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Plant Growth and Seed Yield in Annual Chrysanthemum as Influenced by Growth Chemicals and Pinching

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ABSTRACT

A field experiment was conducted at Horticulture Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi to know the effect of pinching, gibberelic acid (GA_3) and salicylic acid (SA) on growth and seed yield characters of annual chrysanthemum. The treatments constituted of two level of pinching i.e. no pinching and pinching and each at three levels i.e. GA_3 (100 ppm, 200 ppm and 300 ppm) and SA (100 ppm, 150 ppm and 200 ppm) along with control (distilled water). Significantly maximum no. of primary branches/plant, stem diameter, fresh weight of leaf, no. of seeds/peduncle, weight of seeds/peduncle and seed yield/plant was recorded with pinching. However, early seed ripening was noted with no pinching treatment. GA_3 at 100 ppm exhibited maximum no. of primary branches/plant. Significantly maximum leaf area index was observed with GA_3 300 ppm treatment. Among various doses of salicylic acid, SA 100 ppm recorded maximum plant spread, no. of seeds/peduncle, weight of seeds/peduncle seed yield/plant and test weight of seed. Maximum fresh weight of leaf was observed with SA 150 ppm. However, maximum stem diameter was registered with SA 200 ppm. Interaction of pinching with GA_3 and SA gave significant effect on all growth and seed parameters except no. of primary branches/plant, stem diameter and fresh weight of leaf.

Keywords Chrysanthemum GA_3, SA, Pinching, Growth, Seed yield.

INTRODUCTION

Chrysanthemum is a beautiful and possibly the oldest flowering plant that is commercially grown all over the world. It is popular in the international market as cut and loose flower. It is one of the most popular traditional flowers, commonly used as a potted plant, loose flower, cut flower as well as garden border plant. Chrysanthemum due to its wide variability is highly suitable for beds, pots and floral arrangement. It can be used for floral arrangements and culinary purposes (Sisodia *et al.* 2022). The crop is grown in limited areas throughout India and has recently gained

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popularity. Growth regulators have been found to be effective in improving growth, quality and yield of flowering annuals including chrysanthemum (Singh *et al.* 2017, Basit *et al.* 2018). However, limited data on the effects of growth chemicals along with pinching on growth and seed yield parameters of this crop is available. Hence, the experiment was conducted to find out the response of growth promoting chemicals, i.e., GA_3 and SA and pinching on plant growth and seed yield attributes.

MATERIALS AND METHODS

An experiment was carried out to study the effect pinching, salicylic acid (SA) and gibberelic acid (GA_3) on growth and seed yield attributes in annual chrysanthemum. The present study was conducted during 2021-2022 at Horticulture Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh. The experiment consisted of two levels of pinching (no pinching, single pinching), three levels of GA_3 (100 ppm, 200 ppm and 300 ppm), three levels of SA (100 ppm, 150 ppm and 200 ppm) and control (distilled water). The experiment was set up in a Randomized Block Design with fourteen treatment combinations and three replications. Seeds were sown in the last week of November and one-month-old seedlings were transplanted at a distance of 60 cm between rows and 50 cm between plants. Foliar application of GA_3 and SA was applied 21 days after planting (DAT) and pinching was practiced 30 DAT. All of the treatments followed the same cultural practices. Data on various growth and seed yield attributes were observed analyzed statistically.

RESULTS AND DISCUSSION

Effect of pinching on growth attributes

All the growth parameters were found to be significantly influenced by various levels of pinching, except plant spread and leaf area index (Table 1). Statistically, maximum no. of primary branches/plant (34.20), stem diameter (19.05 mm) and fresh leaf weight (3.16 g) was obtained with pinching, whereas the minimum value for these parameters was recorded for no pinching. Data shows that pinching increased the number of branches and stem diameter, which resulted in more fresh leaf weight, possibly due to increased metabolite accumulation. This result corroborates the findings of Singh *et al.* (2017a) and Singh *et al.* (2018) in marigold.

Effect of GA_3 and SA on growth attributes

All the growth parameters were found to be significantly influenced by the applications GA_3 and SA (Table 1). Maximum no. of primary branches/plant (29.22) was recorded with GA_3 100 ppm, which was at par with SA 100 ppm (28.13). Leaf area index (4.71) was observed maximum with the application of GA_3 300 ppm, which was at par with SA 200 ppm (4.59). Padhi *et al.* (2018) found that application of GA_3 stimulated growth and increased biomass in gladiolus. The improved efficiency of GA_3 treated plants could explain the improvement in vegetative characteristics and this is in conformity with the results of Singh *et al.* (2014) and Singh *et al.* (2018) in marigold. Significantly, maximum stem diameter (19.11 mm) was observed with SA 200 ppm, which was at par with GA_3 100 ppm (19.00 mm). However, maximum fresh leaf weight (3.78 g) was obtained with SA 150 ppm, which was at par with SA 200 ppm (3.17 g). Maximum plant spread at 60 DAT (68.16 cm) and at 90 DAT (90.10 cm) was found with SA 100 ppm. These results are in close agreement with the findings of Basit *et al.* (2018) in marigold and Kumar *et al.* (2019) in chrysanthemum.

