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EFFECT OF PINCHING AND BA ON VARIOUS CHARACTERS OF GROWTH AND SEED PARAMETER IN PHLOX

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ABSTRACT

An experiment was conducted at Horticultural Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi in the year 2021-22 to find out the effect of pinching and Benzyl adenine (BA) on growth and flowering attributes in phlox. BA of concentrations 50,100, 150, 200, 250 and 300 ppm was foliar sprayed at 21 days after transplanting followed by pinching at 30 days. Healthy seedlings were transplanted in plots of size 6 × 3 m with spacing of 60 × 50 cm. The experiment was carried out in Randomized Block Design with three replications in each treatment. The results from the experiment revealed that pinching reduced plant height (34.04 cm), whereas, maximum number of primary branches/plant (11.97), leaf area (49.91cm^2) and plant spread at 90 days (49.89 cm) was recorded with BA 200 ppm + pinching treatment. BA 200 ppm registered maximum plant height (38.23 cm), number of primary branches at 90 days (13.42) and plant spread at 90 days (53.75cm). Interaction of no pinching × BA 200 ppm resulted in maximum plant height at 90 DAT (46.78 cm). Maximum primary branches/plant (14.22), leaf area (63.97cm^2) and plant spread (54.25 cm) were reported with interaction of BA 200 ppm × pinching. Minimum days to bud initiation (69.14 days), flowering (80.79 days) and maximum days to flower withering (89.06 days) were seen with no pinching while maximum number of flowers per plant (241.25), fresh weight (1.19 g) and dry weight (0.189 g) of flower were obtained with pinching. Significantly, minimum days to bud initiation (66.75 days), flowering (79.75 days), maximum flower diameter (20.48 cm), fresh weight (1.76 g) and dry weight (0.24 g) of flower were also observed with BA 150 ppm. BA 300 ppm × pinching recorded maximum number of flowers per plant (268.33). Whereas, earliest bud initiation (66.33 days) and flowering (77.50 days) were noticed with the interaction of BA 50 ppm × no pinching.

***Key words*:** Phlox, BA, pinching, growth, flowering.

Introduction

Annuals are the group of plants which complete their life cycle in one season or in a year (Singh and Sisodia, 2017). Phlox (*Phlox drummondii*) is grown both as an annual and perennial plant in the garden. It belongs to the family Polemoniaceae. It is also known as star flower. It is native to the United States of America especially in the region of Texas. One of the most popular and favourite annuals are grown for its brilliant display and long-lasting blooming period. It is easy to cultivation, free flowering

and ranges in height from 5 to 45 cm. The large flowered phloxes are excellent for beds, border and as cut flowers. The compact ones are grown in the window boxes, pot, formal beds and also in edgings. It is also suitable for rock garden and dry walls. Benzyladenine (BA) is recognized by its ability to induce cell division in certain plant tissues. it can also overcome the apical dominance of many plants and stimulate the lateral buds to develop into an entire new plant. BA can delay senescence and cause transport of many solutes from older parts of the leaves or even from older leaves into the treated zone.The influence of benzyl adenine (BA) on flowering varies on the species to species and found beneficial in growth and flowering in calendula and California poppy (Singh, 2003 and Singh, 2005). Apical dominance is one of the major constraints in annual flower crop especially dianthus which hinder the plant from profuse branching and flowering thus pinching is a best approach to increase lateral branches and eventually number of flowers. When the terminal portion of the shoots is clipped early, side branches develop earlier, resulting in a greater number of flowers of superior quality and uniform size (Singh and Sisodia, 2017).

Materials and Methods

The experiment was conducted at Horticultural Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India. Seeds of phlox were sown in a raised nursery bed and after one month the seedlings were transplanted in 6×3 m plots with row to row spacing of 60 cm and plant to plant spacing of 50 cm. Treatments were given with concentrations of BA at 50, 100, 150, 200, 250 and 300ppm at 23 days after transplanting and also single pinching was done at 30 days after transplanting. The experiment was carried out in a Randomized Block Design with three replications. All the package of practices was followed as per recommendation to raise a quality crop. Five plants were selected randomly from each treatment per replication and the observations were recorded on various growth and flowering parameters on these plants. The data was statistically analyzed using analysis of variance.

Results and Discussion

Effect of pinching on growth attributes

The study revealed that the growth parameter *viz*., plant height, number of branches per plant, leaf area and plant spread were significantly influenced by the application of pinching (Table 1). According to ANOVA analysis, when compared to non-pinching, pinching at 30 days reduced plant height (34.04 cm), maximum number of primary branches/plant (11.97), leaf area (49.91cm^2) and plant spread at 90 days (49.89 cm). Conspicuous effect due to pinching was might be due to increased stem length on which maximum number of branches were developed which resulted into more lateral branches and maximum number of flowers and yield increased. These resulted conformities with the finding of Chauhan *et al*., (2005), Singh *et al*., (2015) in marigold, Kumar *et al*., (2011) and Fatma (2017) in calendula.

