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Vishnu Kumar Sharma
M.Sc Scholar, Department of
Horticulture, Institute of
Agricultural Sciences, Banaras
Hindu University, Varanasi, Uttar
Pradesh, India

Pankaj Kumar Meena
Ph.D Research Scholar,
Department of Horticulture
(Floriculture and Landscaping),
Rajasthan College of Agriculture,
MPUAT, Udaipur, Rajasthan,
India

Anjana Sisodia
Assistant Professor, Department of
Horticulture, Institute of
Agricultural Sciences, Banaras
Hindu University, Varanasi, Uttar
Pradesh, India

Suraj Prakash
Ph.D. Research Scholar,
Department of Vegetable Science,
Rajmata Vijayaraje Scindia Krishi
Vishwavidyalaya Gwalior, Madhya
Pradesh

Gattu Rasagnya
MSc Scholar, Department of
Floriculture and Landscaping,
College of Agriculture, Central
Agricultural University, Imphal,
Manipur, India

Dr. Mukul Kumar
Associate Professor- Cum-Sr.
Scientist, Department of Plant
Physiology, HRC, BAU, Sabour,
Bihar, India

Sai Ramesh Dhanekula
Research Assistant, School of
Agriculture, Lovely Professional
University, Phagwara, Punjab,
India

Dr. Rakesh Kumar
Research Scholar, Department of
Agriculture, School of Agricultural
Sciences, Nirwan University
Jaipur, Rajasthan, India

Dr. Bhoirab Gogoi
Subject Matter Specialist
Horticulture, Krishi vigyan Kendra
Jorhat, Assam Agricultural
University, Jorhat, Assam, India

Corresponding Author:
Vishnu Kumar Sharma
M.Sc Scholar, Department of
Horticulture, Institute of
Agricultural Sciences, Banaras
Hindu University, Varanasi, Uttar
Pradesh, India

Effect of plant growth regulators and pinching on plant growth and seed parameters in calendula

Vishnu Kumar Sharma, Pankaj Kumar Meena, Anjana Sisodia, Suraj Prakash, Gattu Rasagnya, Mukul Kumar, Sai Ramesh Dhanekula, Rakesh Kumar and Bhoirab Gogoi

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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 in the year 2021-22 to investigate the effect of pinching, benzyl adenine (BA) and their interaction on growth and seed parameters in calendula. Treatment consists of six levels of BA (50, 100, 150, 200, 250 and 300 ppm) as well as a control (distilled water). The result of experiment revealed that pinching at 30 DAT reduced the plant height and increased the primary number of branches, stem diameter, fresh weight of leaves, dry weight of leaves, plant spread and number of leaves/plant. Exogenous application of BA 150 ppm resulted in maximum plant height and flower fresh weight, plant spread, maximum number of primary branches/plant was reported in BA 250 ppm. BA 200 ppm × pinching showed the best result for stem diameter, fresh weight of flower, number of leaves/plant and maximum weight of the dry flowers. Pinching at 30 DAT increases the days to seed maturity, number of seed/flowers, seed yield/plant, test weight and seed yield/m². BA 250 ppm reported maximum days to seed maturity. Whereas, BA 250 ppm × pinching resulted maximum days to seed mature and maximum test weight. BA 150 ppm × No pinching resulted maximum number of seeds/flower.

Keywords: Calendula, BA, pinching, growth and seed

Introduction

Calendula (*Calendula officinalis*) is a widely used plant in landscapes around the world. It is a medical-ornamental herbaceous annual plant that is native to Southern Europe and belongs to the Asteraceae family. Commonly it is known as pot marigold, garden marigold, English marigold and Scottish marigold. It is an erect, annual herbaceous aromatic plant, grows up to 60 cm in height with angular and glandular stems; flower-heads terminal, light yellow to deep orange, 1.0-1.5 cm long, boat-shaped, faintly ribbed. It can be displayed as in borders, bedding, rock garden, as balcony plants and as cut flower. Flowers are sold in the market as loose or after making garland and are gaining popularity as a cut flower. The removal of a plant's apical is called as pinching. The main objective of pinching is to induce branching, which leads to bushier growth and more flowers and flower yield. It's a cultural operation for enhancing calendula plant growth and flower production by delaying flowering and increasing flower yield. Whereas, plant growth regulators are organic molecules, natural or synthetic, that control one or more physiological processes in plants. The influence of benzyladenine (BA) on flowering varies on the species to species and found beneficial in growth and flowering in calendula and California poppy (Singh, 2005) [19]. This study was designed to evaluate the effect of PGR and pinching on plant growth and seed parameters in calendula.

Materials and Methods

An experiment was conducted to see the effect of benzyl adenine and pinching on growth and seed yield in calendula at the Horticulture Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh during 2021–22. In this study, two levels of pinching (no pinching, single pinching at 30 DAT), six levels of BA (50, 100, 150, 200, 250 and 300 ppm) were used, as well as control (distilled water).