Interaction effect

The data revealed from Table 1 showed the significant effect on all growth attributes except no. of primary branches/plant, stem diameter and fresh weight of leaf due to the interaction of different levels of pinching, GA_3 and SA. Significantly, maximum plant spread at 60 DAT (73.52 cm) and at 90 DAT (95.58 cm) was recorded with pinching × SA 100 ppm. Similarly, maximum leaf area index (5.01) was observed with the interaction of no pinching × GA_3 300 ppm, which was at par with pinching × SA 200 ppm (4.89) and followed by no pinching × SA 100 ppm (4.80). Pinched plants efficiently utilized more nutrients provided by

Table 1. Effect of GA3, SA and pinching on growth attributes of annual chrysanthemum.

Treatment	No. of primary branches/ plant	Stem diameter (mm)	Fresh weight of leaf (g)	Plant spread (cm) at 60 DAT	Plant spread (cm) at 90 DAT	Leaf area index
No pinching	19.89	17.11	2.70	55.56	76.08	4.03
Pinching	34.20	19.05	3.16	56.53	78.62	4.14
CD at 5%	1.37	0.66	0.42	NS	NS	NS
Control	26.05	15.67	2.56	47.33	73.21	3.79
GA_3 100 ppm	29.22	19.00	2.62	58.60	71.51	4.31
GA_3 200 ppm	25.91	17.91	2.84	54.64	72.21	3.32
GA_3 300 ppm	25.68	17.36	2.71	53.61	74.50	4.71
SA 100 ppm	28.13	18.66	2.86	68.16	90.10	3.92
SA 150 ppm	27.13	18.87	3.78	57.16	81.84	3.99
SA 200 ppm	27.24	19.11	3.17	52.80	78.07	4.59
CD at 5%	2.57	1.23	0.78	3.53	7.75	0.51
Interaction						
No pinching × Control	21.39	15.12	2.31	47.81	77.50	3.16
No pinching × GA_3 100 ppm	21.77	17.66	2.26	58.25	72.53	3.89
No pinching × GA_3 200 ppm	17.72	16.04	2.22	55.66	74.00	3.32
No pinching × GA_3 300 ppm	17.53	16.54	2.90	51.33	75.58	5.01
No pinching × SA 100 ppm	20.93	17.67	3.00	62.81	84.62	4.80
No pinching × SA 150 ppm	20.17	18.06	3.04	59.00	71.33	3.75
No pinching × SA 200 ppm	19.71	18.68	3.20	54.04	76.97	4.30
Pinching × Control	30.66	16.21	2.80	46.86	68.92	4.42
Pinching × GA_3 100 ppm	36.67	20.34	2.97	58.95	70.50	4.72
Pinching × GA_3 200 ppm	34.10	19.77	3.45	53.61	70.42	3.32
Pinching × GA_3 300 ppm	33.83	18.17	2.53	55.89	73.42	4.40
Pinching × SA 100 ppm	35.33	19.65	2.72	73.52	95.58	3.04
Pinching × SA 150 ppm	34.10	19.69	4.53	55.33	92.35	4.23
Pinching × SA 200 ppm	34.77	19.54	3.14	51.56	79.16	4.89
CD at 5%	NS	NS	NS	4.99	10.96	0.72

GA_3 and SA, which might have played some role in augmenting plant spread and leaf area index. Beneficial effects of growth chemicals and pinching were noted by Sharma *et al.* (2016) in chrysanthemum, Soltani *et al.* (2014) in pot marigold and Kumar *et al.* (2019a) in rose.

Effect of pinching on seed yield attributes

All the seed yield parameters of annual chrysanthemum were found to be significant by various levels of pinching except test weight of seed (Table 2). Earliest seed ripening (104.33 days) was observed with no pinching, However, maximum no. of seeds/peduncle (300.29), weight of seeds per peduncle (0.65 g) and seed yield per plant (169.08 g) was recorded with pinching, whereas minimum value of these parameters were recorded with no pinching. These results are supported by the results of Singh *et al.* (2015) and Singh *et al.* (2017a) in marigold.

