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Effect of foliar spray of plant growth regulators on the growth and yield of cauliflower (*Brassica oleracea* var. botrytis L.) cv. pant Shubhra

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Abstract
The experiment was carried out with RBD with ten treatments and three replications. All treatments exhibited superior growth and yield of curd. Treatment T_2 found highly effective for growth parameter as it showed greatest plant height (61.80 cm), no. of leaves per plant (23.80), stem length (20.40 cm), leaf length (45 cm) and leaf width (31 cm) while the treatments T_{10}, T_8 and T_6 recorded highest stem diameter (10 cm), leaf width (31.33 cm) and root length (24.40 cm) respectively. The treatment T_6 found highly effective for yield attributing characters as it recorded highest curd diameter (46.20 cm), curd weight (668 gm) while the treatments T_8 and T_9 showed second position respectively. Therefore the treatments T_6, T_2, T_8, and T_{10} found highly effective as it improves vegetative growth, yield and nutritional quality of crop.

Keywords: Cauliflower, plant growth regulators, growth, yield, parameters

Introduction
Cauliflower (*Brassica oleracea* Var. *botrytis* L.) belongs to the natural order of cruciferous family and it is main crop of the group of cole crops. It is a cool season vegetable, more challenging in its climatic requirement than other members in family. Plant is very responsive to unfavorable condition, like strangely hot weather, drought or low temperature, which often result in the development of premature curd. In India cultivation of cauliflower for its compact curd used as cooked raw vegetables, soups and pickles. It is best options of horticultural winter crops of India.

In world India has second position of cauliflower production. Cauliflower area in India is 454.0 thousand ha. and production is 8557 thousand metric tonnes and productivity is 18.85 tones/ha. (Anon, 2017). The major states for growing cauliflower are West Bengal, Bihar, Maharashtra, Madhya Pradesh, Odisha, Gujarat and Chhattisgarh. Chhattisgarh is the 8th position in India for cauliflower production**.** Area under cauliflower in Chhattisgarh is 23.95 thousand hectare with production of 453.19 thousand MT with the productivity is 18.92 MT/ha. The important cauliflower growing districts are Raipur, Durg, Bemetara, Bilaspur, kondagaon, kanker and Korba. (Anon, 2017).

Generally cauliflower is grown in irrigated areas with the help of a large quantity of fertilizers to improve production. Production technologies viz. sowing time, optimal fertilizer, irrigation supplies, adequate weed methods and effective plant protection measures etc. has been identified to improve the productivity of cauliflower crop. These agricultural inputs are extremely expensive or inaccessible for all particularly small and marginal farmers, in adding up to their negative effect on land, plants, man and animals.

During the current years, the plant growth regulators is an exceptional result, which has contribute greatly to the progress of agricultural sciences. They are used by some methods, such as treating seeds, seedlings, dipping and spraying plants. In the most common cases, seedling treatment and foliar spray are measured the frequent and suitable technique of application. The immersion of the seedlings in the solution of the plant growth regulators and their foliar spraying have proved effective in mainly horticultural crops, including cabbage crops.

Among the various plant growth regulators, NAA and GA_3 are very popular and are used on a commercial scale in various crops, including cauliflower.

They help in the synthesis of metabolites, as well as in the translocation of nutrients and assimilation into different parts, which eventually results in a greater yield (Kotecha *et al.*, 2011) [2]. Use of the plant growth regulators has contribute extensively to the increase in yield and quality of vegetables. NAA is an essential plant growth regulator for the tends to stimulate vegetative growth and increase the yield of many vegetables (Rawat *et al.,* 2002) [7].

Materials and Methods

A field experiment to study the "Effect of foliar spray of plant growth regulators on the growth and yield of cauliflower (*Brassica oleracea* var. botrytis L.) cv. Pant Shubhra" was conducted at Research cum Instructional Farm, Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during the kharif season of 2018-19.

The experiment consisting 10 treatment in Randomized Block Design with three replications with 2 × 2 meter plot size and spacing of plant is 60 cm × 45 cm (R × P). The treatment combinations are T_1 - Control, T_2 - GA3 @ 50 ppm, T_3 - GA3 @ 100 ppm, T_4 - GA3 @ 150 ppm, T_5 – NAA @ 100 ppm, T_6 – NAA @ 120 ppm, T_7 – NAA @ 150 ppm, T_8 – IBA @ 5 ppm, T_9 – IBA @ 10 ppm, T_{10} – IBA @ 15 ppm. The first foliar spray was done at 30 days after planting in the morning hours. The second leaf application at 45 days and the third application at 60 days after planting was done after the wetting agent. The uniform spraying was carried out with the help of the knapsack sprayer; the leaves on both sides were completely wet with the spray solution. The total amount of solution required to be sprayed on experimental plants was decided by representative cauliflower plants.

Results and Discussion

The result of present study clearly indicate that plant height, no. of leaves, stem length, stem diameter, length & width of leaves, Root length, curd diameter & weight were significantly increased by application of different plant growth regulator as compare to control.