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

Treatment	PH	NPB	LA	PS
Non pinching	38.86	11.78	49.14	48.25
Pinching	34.04	11.97	49.91	49.89
C.D. at 5%	0.43	0.14	0.69	0.43
Control	36.83	10.00	36.37	46.33
BA 50 ppm	36.04	12.08	45.52	46.50
BA 100 ppm	36.00	11.67	47.68	50.75
BA 150 ppm	36.42	12.25	48.15	47.83
BA 200 ppm	38.23	13.42	57.79	53.75
BA 250 ppm	35.50	11.83	52.93	49.13
BA 300 ppm	36.16	11.92	58.21	49.21
C.D. at 5%	0.81	0.26	1.30	0.80
Interaction (T×P)				
Control × No pinching	41.66	10.33	34.43	45.17
BA 50 ppm × No pinching	33.60	10.16	41.17	45.17
BA 100 ppm × No pinching	39.00	12.33	56.50	47.92
BA 150 ppm × No pinching	39.67	13.00	47.93	50.42
BA 200 ppm × No pinching	46.78	12.50	51.60	53.25
BA 250 ppm × No pinching	35.67	11.66	56.30	50.08
BA 300 ppm × No pinching	35.65	12.50	56.02	45.75
Control × Pinching	32.00	9.66	38.30	47.50
BA 50 ppm × Pinching	38.47	14.00	49.87	47.83
BA 100 ppm × Pinching	33.00	11.00	38.87	53.58
BA 150 ppm × Pinching	33.17	11.50	48.37	45.25
BA 200 ppm × Pinching	29.67	14.33	63.97	54.25
BA 250 ppm × Pinching	35.33	12.00	49.57	48.17
BA 300 ppm × Pinching	36.67	11.33	60.40	52.67
C.D. at 5%	1.15	0.36	1.8321	1.14

PH: Plant height at 90 days (cm); NPB: No. of primary branches at 90 days; LA: Leaf area(cm^2); PS: Plant spread at 90 days(cm)

Effect of BA on growth attributes

The obtained results (Tables 1) revealed that application of benzyl adenine at 200 and 300 ppm created significant stimulative effects on growth parameters of phlox. These effects were clear with the resulted induced increases in plant height, number of primary branches, leaf area and plant spread. maximum plant height (38.23 cm), primary branches at 90 days/plant (13.42) and plant spread at 90 days (53.75 cm) was observed with BA200

Table 2: Effect of BA and pinching on flowering parameters in phlox.

Treatment	Bud initiation (days)	Days to flower initiation	Flower diameter (cm)	Fresh weight of flower (gm)	Dry weight of flower (gm)	Flower withering (days)	Total number of flowers
Non pinching	69.14	80.79	19.83	1.04	0.187	86.48	198.82
Pinching	72.19	83.86	19.97	1.19	0.189	89.06	241.25
C.D. at 5%	1.13	1.40	0.14	0.09	NS	0.33	3.95
Control	75.33	88.00	18.89	0.98	0.16	86.42	184.78
BA 50ppm	71.92	81.92	19.60	0.99	0.19	87.25	198.97
BA 100ppm	71.08	82.33	20.21	0.98	0.18	88.58	192.17
BA 150 ppm	66.75	79.75	20.48	1.76	0.24	90.69	236.75
BA 200ppm	69.58	80.83	20.41	1.00	0.18	87.42	244.89
BA 250ppm	69.50	81.33	20.53	1.08	0.19	87.03	243.09
BA 300ppm	70.50	82.08	19.18	1.03	0.18	87.00	239.58
C.D. at 5%	2.12	2.62	0.27	0.18	0.02	0.62	7.38
Interaction (T×P)							
Control × No pinching	74.00	87.50	19.35	0.93	0.17	86.00	159.56
BA 50 ppm × No pinching	66.33	77.50	19.83	1.04	0.20	84.50	173.67
BA 100 ppm × No pinching	68.67	80.00	20.61	0.98	0.18	86.66	193.00
BA 150 ppm × No pinching	67.17	79.67	19.68	1.21	0.21	89.39	211.00
BA 200 ppm × No pinching	68.67	79.67	20.61	0.94	0.16	86.50	221.66
BA 250 ppm × No pinching	69.00	80.17	19.83	1.19	0.22	85.83	222.00
BA 300 ppm × No pinching	69.67	81.00	18.87	1.02	0.17	86.50	210.83
Control × Pinching	76.67	88.50	18.42	1.04	0.15	86.83	210.00
BA 50 ppm × Pinching	77.00	86.33	19.38	0.95	0.19	90.00	224.28
BA 100 ppm × Pinching	73.50	84.67	19.81	0.99	0.17	90.50	191.33
BA 150 ppm × Pinching	67.33	79.83	21.28	2.30	0.26	92.00	262.50
BA 200 ppm × Pinching	70.50	82.00	20.21	1.06	0.20	88.33	268.11
BA 250 ppm × Pinching	70.00	82.50	21.22	0.98	0.16	88.22	264.17
BA 300 ppm × Pinching	71.33	83.17	19.50	1.03	0.19	87.50	268.33
C.D. at 5%	2.99	3.77	0.38	0.25	0.03	0.88	10.44

ppm. However, maximum leaf area (58.21cm^2) was recorded with application of BA at 300 ppm. This increase in plant height and plant spread due to the role of the BA in cell elongation and division. its lead to increase the nitrogen content on leaves which is important in the formation of protein, nucleic acid, chlorophyll, enzyme, vitamins and plant hormones. In addition to the formation of cell membrane, ATP and NADP and amides. Maximum plant height and plants spread with application of BA has been noticed in lily (Naji *et al*., 2015) and in chrysanthemum (Singh and Bala, 2018).

