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Influence of nitrogen levels and micronutrients on growth and yield parameters on cauliflower (*Brassica oleracea* var. *botrytis*)

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Abstract
The present research work entitled “Influence of nitrogen levels and micronutrients on growth and yield parameters on Cauliflower (*Brassica oleracea* var. *botrytis*) conducted at the Guru Kashi University Research Farm during the rabi season of the year 2023-2024 to find out the response of combination of nitrogen (0, 25, 40, 50, 60 and 70 kg/acre) with 100 ppm Boron and 50 ppm molybdenum. The experiment was consisted six treatment combinations and was laid out in Randomized Block Design (RBD) with four replications. Maximum plant height (72.75 cm) and breadth of leaf (23.50 cm) was recorded from 40 kg N / acre +100 ppm B + 50 ppm Mo in cauliflower. The maximum plant height (28.47 cm), highest leaf length (47.75 cm), the number of leaves per plant (22.75), equatorial diameter (18.47 cm), polar diameter (18.62 cm), weight without folded leaves (800.75 gm), curd yield/plot (15.17 kg) and total yield 117.85 (q/acre) in cauliflower was observed in treatment 50 kg N /acre +100 ppm B + 50 ppm Mo.

Keywords: Cauliflower, micronutrients, nitrogen, boron, molybdenum

Introduction
Cauliflower, scientifically known as *Brassica oleracea* L. var. botrytis, is a thermosensitive crop belonging to the Cruciferae family. It is commonly referred to as "Phul gobhi" in India. The introduction of cauliflower to India dates back to 1822 when Dr. Jemson brought it from England. The crop's domestication traces back to the coastal areas of the Mediterranean Sea. Cauliflower has a chromosome number of 2n=18 and derives its name from the Latin words 'caulis,' meaning stem, and 'floris,' meaning flower. India holds the top position globally in cauliflower production. The ancestor of cauliflower is *Brassica cretica*. Indian varieties of cauliflower have been developed through intercrossing between Cornish and European types (Muthukumar and Selvakumar, 2017) [4].

The consumable part of cauliflower is the "Curd," composed of closely packed flower buds that are not fully developed. These buds are connected to fleshy stalks, which store most of the nutrients needed for their development. A key characteristic of the Cruciferae family is the presence of six stamens two short, four long and four petals arranged opposite each other in a square cross-section. Cauliflower produces a special type of pod called a siliqua.

Cauliflower is rich source of minerals and vitamins. It provides good quantity of Vitamin C and folate. Cauliflower has moisture content approx. 90%, protein 2.6 g. fat 0.4 g, thiamine 0.04 mg, riboflavin 0.10 mg per 100 g. It has 53 mg Sodium, 57 mg Phosphorus, 138 mg Potassium, 33 mg Calcium, 18 mg Magnesium, 0.4 mg Zinc, 1.23 mg Iron, 231 mg Sulfur, 0.003 mg Chromium, 0.13 mg Copper per 100 g. Vitamins includes 30 mg Carotene, 0.04 mg Thiamine, 0.1 mg Riboflavin, 1 mg Niacin per 100 g. Total carbohydrates are 4 K. Cal. (Dhaliwal 2017) [2].

It’s a well-known fact that a crop when sown at optimum time is able to exploit all the environment factors efficiently in the process of dry matter accumulation. The date of sowing is governed mainly by temperature, sunlight intensity, duration and rainfall. These are the crucial factors that can decide establishment, growth and performance of crop through changing morphological system, physiological functioning and time available for the

crop to complete its life cycle. Seeds of cauliflower are produced in the country in a small scale but the maximum amount of seeds of cauliflower is imported from other countries. Cauliflower requires optimum temperature and humidity conditions for seed production. The optimum temperature for cauliflower withstands is 10 to 15 °C (Din *et al*., 2007) [1]. Lavanya *et al*., (2014) [3] recommended that optimum temperature is suitable treatment combination for higher yield. The present study was undertaken to evaluate the effect of different sowing dates on the growth and yield characteristics of cauliflower and broccoli with objectives:

1. To evaluate the effect of nitrogen for growth and yield parameters of cauliflower.
2. To evaluate the micronutrients (Boron & molybdenum) for growth and yield parameters of cauliflower.