The experiment was designed in a Randomized Block Design, with seven treatments replicated three times. One month-old seedlings were transplanted at a distance of 60 cm between rows and 50 cm between plants. Different concentrations of BA were sprayed on the plants 21 days after transplanting to run-off stage. Whereas, pinching was practiced 30 days after transplanting. Observations on various growth and seed attributes were recorded, results thus obtained, were subjected to statistical analysis.

Results and Discussion

Effect of pinching and BA on growth attributes in calendula

It is evident from the Table 1 that pinching at 30 DAT reduced the plant height up to 18.61 cm and increased the primary number of branches (8.90), stem diameter (20.09 mm), fresh weight of leaves (6.04 g), dry weight of leaves (0.91 g), plant spread (43.01 cm) and number of leaves/plant (711.83) when compared to non-pinching. This might be due to pinching that reduces the plant height and encourages the side branches after removal of apical dominance, which might have favoured in increasing the stem diameter, primary branches, spread of plant. Increased plant spread and number of primary branches and leaves per plant with pinching are in conformity with the finding of Singh *et al.* (2015) ^[19] in marigold, Salve *et al.* (2016) ^[15] and Jena, (2016) ^[11] in chrysanthemum.

The foliar application of BA 150 ppm resulted in maximum plant height (24.03 cm), fresh leaves weight (6.60 g), plant spread (46.92 cm). Maximum number of primary branches/plant (10.94) was reported with BA 250 ppm. Maximum stem diameter (8.60 mm) and maximum number of leaves/plant (754.77) were reported in treatment BA 200 ppm. This increase in stem length, plant height and stem diameter is due to the role of the BA in cell elongation and division. Cytokinin lead to increase the nitrogen content on leaves which is important in the formation of protein, nucleic acid, chlorophyll, enzyme, vitamins and plant hormones. Similar trend was found by Gabrel *et al.* (2018) ^[8] and Khattab. (2017) ^[12] in chrysanthemum.

Interaction effect

As per the Table 1 it is clear that BA 150 ppm × No pinching shows maximum plant height (26.52 cm). Maximum number of branches were reported with interaction of BA 250 ppm × Pinching. BA 200 ppm × Pinching showed maximum stem diameter (22.36 mm), fresh weight of leaves (7.15 g) and number of leaves/plant (898.59). BA 100 ppm × Pinching resulted with maximum plant spread (48.01). Similar results were also reported by Ali *et al.* (2021) ^[2] in zinnia.

Effect of pinching and BA on seed yield attributes in calendula

It is evident from the Table 2 that all the seed yield attributes are significantly influenced by the treatment of pinching and BA. Maximum days to seed maturity (104.82 days), number of seeds/flower (32.72), seed yield/plant (41.00 g), test weight (10.05 g), seed yield/m² (262.39 g) were reported with pinching. These results are in line with the findings of Bhat and Shepherd (2007) ^[5], Singh *et al.* (2015) ^[19], Baskaran and Abirami (2017) ^[4] in marigold. The foliar application of BA 250 ppm reported maximum days to seed mature (101.02 days), number of seeds/flower (33.58), seed yield/plant (43.23 g), test weight (10.55 g) and seed yield/m² (289.25 g). Similar trend of results was reported by Khattab (2017) ^[12] in chrysanthemum, El-Ghait (2020) ^[6] in jasmine.

Interaction

As shown in Table 2 BA 250 ppm × pinching resulted in maximum days to seed mature (108.22 days) and test weight (11.22 g). BA 100 ppm × no pinching showed maximum number of seeds/flower (36.42). Maximum seed yield/plant (49.89 g) was reported with interaction of BA 200 ppm × pinching. Maximum seed yield/m² (379.50) was observed with interaction of BA 150 ppm × pinching. Interaction of BA 250 × pinching resulted maximum test weight (11.22 g). This might be due to the interaction effect of growth regulator with pinching had a positive influence on yield attributing characters in marigold (Badge *et al.*, 2015) ^[3].

Table 1: Effect of BA and pinching on growth parameters in calendula.