Interaction effect

The effect of interaction between application of BA and pinching was found to be significant (Table 1). Significantly maximum number of primary branches at 90 days/plant (14.33) was found with pinching × BA 200 ppm which was at par with pinching × BA 50 ppm. The improvement in various growth characteristics is most likely due to the physiological action of BA, which increased the number and size of meristematic tissue cells and along with this pinching breaks the apical dominance enhancing lateral growth which resulted in maximum number of primary branches leading to more accumulation of biomass. Maximum plant height at 90 DAT (46.78 cm) was observed with interaction of no pinching × BA 200 ppm. Maximum leaf area (63.97cm^2) and spread (54.25 cm) was also noted in interaction of pinching × BA 200 ppm. The interaction effect of growth regulator with pinching had a positive influenceon growth attributing characters in marigold (Badge *et al*., 2015).

Effect of pinching on flowering attributes

All the flowering characteristics are significantly influenced by pinching except dry weight of flower (Table 2). Statistically, minimum days to bud initiation (69.14 days), flowering (80.79 days) and maximum days to flower withering (89.06 days) were seen with no pinching. However, maximum bud diameter (19.97 cm) was recorded with pinching at 30 DAT. Similarly, maximum number of flowers per plant (241.25), fresh (1.19 g) and dry weight of flower (0.189 g) were obtained with pinching

at 30 DAT. This was due to superior growth obtained in pinched plants, which was responsible for the production of bigger flowers, a greater number of flowers and, as a result, more flower weight in pinching. These results are in close agreement with the findings of Singh *et al*., (2018), Singh *et al*., (2017) in marigold, Singh and Baboo (2003) in chrysanthemum and Gaidhani *et al*., (2020) in china aster.

Effect of BA on flowering attributes

All the flowering attributes were significantly influenced due to various levels of BA in phlox (Table 2). Significantly, minimum days to bud initiation (66.75 days), flowering (79.75 days), fresh weight of flower (1.76 g), dry weight of flower (0.24 g) and flower diameter (20.48 cm) were recorded with BA 150 ppm. Application of BA 200 ppm resulted maximum number of flower andlongevity of flowers (90.69 days). These increases in flowering attributes by application of BA might be due to the enhanced cell division, cell elongation and improved translocation of metabolites to the flowers. These findings are corroborated with the results of Asil *et al*., (2011) in tuberose, Shoura (2018) in rose and Singh *et al*., (2018) in lily.

Interaction effect

The effect of interaction between BA and pinching was found to be significant (Table 2). Earliest bud initiation (66.33 days) and flowering (77.50 days) were noticed with the interaction of BA 50 ppm ×nopinching. Significantly, maximum flower diameter (21.28 cm), fresh weight of flower (2.30 g), dry weight of flower (0.26 g) and flower withering (92.00 days) were recorded with interaction of BA 150 ppm × pinching. Maximum number of flower (268.33) was observed with the interaction of BA 300 ppm × pinching. Similar trend of results was reported by Badge *et al*., (2015), Singh *et al*., (2017) in marigold and Ali *et al*., (2021) in zinnia.

Conclusion

The present investigation revealed that pinching and benzyladenine (BA) application, either individually or in combination, significantly influenced the growth and flowering characteristics of phlox. Pinching at 30 days after transplanting reduced plant height but enhanced branching, leaf area, plant spread, flower diameter, number of flowers per plant and flower weight. Among the different concentrations of BA, BA 200 ppm was most effective for vegetative growth, recording higher plant height, number of primary branches and plant spread, while BA 300 ppm resulted in maximum leaf area. The interaction of BA 200 ppm with pinching produced superior vegetative growth, particularly in terms of primary branches (14.33), leaf area (63.97 cm^2) and plant spread (54.25 cm). For flowering performance, BA 150 ppm was particularly effective, resulting in earlier bud initiation and flowering, greater flower diameter, and maximum fresh and dry flower weight. The interaction of BA 150 ppm with pinching further improved flower quality, producing the maximum flower diameter (21.28 cm), fresh flower weight (2.30 g), dry flower weight (0.26 g) and flower withering period (92.00 days). However, the maximum number of flowers per plant was recorded with BA 300 ppm × pinching (268.33). Therefore, the combined application of appropriate BA concentration with pinching can be effectively used to improve vegetative growth, flowering and flower quality in phlox. Based on the present study, BA 200 ppm with pinching may be considered for improving vegetative growth, whereas BA 150 ppm with pinching may be useful for enhancing flower quality and yield-related attributes.

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