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Effect of Fertility Levels and Boron on Vegetative Growth Parameters of Cauliflower (*Brassica oleracea* var *botrytis* L.) under Lucknow Conditions

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ABSTRACT

The field experiment was conducted during rabi season of 2018-19. The experiment comprised of 16 treatment combinations with four levels of each fertility levels (Control, 100% RDF through inorganic fertilizers, 75% RDF through inorganic fertilizers +25% through VC and 50% RDF through inorganic fertilizers + 50% through VC) and boron levels (Control, 1.5 kg/ha, 2 kg/ha and 2.5 kg/ha) in Randomized Block Design with three replications. The application of 75% RDF through inorganic fertilizers + 25% through VC resulted in the maximum and significantly more values of growth attributes viz., plant height (25.46 cm and 55.63 cm at 30 and 60 DAT), number of leaves (12.11 and 22.03 at 30 and 60 DAT), length of leaf (20.57 cm and 33.25 cm at 30 and 60 DAT), width of leaf (11.07 cm and 31.92 cm at 30 and 60 DAT), diameter of stem (1.14 cm and 2.26 cm at 30 and 60 DAT), plant spread (16.21 cm and 42.50 cm at 30 and 60 DAT), as compared to control. Similarly, the application of 2.5 kg zinc ha^{-1} resulted in the maximum and significantly more values of growth attributes viz., plant height (24.24 cm and 53.78 cm at 30 and 60 DAT) and number of leaves per plant (12.32 and 22.28 at 30 and 60 DAT), length of leaf (21.54 cm and 34.11 cm at 30 and 60 DAT), width of leaf (10.78 cm and 33.18 cm at 30 and 60 DAT), stem diameter (1.14 cm and 2.32 cm at 30 and 60 DAT), plant spread (16.16 cm and 42.08 cm at 30 and 60 DAT). It is recommended for higher production of cauliflower under Lucknow conditions.

Keywords Cauliflower, Growth, Fertility level, Boron.

INTRODUCTION

Cauliflower (*Brassica oleracea* var *botrytis* L.) belongs to family Cruciferae. It is one of the most important winter vegetable grown widely. It is being grown round the year for its white and tender curd. It is widely cultivated all over India and Abroad for its special nutritive values, high productivity and wider adaptability under different ecological conditions. Cauliflower was introduced from England to India in 1822 by Jemson, incharge of company Bagh, Saharanpur Uttar Pradesh. In India, two separate groups of cauliflower are commonly grown viz. Indian or

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tropical types (originate in India) and temperate type also known as snowball type. The typical Indian or tropical cauliflowers have been developed from inter-crossing of Cornish type (biennial) with European strains. These have more variability and strong self-incompatible. Whereas temperate types have less variability with less or no-self-incompatible.

Cauliflower has small thick stem, bearing whorl of leaves and branched tap root system. The main point develops into shortened shoot system whose apices make up the convex surface of curd. It is used as fried as well as dried vegetable, soup and pickles. It is a rich source of nutrient including vitamin-A (51 IU), vitamin-C (56 mg), riboflavin (0.10 mg), thiamin (0.04 mg), nicotinic acid (1.0 mg), calcium (33 mg), phosphorus (57 mg), potassium (138 mg), moisture (90.8 g), carbohydrates (4.0 g), protein (2.6 g), fat (0.4 g), fiber (1.2 g) and iron (1.5 mg) as per 100 g of edible portion of cauliflower (Fageria et al. 2012).

