem diameter observed was 17.65 cm and 3.32 cm respectively likewise maximum plant spread recorded was 4354.82 cm^2 and maximum leaf area index was 303.52 cm^2.

Effect of micronutrients on yield of cauliflower

The foliar application of micronutrients on 15, 45 and 75 days shows significant increase in yield the maximum yield obtained was 10.52 kg/plot in treatment combination of 0.2% Borax + 0.5% Manganese sulphate + 0.1% Ammonium molybdate whereas the minimum yield was recorded in control 6.50 kg/plot where only water was sprayed.

Increase in number of leaves, plant height, stem length, stem diameter, plant spread, leaf area index and yield are positive effects. These micronutrients plays vital role in growth and development and their effects are concerned with particular characteristics or features like molybdenum is required for plant growth. This could be the result of availability of required quantity of essential plant nutrients at various growth stages leading to hastening the metabolic processes of plant that might have resulted in production of more number of leaves in this treatment. Similar results were also reported by Naryanamma *et al.* (2007) [11], Yadav *et al.* (2009) [16], Sitapara *et al.* (2011) [15] and Kumar *et al.* (2012) [8]. Boron helps in cell elongation, cell differentiation and carbohydrate translocation and molybdenum is component of several enzymes, including nitrogenase and nitrate reductase both of which participate in nitrogen metabolism. Both of them lead to better growth and development of crop. The treatments applied led to increase in plant height and stem length, which may be due to pronounced effect of micronutrient especially boron that accelerate net photosynthesis, protein synthesis, dry matter content as well as growth and yield of crop (Kalewar *et al.* 1993; Hemantranjan, 1982) [6, 5]. Similar effect was also observed by Singh (2004) [12], who reported that boron exhibited the pronounced effect in improving the vegetative growth of the plant, maximum stalk length was noted with the application of borax (10 kg/ha) as soil application. The reason behind this trend of plant spread and leaf area index may be due to the fact that abundant supply of available micronutrients resulted in comparatively less retention in the roots and more translocation to aerial parts for synthesis of protoplasmic proteins and other metabolites enabling the expansion of photosynthetic area, hence the spread. The similar results were also obtained in the finding of Kanujia *et al.* (2006) [7] and Naryanamma *et al.* (2007) [11]. Boron also plays vital role in this as it is a constituent of cell membrane and is essential for cell division. In case of boron deficiency, cell division ceases at the growing point, which especially leads to disorder in cauliflower like hollow stem and browning (Singh, 1991) [13]. It is also concerned with the precipitation of excess cations, buffer action and maintenance of conduction tissue and also helps in absorption of nitrogen (Singh, 1991) [13]. The contribution of foliar application of different micronutrient mixture to increase in yields can be attributed to the enhanced availability of essential plant nutrients at the required growth stages, which, increased rate and efficiency of metabolic activities resulting in high assimilation of proteins and carbohydrates, which in turn helped in better nutrient absorption by plants resulting in better yields. The results obtained corroborated with the reports of Kanujia *et al.* (2006) [7], Nandi and Nayak (2008) [10] and Yadav *et al.* (2009) [16].

Conclusion

The results indicate that the foliar application of combined micronutrients at 15, 45 and 75 days after sowing positively influenced the growth and yield of cauliflower. Based on the results obtained it can be concluded that for getting higher yield and good vegetative growth of the crop foliar application of 0.2% Borax+ 0.1% Ammonium molybdate + 0.5% Manganese sulphate at 15, 45 and 75 days after sowing may be done.

Table 1: Effect of micronutrients on no. of leaves, plant height, stem length, stem diameter, plant spread, leaf area index and yield of cauliflower

