



ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(11): 1759-1762
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www.thepharmajournal.com
Received: 10-09-2021
Accepted: 19-10-2021

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Effect of pinching levels and paclobutrazol on growth, yield and pot Presentability of potted annual: *Zinnia elegans*

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Abstract

The present investigation entitled “Effect of growth, yield and pot presentability of potted annual – *Zinnia elegans*” was carried out in the College of Horticulture, Rajendranagar during Rabi 2020 – 2021 to find out the effect of pinching practices (Single, double and no pinch) and paclobutrazol at 0, 50, 100 and 150 ppm as well as interaction among them on growth, flower yield and pot presentability of potted annual- *Zinnia elegans*. The obtained results revealed that the pinching increased number of branches per plant, plant spread (E-W and N-S), number of flowers per plant, pot presentability, days to flower bud initiation and days to full bloom but decreased plant height, internodal length, flower diameter. PBZ treatments increased number of branches, flowers per plant, plant spread (E-W & N-S), pot presentability, days to flower bud initiation, full bloom but decreased plant height, internodal length and flower diameter. Among treatment combinations, double pinching with 150 ppm reduced the plant height, internodal length and flower diameter to maximum extent. Double pinching with 100 ppm paclobutrazol was found best for all growth, flower yield and pot presentability.

Keywords: Pinching, paclobutrazol, zinnia, anti- gibberellins, pot presentability

Introduction

Zinnia is a genus of annual flowering plant belonging to Asteraceae (Compositae) family with about 20 species. *Zinnia elegans* is the most popular and well known annual among the genus. *Zinnia* flowers exhibit bright, uniform color sturdy stems with disease resistant plants and long vase life. The chromosome number of *Zinnia elegans* is $2n = 24$.

Zinnia elegans is commonly known as ‘Youth-and-age plant’, ‘common zinnia’ and ‘elegant zinnia’. It is a symbol of endurance, goodness and friendship and the genus was named after a German botanist Johann Gottfried Zinn. It is said to be originated in Mexico and some parts of South and Central America.

In most of the potted plants, the presentability depends on the bushy appearance which can be manipulated by checking the vertical growth of the plant and encouraging lateral shoot. Growth retardants and pinching practices are often used during growing stage to decrease the plant vigour and compact the plant growth mainly in potted plants. Growth retardants are known to produce compact plants, increase the number of flowers and delay or hasten flowering (Bayaskar *et al.* 2019). The main objective of them is to slow stem stretch while allowing the plant to grow.

Paclobutrazol is one of the commonly used growth regulators. It is available in the form of Cultar (25% a.i. as soluble concentrations). It was found to restrict gibberellin biosynthesis in plant by inhibiting activity of ent-kaurene oxidase and cytochrome P450 oxidase, thus restricting the oxidation of ent-kaurene to ent-kaurenoic acid (Dalziel and Lawrence 1984) [1].

Pinching is the process of removal of apical bud along with few leaves. The main purpose of this operation is to encourage branching to produce bushy growth and the production of more flowers and enhance pot presentability of potted zinnia.

Materials and Methods

This study entitled “Effect of pinching practices and paclobutrazol on growth, yield and pot Presentability of *Zinnia elegans*” was carried out during the rabi season of the year 2020-21 at College of Horticulture, Rajendranagar, Telangana of Sri Konda Laxman Telangana State Horticultural University.

This pot experiment was laid out in Factorial Completely Randomized Design (FCRD) with 12 treatments and 3 replications. The treatments consisted of three levels of pinching viz., P1: Single pinching, P2: double pinching and P3: no pinching with four concentrations of paclobutrazol viz., R1: 50 ppm paclobutrazol, R2: 100 ppm paclobutrazol, R3: 150 ppm paclobutrazol and R4: No spray.