Materials and Methods

The present research work entitled "Influence of nitrogen levels and micronutrients on growth and yield parameters on Cauliflower (*Brassica oleracea* var. *botrytis*) was carried out in the winter of 2023–2024 at the Talwandi Sabo (Bathinda) experimental site of the Guru Kashi University Research Farm. The experiment was consisted seven treatment combinations, and was laid out in Randomized Block Design (RBD) with four replications. The whole experimental area was divided into four equal blocks. Each block was then further divided into six plots. A distance of 45 cm X 30 cm is maintained between row to row and plant to plant within the each plot (2.5 x 2.5=5 $m^{2)}$. Total area for experiment was 280 m^2. The blocks were kept to facilitate different intercultural operations. The crop was raised by following the package of practice recommended by PAU, Ludhiana. The observations were recorded in cauliflower *viz.* Plant height (cm), Number of leaves per plant (no), Leaf length (cm), Breadth of leaves (cm), Equatorial diameter of curd (cm), polar diameter of curd (cm), fresh weight of curd (gm), Curd yield / plot (kg) and yield (q/ acre).

Treatments Detail

- Control
- 25 kg N/acre +100 ppm B + 50 ppm Mo
- 40 kg N/acre +100 ppm B + 50 ppm Mo
- 50 kg N/acre +100 ppm B + 50 ppm Mo
- 60 kg N/acre +100 ppm B + 50 ppm Mo
- 70 kg N/acre +100 ppm B + 50 ppm Mo

Results and Discussion

Data relating to the various growth, yield and quality characteristic of cauliflower and was subjected to statistical analysis for interpretation of result. The data recorded for important characters have also been presented graphically for elucidation of the important trends, wherever, necessary.

Plant height (cm)

Plant height significantly affected by the nitrogen levels and micronutrients (Table II). But maximum plant height (72.75 cm) was recorded from 40 kg N /ha acre +100 ppm B + 50 ppm Mo and followed by treatment from 50 kg N /ha acre +100 ppm B + 50 ppm Mo with plant height 61.25 cm. While, minimum plant height (47.50 cm) was observed in control treatment was applied. Moniruzzaman *et al.* (2007) [5], Moreover, boron took part in sugar translocation which might be lead to the increased height of plant.

Leaf length (cm)

The highest leaf length (47.75 cm) was observed in treatment 50 kg N /ha acre +100 ppm B + 50 ppm Mo which was statically at par with the leaf length (46.00 cm) in 40 kg N /ha acre +100 ppm B + 50 ppm Mo, 43.50 cm leaf length in treatment 60 kg N /ha acre +100 ppm B + 50ppm Mo and 43.25 cm leaf length in treatment 70 kg N /ha acre +100 ppm B + 50 ppm Mo, Lowest leaf length was noted in control treatment 33.75 cm leaf length.

Breadth of leaf (cm)

Data in Table I revealed that breadth of leaf increased significantly due to different nitrogen and micronutrients treatments. The breadth of leaf 23.50 cm significantly maximum shown by 40 kg N /ha acre +100 ppm B + 50 ppm Mo and followed by 70 kg N /ha acre +100 ppm B + 50 ppm Mo with breadth of leaf 20.25 cm. Lowest was noted in 25 kg N /ha acre +100 ppm B + 50 ppm Mo, treatment with 17.75 cm reading.

Table 1: Influence of nitrogen levels and micronutrients on Plant height (cm), length of leaf and breadth of leaf cm) of Cauliflower (*Brassica oleracea* var. *botrytis*)

Treatment	Plant Height (cm)	Length of Leaf (cm)	Breadth of Leaf (cm)
Control	47.5	33.75	20.5
25 kg N/acre +100 ppm B + 50 ppm Mo	47.75	40.25	17.75
40 kg N/acre +100 ppm B + 50 ppm Mo	72.75	46	23.5
50 kg N/acre +100 ppm B + 50 ppm Mo	61.25	47.75	19.25
60 kg N/acre +100 ppm B + 50 ppm Mo	47.5	43.5	19.75
70 kg N/acre +100 ppm B + 50 ppm Mo	57	43.25	20.25
C D at 5%	7.609	4.382	2.814
SE(m)	2.502	1.44	0.925
SE(d)	3.538	2.037	1.308
C.V.	8.994	6.792	9.173

Number of leaves per plant (No.)

A scrutiny of data in table III reflects that for the number of leaves per plant was recorded significantly highest 22.75 under 50 kg N /ha acre +100 ppm B + 50 ppm Mo and 22.00 number of leaves per plant followed by 40 kg N /ha acre +100 ppm B + 50ppm Mo treatment. Lowest values for number of leaves per plant was recorded in control treatment (20.25).

Equatorial diameter (cm)

Data in Table III revealed that equatorial diameter increased significantly due to different nitrogen and micronutrients treatments. Significantly maximum equatorial diameter 18.47 cm was recorded in treatment 50 kg N /ha acre +100

ppm B + 50 ppm Mo and followed by 40 kg N /ha acre +100 ppm B + 50 ppm Mo 150 kg N/ha with 16.57 cm equatorial diameter. Lowest equatorial diameter 13.32 cm was recorded in control treatment.