India is the largest producer of cauliflower in the world. It is grown commercially on an area of about 433.9 lakh hectares with an annual production 85.73 lakh tones and productivity of 19.8 MT/ha in India (Anonymous 2017). In India, major cauliflower growing states are West Bengal, Bihar, Orissa, Uttar Pradesh, Assam, Haryana, Maharashtra and Rajasthan. The yield of cauliflower is directly influenced with manuring and fertilization. Being heavy feeder crop, balanced fertilization is very important for better productivity. Cauliflower is a heavy feeder of mineral elements and it removes large amount of macro-nutrients from the soil. It was reported that an yield of 50 tones removes approximately 200kg of N, 85 kg of P_2O_5 and 220 kg K_2O per ha. Thus, a major constraint in increasing crop yields is the supply of nutrients. It is evident that without use of macro and micro nutrients, not possible to get the maximum benefit in cauliflower. Nitrogen could increase production of cauliflower, but the curd quality is affected by high nitrogen contents with deficits of other nutrients could reduce the storage life of cauliflower and buttoning. Both the higher doses and lower doses of nitrogen may affect the curd yield of cauliflower. Hence, an adequate supply of nitrogen is extremely important to maintain optimum growth and yield. phosphorus is indispensable constituent of nucleic acid, phosphoric acid and several enzymes. It is also needed for the transfer of energy within the plant system and has beneficial effect on early root development, plant growth and quality of produce. So, an adequate supply of phosphorus in early stage of plant life is an important in laying down the primordial for the reproductive parts of the cauliflower. It is also an essential constituent for majority of enzymes which is the great important in transformation of energy in carbohydrate and fat metabolism and also in respiration in plants. Likewise, potassium also play vital role in crop productivity. It imparts increased vigour and disease resistance to plant and function as in activator of numerous enzymes. It also regulates water conduction within the plant cell and water loss from the plant by maintaining the balance between anabolism, respiration and transpiration. Thus, reduces tendency to wilt and help in better utilization of available water which ultimately help in the formation of protein, chlorophyll and quality (Rutkauskiene and Poderys 1999). Besides macro nutrients like NPK, micro nutrients are also having great importantnce for growth and production of cauliflower. Boron is also an essential plant micro nutrient for a constituent of cell membrane and essential for cell division. Deficiency of boron causes abnormal cell division at the points which especially lead to disorder like hollow stem in cauliflower. Boron is also concerned with the precipitation of excess cation, buffer action, maintenance of conducting tissues and help in absorption of nitrogen. Its primary role is concerned with metabolism both uptake and its efficient use in plants. Boron also affect the cambial and phloem tissues of storage root or stem apical meristems and leaves, vascular cambia of fruits and other organs which are capable of meristematic activities (Singh 1991).

MATERIALS AND METHODS

The present investigation "Effect of fertility levels and boron on vegetative growth parameters of cauliflower (*Brassica oleracea* var *botrytis* L.) under Lucknow conditions" as conducted at Horticultural Research Farm-I of the Department of Horticulture, Babasaheb Bhimrao Ambedkar University (A Central University), Vidya Vihar, Raebareli Road, Lucknow, UP, India during *rabi* season of 2018—19. The seed of cauliflower variety Pusa Snowball K-1 were sown

on nursery beds of Horticulture Research Farm, BBAU, Lucknow, through broadcasting methods on two raised nursery beds of 3 × 1 × 0.15 m size were prepared by mixing well rotten farm yard manure in soil at the rate of 15 kg per square meter. Seeds were treated with 0.02% thiram to check the infection of damping off. Seeds were sown on 12th October, 2018 in shallow furrows 5-6 cm apart by dropping the seeds at 1-2 cm depth. A thin layer of powdered leaf mould was applied to cover the seed. Regular watering, hoeing, weeding, plant protection measures, were done time to time. The seedlings were ready for transplanting within five-six weeks. Five plants were randomly selected and tagged before flowering from each line to recorded the data on the following attributes. The observations were record on plant height, number of leaves per plant, width of leaves (cm), length of leaves (cm), stem diameter (cm), days taken to curd initiation, plant spread (cm). Least significant difference at 5% level was used for finding the significant differences among the treatment means. The data obtained from selected plants were subjected to analysis of variance (Panse and Sukhatme 1961).

RESULTS AND DISCUSSION

Growth characters

Effect of fertility levels

The results of present investigation on inoculation of various fertility levels increased the plant height, number of leaves, leaf length, leaf width, stem diameter, days taken to curd initiation and plant spread at different growth stages of the crop over control. The perusal of data revealed that the plant height at 30 and 60 DAT was significantly affected by various fertility levels. The maximum plant height at 30 and 60 DAT was (25.46 and 55.63 cm, respectively) observed in 75% RDF through inorganic fertilizers + 25% through vermicompost (F_2) , which was found to be significantly higher over F_0, F_1 and F_3 treatment respectively. However the minimum plant height (21.91 and 23.04 cm) at 30 and 60 DAT was attained with the treatment F_0. The maximum number of leaves per plant at 30 and 60 DAT (12.11 and 22.03, respectively) was recorded under F_2 i.e. 75% RDF through inorganic fertilizers and 25% through vermicompost, which was found to be significantly higher over F_0, F_1 and F_3 but statistically at par to F_3 treatment. While the minimum number of leaves per plant at 30 and 60 DAT(11.00 and 20.00 respectively) recorded under the treatment F_0 (control).