Seeds were sown in plug trays filled with a mixture of coco peat and vermicompost and seedlings were transplanted after one month into pots. Plants with single and double pinch treatments were pinched at 3rd to 4th pair leaf stage and the plants with no pinch treatments were left unpinched. Plants with double pinch were pinched second time when the branches of single pinch have 3-4 pairs of leaves. Paclobutrazol solution was prepared at three different concentrations of 50 ppm, 100 ppm and 150 ppm and sprayed respectively on plants twice at 7th and 21st days after pinching. Five plants from each treatment were selected, tagged and data was recorded for plant height (cm), internodal length (cm), number of branches per plant, plant spread (E-W & N-S) (cm), flower diameter (cm), days taken to flower bud initiation (DAT), days taken to full bloom (DAT), Number of flowers per plant, pot presentability (score) according to Conver (1986).

Results

Plant height (cm)

Large plant height with more internodal length is a main hindrance for potted zinnias to attain good pot presentability score. Hence, a study on pinching methods and paclobutrazol concentrations were evaluated for a obtaining a compact

potted zinnia. From the table (1), it can be concluded that the double pinching significantly reduced the overall plant height compared to single pinching and no pinching. The reduction in plant height in pinched plants might be due to removal of apical meristematic tissue, inhibiting apical dominance (Mutlu and Agan, 2015) [2]. Among the PBZ concentrations, a spray @ 150 ppm was observed to reduce the plant height to maximum extent. The reduction in plant height with the paclobutrazol spray might be due to inhibition of gibberellin biosynthesis and restricted growth of the internodes. As a result, the cell elongation was restricted as reported by Laermann *et al.* (1992) [3]. The interaction among the treatments indicated that the combination of double pinching with paclobutrazol @ 150 ppm concentration effectively controlled the plant height when compared to all other treatments.

Internodal length (cm)

Data presented in table (1) indicated that double pinching reduced the internodal length compared single pinching and no pinching treatments. This decrease in internodal length due to pinching may be due to the restricted growth with increase in pinching levels. PBZ application at higher concentrations resulted in reduced internodal length. According to the finding of Fletcher *et al.* (2000) [4], reduced height is a consequence of paclobutrazol induced gibberellin inhibition exemplified by reduced internodal elongation. The interaction effect of treatments revealed that a spray of double pinching @ 150 ppm of paclobutrazol increased the stem diameter compared to all other treatments.

Table 1: Effect of pinching levels and paclobutrazol on plant height (cm) and Internodal length (cm) of potted annual - Zinnia elegans.

Treatments	Pinching levels (P)				Pinching levels (P)			
	Plant height (cm)				Internodal length (cm)			
PBZ concentrations (R)	Single pinch	Double pinch	No pinch	Mean	Single pinch	Double pinch	No pinch	Mean
50 ppm	28.48	24.97	32.74	28.73	3.61	2.65	4.56	3.60
100ppm	27.54	23.69	31.33	27.52	3.52	2.49	4.52	3.51
150 ppm	25.54	21.55	30.29	25.79	3.21	2.18	3.96	3.11
0 ppm	30.19	25.18	36.58	30.65	4.05	3.13	5.16	4.11
Mean	27.93	23.84	32.73		3.59	2.61	4.55	
	S.Em±		C. D at 5%		S.Em±		C. D at 5%	
Pinching (P)	0.26		0.78		0.05		0.15	
Paclobutrazol (R)	0.31		0.90		0.06		0.17	
P X R	0.53		1.57		0.10		NS	

Plant spread (E-W & N-S) (cm)

Plant spread is another important character preferred for presentability of potted Zinnias. From table (2), it could be concluded that the plant spread was found to be maximum in double pinching. The increase in plant spread may be due to pinching that might have restricted the vertical growth, diverted the plant metabolites at meristematic tissues, and thus leading to more of horizontal growth and resulting in

increased plant spread in E-W and N-S direction. Similarly, with the 100 ppm paclobutrazol application the plant spread was more. Similar results were reported by Pinto *et al.* (2003) [5] in zinnia and Latimer *et al.* (1991) [6] in zinnia, impatiens and marigold where the plant spread on both directions was observed to be decreased. With regards to treatment interactions, double pinching with 100ppm paclobutrazol had maximum plant spread both in E-W & N-S directions.