Polar diameter (cm): Significantly maximum polar diameter 18.62 cm was recorded in 50 kg N /ha acre +100 ppm B + 50 ppm Mo treatment and at par by 40 kg N /ha acre +100 ppm B + 50 ppm Mo 100 kg N/ha treatment with 17.52 cm polar diameter. Lowest polar diameter 13.25 cm was recorded in treatment.

Table 2: Influence of nitrogen levels and micronutrients on No of Leaves per plant, Equatorial diameter of curd (cm) and Polar Diameter of curd (cm) of Cauliflower (*Brassica oleracea* var. *botrytis*)

Treatment	No of Leaves per plant	Equatorial diameter of curd	Polar Diameter of curd
Control	22.25	13.325	13.25
25 kg N/acre +100 ppm B + 50 ppm Mo	20.25	15.55	15.325
40 kg N/acre +100 ppm B + 50 ppm Mo	22	16.575	17.525
50 kg N/acre +100 ppm B + 50 ppm Mo	22.75	18.475	18.625
60 kg N/acre +100 ppm B + 50 ppm Mo	20.75	16.4	16.75
70 kg N/acre +100 ppm B + 50 ppm Mo	20.5	16.25	17.25
C D at 5%	N/A	0.842	1.129
SE(m)	1.345	0.277	0.371
SE(d)	1.902	0.392	0.525
C.V.	12.558	3.441	4.512

Fresh weight of curd (gm)

The analysis of variance depicted significant (p<0.05) effect of varying nitrogen and micronutrients doses on the weight of cauliflower head without folded leaves. The cauliflower plants produced head with maximum weight without folded leaves (800.75 gm) when fertilized with 50 kg N /ha acre +100 ppm B + 50 Mo treatment, closely followed by 726.25 gm weight of head without folded leaves, recorded in crop receiving 60 kg N /ha acre +100 ppm B + 50 Mo. However, the weight of head without folded leaves in cauliflower was lowest (413.75 gm) in plots with control treatment. It was observed that the weight of head without folded leaves increased successively with each increment in nitrogen and micronutrients and this trend was mainly associated with the plant height and head diameter.

Curd yield/plot (Kg)

The perusal of data indicated that all the treatment increased the curd yield/plot (Kg). Significantly maximum curd yield/plot 15.17 kg was recorded in 50 kg N /ha acre +100 ppm B + 50 Mo and at par by 60 kg N /ha acre +100 ppm B + 50 Mo with 13.75 kg curd yield/plot. Lowest curd yield/plot 7.80 kg recorded in control treatment.

Curd Yield (q/acre)

Data indicated that all the treatment increased the curd yield (q/acre). Significantly maximum total yield 117.85 (q/acre) was recorded in 50 kg N /ha acre +100 ppm B + 50 Mo treatment and at par by 60 kg N /ha acre +100 ppm B + 50 Mo 150 kg N/ha treatment with curd yield 113.67 (q/acre). Lowest curd yield 61.65 (q/acre) recorded in control treatment.

Table 3: Influence of nitrogen levels and micronutrients on Fresh weight of curd (gm), Curd yield per plot (Kg) and Curd yield per acre (q) of Cauliflower (*Brassica oleracea* var. *botrytis*)

Treatment	Fresh weight of curd (gm)	Curd yield per plot (Kg)	Curd yield per acre (q)
Control	413.75	7.8	61.653
25 kg N/acre +100 ppm B + 50 ppm Mo	435.25	8.2	63.595
40 kg N/acre +100 ppm B + 50 ppm Mo	612	11.55	90.365
50 kg N/acre +100 ppm B + 50 ppm Mo	800.75	15.175	117.85
60 kg N/acre +100 ppm B + 50 ppm Mo	726.25	13.75	104.675
70 kg N/acre +100 ppm B + 50 ppm Mo	663	12.525	97.45
C D at 5%	16.286	0.31	4.202
SE(m)	5.354	0.102	1.381
SE(d)	7.572	0.144	1.954
C.V.	1.76	1.774	3.095

Conclusion

In conclusion the salient findings of the present study, entitled "Influence of nitrogen levels and micronutrients on growth and yield parameters on Cauliflower (*Brassica oleracea* var. *botrytis*)" clearly indicates that significant variation having maximum yield, was recorded in the treatment receiving 50 kg nitrogen acre in combination with 100 ppm Boron and 50 ppm Molybdenum spray shows maximum result in cauliflower.

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