Different fertility levels significantly influenced the length of leaves of cauliflower and the maximum length of leaves at 30 and 60 DAT was (20.57 and 33.18 cm, respectively) observed in 75% RDF through inorganic fertilizers + 25% through vermicompost (F_2), which was found to be significantly higher over F_0, F_1 and F_3 treatment respectively but statistically at par to F_3 treatment at 60 DAT. However the minimum length of leaf (18.29 and 28.73 cm) at 30 and 60 DAT was attained with the treatment control (F_0). The maximum width of leaves at 30 and 60 DAT was (11.07 and 31.02 cm, respectively) observed in 75% RDF through inorganic fertilizers + 25% through vermicompost (F_2), which was found to be significantly higher over F_0, F_1 and F_3 treatment respectively. However the minimum width of leaf (7.26 and 29.04 cm) at 30 and 60 DAT was attained with the treartment control (F_0). The diameter of stem at 30 and 60 DAT were also significantly influenced by boron treatments (Tables 1 and 2). Plants treated with 75% RDF through inorganic fertilizers + 25% through vermicompost (F_2) recorded maximum diameter of stem. (1.14 and 2.26 cm) at 30 and 60 DAT respectively which was found significantly higher

Table 1. Effect of fertility levels and boron on vegetative growth parameters of cauliflower.

Symbol	Treatments	Plant height (cm)		Number of leaves		Length of leaf (cm)		Width of leaf (cm)	
		30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT
Fertility level									
F_0	Control	21.91	46.23	11.00	20.00	18.29	28.73	7.26	28.95
F_1	100% RDF through inorganic fertilizers	24.57	54.29	11.23	20.33	20.12	33.18	8.47	29.04

Table 1. Continued.

Symbol	Treatments	Plant height (cm) 30 DAT	Plant height (cm) 60 DAT	Number of leaves 30 DAT	Number of leaves 60 DAT	Length of leaf (cm) 30 DAT	Length of leaf (cm) 60 DAT	Width of leaf (cm) 30 DAT	Width of leaf (cm) 60 DAT
F_2	75% RDF through inorganic fertilizers + 25% through VC	25.46	55.63	12.11	22.03	20.57	33.25	11.07	31.92
F_3	50% RDF through inorganic fertilizers + 50% through VC	23.38	53.96	11.68	21.45	19.77	33.06	9.59	31.02
Boron level									
B_0	Control	23.04	50.41	10.68	19.57	16.67	29.40	7.38	27.27
B_1	1.5 kg/ha	23.91	52.34	11.57	20.95	19.10	32.54	8.44	29.32
B_2	2 kg/ha	24.11	53.58	11.47	21.01	21.43	33.17	7.79	31.17
B_3	2.5 kg/ha	24.24	53.78	12.32	22.28	21.54	34.11	10.78	33.18
SEm ±		0.29	0.44	0.23	0.33	0.25	0.41	0.26	0.36
CD (p=0.05)		0.85	1.29	0.66	0.94	0.73	1.19	0.76	1.03
Interaction (F × B)									
SEm ±		0.59	0.87	0.46	0.65	0.50	0.82	0.52	0.71
CD (p=0.05)		1.71	2.57	1.32	1.89	1.45	2.38	1.52	2.07

over F_0 and F_1, but statistically at par to F_3 treatment at 30 and 60 DAT. While the minimum diameter of stem (1.01 and 1.96 cm) was recorded at 30 and 60 DAT with the treatment F_0 (control). The maximum plant spreading at 30 and 60 DAT was (16.21 and 42.50 cm, respectively) observed in 75% RDF through inorganic fertilizers + 25% through vermicompost (F_2), which was found to be significantly higher over F_0, F_1 and F_3 treatment respectively. However the minimum plant spread (13.03 and 38.43 cm) at 30 and 60 DAT was

Table 2. Effect of fertility levels and boron on vegetative growth parameters of cauliflower.