Effect of GA_3 and SA on seed yield attributes

Significant difference was found due to application of GA_3 and SA at different concentrations on various seed yield parameters (Table 2). Earliest seed ripening (102.56 days) was recorded with control. However, maximum no. of seeds/peduncle (338.28), weight of seeds per peduncle (0.80 g) and seed yield per plant (184.56 g) were recorded with the application of SA 100 ppm. Similarly, maximum test weight of seed (2.39 g) was noted with the application of SA 100 ppm, which was at par with SA 200 ppm (2.35 g). SA is an important hormone that regulates many

Table 2. Effect of GA_3, SA and pinching on seed yield attributes of annual chrysanthemum.

Treatment	Days to seed ripening	No. of seeds/ peduncle	Weight of seeds/ peduncle (g)	Test weight of seed (g)	Seed yield/ plant (g)
No pinching	104.33	284.86	0.62	2.16	144.55
Pinching	109.90	300.29	0.65	2.23	169.08
CD at 5%	1.79	4.51	0.02	NS	4.03
Control	102.56	261.78	0.57	2.05	137.45
GA_3 100 ppm	105.81	291.98	0.59	2.11	167.98
GA_3 200 ppm	110.24	284.11	0.64	2.28	150.36
GA_3 300 ppm	105.19	282.89	0.61	2.17	149.37
SA 100 ppm	106.20	338.28	0.80	2.39	184.56
SA 150 ppm	111.44	309.87	0.66	2.11	163.18
SA 200 ppm	108.33	279.09	0.56	2.35	144.78
CD at 5%	3.35	8.44	0.03	0.19	7.54
Interaction					
No pinching × Control	102.24	270.10	0.45	2.03	114.02
No pinching × GA_3 100 ppm	100.32	301.55	0.58	2.09	165.50
No pinching × GA_3 200 ppm	105.10	290.15	0.63	2.34	115.27
No pinching × GA_3 300 ppm	100.39	224.35	0.62	1.99	144.36
No pinching × SA 100 ppm	104.87	325.86	0.90	2.00	186.58
No pinching × SA 150 ppm	109.60	294.32	0.61	2.14	163.55
No pinching × SA 200 ppm	107.77	287.65	0.53	2.34	122.56
Pinching × Control	102.89	253.45	0.69	2.07	160.89
Pinching × GA_3 100 ppm	111.31	282.40	0.59	2.13	170.47
Pinching × GA_3 200 ppm	115.39	278.07	0.65	2.28	185.46
Pinching × GA_3 300 ppm	110.00	341.43	0.61	2.17	154.38
Pinching × SA 100 ppm	107.53	350.69	0.70	2.39	182.53
Pinching × SA 150 ppm	113.29	325.42	0.69	2.11	162.82
Pinching × SA 200 ppm	108.88	270.53	0.60	2.36	167.01
CD at 5%	4.74	11.94	0.04	0.27	10.66

aspects of plant growth and development, as well as thermo-genesis and disease resistance, in a direct or indirect manner (Vlot *et al.* 2009). These findings are corroborated by the results of Singh *et al.* (2019) and Kumar *et al.* (2019a) in rose.

Interaction effect

Data revealed from Table 2 showed the significant effect on all seed yield parameters due to the interaction effect of various levels of pinching, GA_3 and SA. Earliest seed ripening (100.32 days) was recorded with the interaction of no pinching × GA_3 100 ppm. Significantly, maximum no. of seeds/plant (350.69) was observed with the interaction of pinching × SA 100 ppm, which was at par with pinching × GA_3 300 ppm (341.43). Maximum weight of seeds per peduncle (0.90 g) was obtained with the interaction of no pinching × SA 100 ppm. Similarly, maximum test weight (2.39 g) was noted with the interaction of pinching × SA 100 ppm, which was at par with pinching × SA 100 ppm (2.36 g) and followed by no pinching × GA_3 200 ppm (2.34 g). Statistically, maximum seed yield per plant (186.58 g) was observed with the interaction of no pinching × SA 100 ppm, which was at par with pinching × GA_3 200 ppm (185.46 g) and followed by pinching × SA 100 ppm (182.53 g). In the present experiment, the combination of pinching, GA_3 and SA strikingly influenced seed yield parameters. This might be due to cell elongation and metabolite accumulation, which influenced floral morphogenesis and resulted in the highest number of seeds per peduncle, test weight, and seed yield per plant. Similar findings are also reported by Singh

(2005) in California poppy, Yadav *et al*. (2015), Singh *et al.* (2017) and Singh *et al.* (2018) in marigold.

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