The mean values of different growth and yield parameters with respect to plant growth regulators are presented in Table 1. The highest plant height was recorded in T_2 (61.80 cm), which was followed by T_{10} (61 cm), T_5 (60.60 cm) T_3 (60 cm), T_4 (58.80 cm), T_7 (58.60 cm), T_6 (57.60 cm), T_8 (53.60 cm) and T_9 (52.40 cm. Similar results were reported by Reza *et al.* (2015). The Maximum Number of leaves was recorded in T_2 (23.80) followed by T_6 (23.60), T_8 (22.00), T_2 (20.80), T_5 (20.20) and T_7 (19.80). These results are in conformity with Meena *et al.* (2018) [4].

The Maximum stem length was recorded in T_2 (20.40 cm) & T_5 (20.40 cm) followed by T_3 (20 cm), T_6 (20 cm), T_7 (19.80 cm), T_9 (19.80 cm) and T_{10} (19.40 cm). Similar results had also been reported by Meena *et al.* (2018) [4]. The maximum stem diameter showed by treatment T_{10} (10 cm) followed by T_6 (9.20 cm), T_2 (8.80 cm), T_4 (8.60 cm), T_3 (8 cm), T_8 (7.60 cm), T_9 (7.60 cm) and T_5 (7.20 cm). The results of present investigation are in accordance with finding of Mishra and Singh (1986) [5].

The Maximum length of leaves was recorded in T_2 (45 cm), T_6 (44 cm), T_1 (43.40 cm), T_3 (43.20 cm), T_4 (42 cm), T_9 (41.80 cm), T_5 (40.60 cm), T_6 (39.40 cm) and T_8 (39 cm). This is in line finding of Rahman *et al.* (2016) [6]. The Maximum Width of leaves was recorded in T_8 (31.33 cm), T_2 (31 cm), T_5 (30.66 cm), T_9 (30.80 cm), T_3 (30.40 cm), T_6 (30.20 cm), T_{10} (29.80 cm), T_4 (29.40 cm) and T_7 (29.40 cm). Similar results had also been reported by Rahman *et al.* (2016) [6].

The maximum root length was recorded in T_6 (24.40 cm), T_1 (23.60 cm), T_3 (23.60 cm), T_2 (23 cm), T_8 (22.80 cm), T_5 (22.40 cm), T_4 (21.60 cm), T_7 (20.80 cm) and T_9 (20 cm). The results of present investigation are in accordance with finding of Lendve., (2010) [3]. The Maximum curd diameter was recorded in T_6 (46.20 cm) followed by T_8 (41 cm), T_{10} (41 cm), T_3 (40.20 cm), T_2 (40 cm), T_7 (37.6 cm), T_4 (37.4 cm), T_9 (37 cm) and T_5 (33.4 cm). Similar results were reported by Abdulla *et al.* (1980) [1].

The treatment T_6 recorded highest curd weight 668 gm followed by T_8 (538 gm), T_3 (514 gm), T_{10} (504 gm), T_2 (492 gm), T_9 (448 gm), T_4 (446 gm), T_7 (444 gm) and T_5 (410 gm). Similar results were reported by Abdulla *et al.* (1980) [1].

Table 1: Mean performance of Effect of foliar spray of plant growth regulators on growth, yield and quality parameters of cauliflower cv. Pant Shubhra.

Treatment	1	2	3	4	5	6	7	8	9
T_1	51.60	14.40	18.20	7.20	37.80	28.60	19.60	33.40	406
T_2	61.80	23.80	20.40	8.80	45.40	31	23	40	492
T_3	60	20.80	20	8	43.20	30.40	23.60	40.20	514
T_4	58.80	18	19.20	8.60	42	29.40	21.60	37.40	446
T_5	60.60	20.20	20.40	7.20	40.60	30.66	22.40	33.40	410
T_6	57.60	23.60	20	9.20	39.40	30.20	24.40	46.20	668
T_7	58.60	19.80	19.80	7.40	44	29.40	20.80	37.60	444
T_8	52.40	22	18.20	7.60	39	31.33	22.80	41	538
T_9	53.60	18.20	19.80	7.60	41.80	30.80	20	37	548
T_{10}	61	16.20	19.40	10	43.40	29.80	23.60	41	504
Mean	57.60	19.70	19.54	8.16	41.66	30.15	22.18	38.72	497
SE(m±)	2.98	1.01	1.01	0.42	2.16	1.55	1.14	1.99	25.52
CV	8.96	8.85	8.94	8.96	8.97	8.91	8.89	8.89	8.89
CD (0.05)	9.16	3.10	3.10	1.30	6.64	4.77	3.50	6.12	78.49

Note

1. Plant height (cm) 2. Number of leaves 3. Stem length (cm)
4. Stem diameter (cm) 5. Length of leaves (cm) 6. Width of leaves (cm)
7. Root length (cm) 8. Curd diameter (cm) 9. Curd weight (g)

Conclusion

The sprays of plant growth regulators are effective response in growth, and yield of cauliflower and in increasing the yield. The findings revealed that treatment T_6- NAA @ 120 ppm recorded the maximum (length of root, curd weight, curd diameter.), T_2 – GA_3 @ 50 ppm recorded the maximum (Plant height, Number of leaves, Stem length).

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