Symbol	Treatments	Plant spread (cm) 30 DAT	Plant spread (cm) 60 DAT	Days taken to curd Initiation	Stem diameter (cm) 30 DAT	Stem diameter (cm) 60 DAT
Fertility level						
F_0	Control	13.03	38.43	1.01	1.01	1.96
F_1	100% RDF through inorganic fertilizers	15.17	42.10	1.13	1.13	2.20
F_2	75% RDF through inorganic fertilizers + 25% through VC	16.21	42.50	1.14	1.14	2.26
F_3	50% RDF through inorganic fertilizers + 50% through VC	15.21	40.86	1.12	1.12	2.14
Boron level						
B_0	Control	14.27	40.04	1.09	1.09	2.03
B_1	1.5 kg/ha	14.51	41.25	1.05	1.05	2.06
B_2	2 kg/ha	14.68	40.52	1.13	1.13	2.14
B_3	2.5 kg/ha	16.16	42.08	1.14	1.14	2.32
SEm ±		0.22	0.29	1.73	0.02	0.06
CD (p=0.05)		0.64	0.85	N/S	0.06	0.17
Interaction (F× B)						
SEm ±		0.44	0.59	3.47	0.04	0.11
CD (p=0.05)		1.27	1.71	N/S	0.12	0.34

attained with the treatment control (F_0). The days taken to curd initiation were affected non-significantly due to different fertility levels.

However, different fertility levels were found to be non-significant to curd initiation of cauliflower. This might be due to the better nutritional environment in the root zone for growth at development of the plant. The significant influence of inorganic fertilizers in combination with vermicompost on plant growth of cauliflower seems to be account of urea, SSP and MOP supplied at initial growth stages whereas, vermicompost provided the nutrients throughout the cropping season matching to the need of the plants. An added advantage of vermicompost is that besides supplying all the essential nutrient it improves the physical and biological properties of soil in respect of granulation, friability, porosity and water holding capacity. The positive effect of inorganic fertilizers and vermicompost on growth by providing a balanced nutritional environment favorable both in soil rhizospheres and in plant system. The results are close conformity with findings of Kumhar et al. (2004) in cauliflower, Patil (2003) in tomato and Mahmood et al (2007) in cauliflower.

Effect of boron levels

The maximum plant height was 24.24 cm and 53.78 cm at 30 and 60 DAT respectively were recorded with 2.5 kg boron per ha. However, it remain statistically at par with 2.0 kg boron per ha at 30 and 60 DAT, respectively. While the minimum plant height (21.91 and 23.04 cm) at 30 and 60 DAT was attained with the treatment B_0. Plants treated with higher dose of boron B_3 (2.5 kg /ha) recorded maximum number of leaves (12.32 and 22.28) per plant at 30 and 60 DAT, respectively which was found to be significantly higher over B_0, B_1 and B_2. But the minimum number of leaves (10.68 and 19.57) per plant was recorded at 30 and 60 DAT with the treatment B_0 (control). The maximum length of leaf (21.54 and 34.11 cm) at 30 and 60 DAT, respectivly which was found to be significantly higher over B_0, B_1 and B_2, but statistically at par to F_3 treatment at 30 and 60 DAT. While the minimum length of leaf (16.69 and 29.40 cm) was recorded at 30 and 60 DAT with the treatment B_0 (control). Plants treated with higher dose of boron B_3 (2.5 kg/ha) recorded maximum width of leaf (10.78 and 33.18 cm) at 30 and 60 DAT, respectively which was found to be significantly higher over B_0, B_1 and B_2, while the minimum width of leaf (7.38 and 27.27 cm) was recorded at 30 and 60 DAT with the treatment B_0 (control). Plants treated with higher dose of boron B_3 (2.5 kg/ha) recorded maximum diameter of stem (1.14 and 2.32 cm) at 30 and 60 DAT, respectively which was found to be significantly higher over B_0 and B_1, but statistically at par to B_2 treatment at 30 DAT. While the minimum diameter of stem (1.09 and 2.03 cm) was recorded at 30 and 60 DAT with the treatment B_0 (control). Plants treated with higher dose of boron B_3 (2.5 kg/ha) recorded maximum plant spread (16.16 and 42.08 cm) at 30 and 60 DAT, respectively which was found to be significantly higher over B_0, B_1 and B_2. While the minimum plant spread (14.27 and 40.04 cm) was recorded at 30 and 60 DAT with the treatment B_0 (control). Days taken to curd initiation were affected non-significantly due to different fertility levels and boron. These findings clearly indicated that boron played a significant role for enhancing the growth of cauliflower. It might be due to supply of micro nutrients and availability of uptake nutrients in soil due to favorable conditions. Boron 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 lead to disorder in cauliflower like hollow stem and browning (Singh 1991). These results are close conformity with findings of Moniruzzaman et al. (2007) in broccoli, Singh et al. (2011) in cauliflower, Kumar et al. (2012) in also cauliflower and Devi et al. (2012) in cabbage.

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