Treatment	Plant height at 60 DAT	No. of primary branches at 60 DAT	Stem diameter	Fresh weight of leaves	Dry weight of leaves	Plant spread at 60 DAT (cm)	Number of leaves/plant
Non pinching	24.10	8.81	14.81	5.24	0.76	41.61	579.02
Pinching	18.61	8.90	20.09	6.04	0.91	43.01	711.83
C.D. at 5%	0.87	0.00	0.64	0.55	0.04	0.45	49.61
Control	19.70	7.54	16.43	4.78	1.03	39.70	569.19
BA 50 ppm	19.76	8.60	16.71	4.90	0.80	40.22	595.33
BA 100 ppm	21.44	8.46	17.10	5.35	0.74	44.52	616.36
BA 150 ppm	24.03	8.48	18.18	6.60	0.75	46.92	601.83
BA 200 ppm	21.68	8.58	18.60	6.31	0.88	40.04	754.77
BA 250 ppm	22.41	10.94	17.51	5.81	0.98	43.88	702.69
BA 300 ppm	20.47	9.38	17.63	5.76	0.66	40.89	677.81
C.D. at 5%	1.63	0.01	1.20	1.03	0.07	0.84	92.81
Interaction (T×P)							
Control × No pinching	22.22	8.64	14.70	5.18	0.93	39.51	507.39
BA 50 ppm × No pinching	22.14	8.94	14.46	4.74	0.72	40.43	531.72
BA 100 ppm × No pinching	24.21	9.11	14.37	4.98	0.78	41.03	598.50
BA 150 ppm × No pinching	26.52	7.64	15.59	6.10	0.73	47.38	510.78
BA 200 ppm × No pinching	24.70	8.05	14.83	5.46	0.73	40.81	610.94
BA 250 ppm × No pinching	26.35	10.16	15.32	4.60	1.00	42.71	638.50
BA 300 ppm × No pinching	22.53	9.10	14.38	5.64	0.45	39.42	655.33
Control × Pinching	17.18	6.43	18.15	4.37	1.13	39.88	631.00

BA 50 ppm × Pinching	17.37	8.26	18.96	5.06	0.88	40.00	658.94
BA 100 ppm × Pinching	18.67	7.80	19.83	5.71	0.70	48.01	634.22
BA 150 ppm × Pinching	21.55	9.32	20.76	7.11	0.78	46.47	692.89
BA 200 ppm × Pinching	18.66	9.11	22.36	7.15	1.02	39.27	898.59
BA 250 ppm × Pinching	18.47	11.72	19.70	7.02	0.96	45.05	766.89
BA 300 ppm × Pinching	18.40	9.66	20.87	5.88	0.86	42.36	700.28
C.D. at 5%	N/S	0.01	1.69	N/S	0.11	1.19	N/S

Table 2: Effect of BA and pinching on seed yield attributes of calendula.

Treatment	Days to seed maturity	Number of seeds/flower	Seed yield/plant	Test weight	Seed yield/m ²
Non pinching	93.79	31.15	34.91	9.14	206.33
Pinching	104.82	32.72	41.00	10.05	262.39
C.D. at 5%	0.70	0.63	0.97	0.63	4.38
Control	95.11	27.17	31.27	8.81	182.32
BA 50 ppm	98.83	31.65	39.91	9.61	237.08
BA 100 ppm	100.60	33.16	33.94	9.00	212.46
BA 150 ppm	100.16	33.58	43.23	10.55	289.25
BA 200 ppm	101.02	32.08	42.66	9.65	252.51
BA 250 ppm	100.80	32.88	40.88	9.90	250.89
BA 300 ppm	98.58	33.02	33.81	9.67	216.01
C.D. at 5%	1.30	1.18	1.81	1.18	8.20
Interaction (T×P)					
Control × No pinching	92.61	25.92	19.98	8.41	119.67
BA 50 ppm × No pinching	92.61	28.12	39.42	9.40	242.90
BA 100 ppm × No pinching	96.61	36.42	32.50	8.24	190.16
BA 150 ppm × No pinching	93.33	33.65	46.38	10.51	199.00
BA 200 ppm × No pinching	95.00	29.85	35.43	8.63	208.22
BA 250 ppm × No pinching	93.39	31.72	38.10	8.59	234.11
BA 300 ppm × No pinching	92.94	32.33	32.53	10.23	250.27
Control × Pinching	97.61	28.41	42.56	9.20	244.98
BA 50 ppm × Pinching	105.05	35.17	40.39	9.82	231.27
BA 100 ppm × Pinching	104.60	29.90	35.38	9.76	234.76
BA 150 ppm × Pinching	107.00	33.51	40.07	10.59	379.50
BA 200 ppm × Pinching	107.05	34.31	49.89	10.68	296.80
BA 250 ppm × Pinching	108.22	34.03	43.66	11.22	267.67
BA 300 ppm × Pinching	104.22	33.72	35.08	9.10	181.75
C.D. at 5%	1.84	1.67	2.56	1.67	11.59

Conclusion

Thus from present investigation it is clearly seen effect of BA, pinching and their interactions has a significant effect on growth and seed yield in calendula. It was concluded that pinching, BA 150 ppm and interaction of BA 200 with pinching resulted in superior growth parameter in calendula. Whereas, pinching, BA 250 ppm and their interaction of BA 200 ppm with pinching had significant effect of seed yield in calendula.

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Conflict of Interest: None

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