T. No.	Treatments	No. of leaves	Plant height (cm)	Stem length (cm)	Stem diameter (cm)	Plant spread (cm^2)	Leaf area index (cm^2)	Yield (kg/plot)
T1	B	11.51	28.24	14.53	2.4	3831.2	204.14	7.88
T2	Mo	11.99	27.85	14.46	2.91	3939.4	210.43	7.51
T3	Mn	11.26	26.78	13.39	2.58	3899.4	212.88	7.77
T4	B+ Mo	12.9	30.11	15.22	3.09	4065.8	243.43	8.09
T5	B+Mn	12.66	30.49	14.37	3.67	4255.3	278.38	8.02
T6	Mo+ Mn	14.17	29.2	14.9	3.16	4099.4	262.41	8.01
T7	B+Mo+Mn	19.1	31.16	17.65	3.32	4354.8	303.52	10.52
T 0	Control	9.45	22.16	12.87	2.05	3068.9	209.24	6.5
	Sem ±	0.77	1.77	0.97	0.17	248.15	16.68	0.71
	CD (0.05)	2.32	5.36	2.94	0.52	752.63	50.6	2.17
	CV (%)	10.29	10.82	11.42	10.19	10.91	12.01	15.38

B = 0.2% Borax, Mo = 0.1% Ammonium molybdate, Mn = 0.5% Manganese sulphate

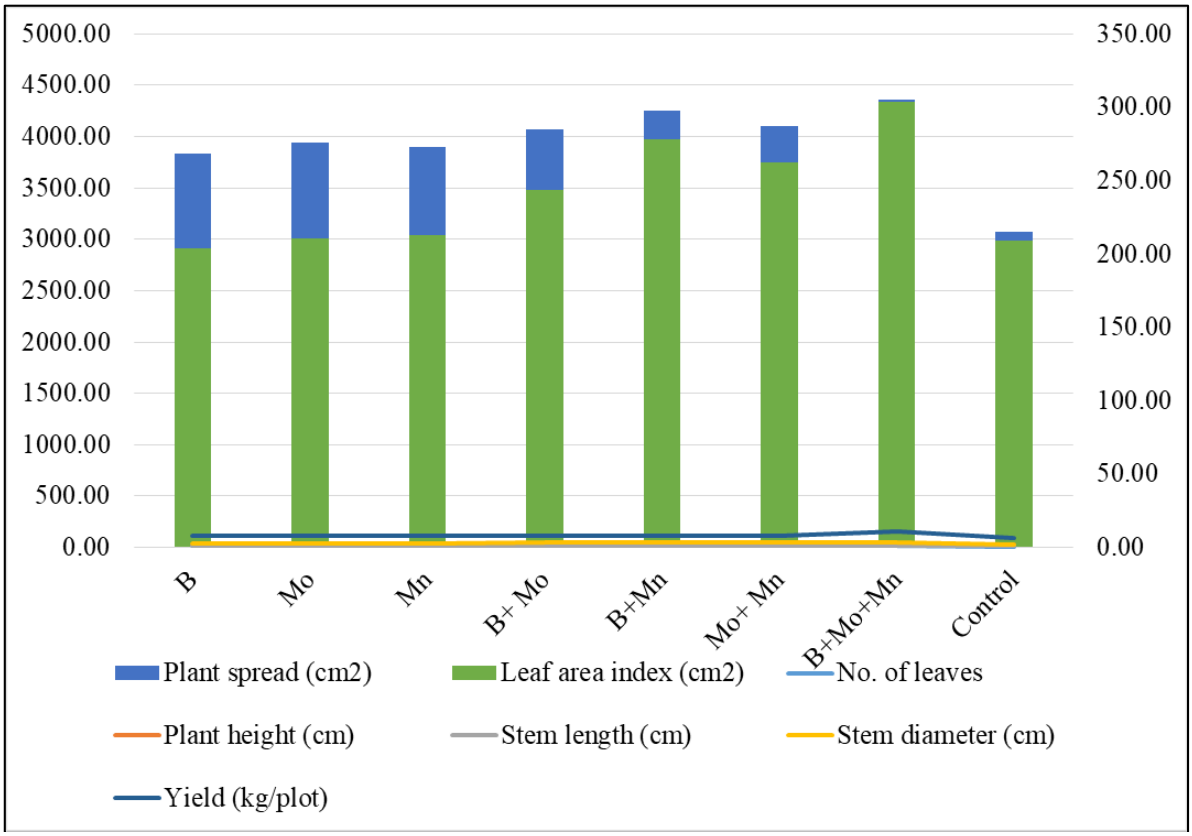

Fig. 1: Influence of micronutrient on growth and yield of cauliflower

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