Table 2: Effect of pinching levels and paclobutrazol on plant spread (E-W & N-S) (cm) of potted annual - Zinnia elegans.

Treatments	Pinching levels (P)				Pinching levels (P)			
	Plant spread (E-W) (cm)				Plant spread (N-S) (cm)			
PBZ concentrations (R)	Single pinch	Double pinch	No pinch	Mean	Single pinch	Double pinch	No pinch	Mean
50 ppm	18.64	23.64	16.25	19.51	17.34	22.41	14.36	18.03
100ppm	20.93	25.78	18.65	21.78	19.09	24.52	17.45	20.35
150 ppm	19.37	25.13	17.86	20.78	18.41	23.56	16.87	19.61
0 ppm	17.13	22.17	14.97	18.09	16.57	21.94	12.13	16.88
Mean	19.01	24.18	16.93		17.85	23.10	15.20	
	S. Em±		C. D at 5%		S. Em±		C. D at 5%	

Pinching (P)	0.06	0.20	0.22	0.66
Paclobutrazol (R)	0.08	0.23	0.26	0.76
P X R	0.13	0.40	0.45	1.32

Number of branches per plant: The results presented in the table (3) indicated that the treatments differed significantly with regard to number of branches per plant. The double pinched plants resulted in a significant increase in number of branches per plant than single pinched and unpinched plants. Increased number of branches due to pinching might be attributed to the breaking of apical dominance and sprouting of axillary buds as reported by Khan *et al.* (2018) [7]. While, 100 ppm paclobutrazol showed maximum number of branches, the increase in number of branches by paclobutrazol application is correlated with greater metabolic and divisional activity in the shoot apical meristematic region. Increased branching indicates that paclobutrazol caused major changes in apical dominance and induced lateral bud initiation as observed by Setia *et al.* (1995) [8]. The data from the interaction of the factors under investigation showed that 100 ppm paclobutrazol with double pinching had maximum number of branches than other treatments.

Flower diameter (cm): For a potted plant like Zinnia, more

number of smaller size flowers will have good presentability rather than to have few larger flowers. It is noticed from the results in table (3) that the plants with double pinching had less diameter than single pinched and unpinched plants. The decrease in flower diameter might be attributed to the fact that in pinched plant energy is shared by the developing side branches, while in case of unpinched plants the energy sharing is limited to the flower developing on main branch only. Among the paclobutrazol concentrations, spray of 150 ppm concentration of paclobutrazol showed least diameter among other concentrations. The decrease in flower diameter with the application of paclobutrazol might be due to its growth retarding effect which reduces the plant height, increases the main and secondary branching thereby increasing the number of flowers with reduced flower diameter as reported by Chauhan *et al.* (2021) [9]. Interaction effects of two factors showed that a combination of double pinching with 150 ppm concentration resulted in flowers with smaller diameter than other treatments.

Table 3: Effect of pinching levels and paclobutrazol on number of branches per plant and flower diameter (cm) of potted annual - *Zinnia elegans*.

Treatments	Pinching levels (P)				Pinching levels (P)			
	Number of branches per plant				Flower diameter (cm)			
PBZ concentrations (R)	Single pinch	Double pinch	No pinch	Mean	Single pinch	Double pinch	No pinch	Mean
50 ppm	15.24	23.36	8.32	15.64	6.46	5.39	7.46	6.43
100ppm	18.98	25.56	10.36	18.30	5.82	4.87	6.86	5.85
150 ppm	16.58	24.88	9.14	16.86	5.54	4.49	6.65	5.56
0 ppm	14.54	20.43	7.32	14.09	6.79	5.94	7.88	6.87
Mean	16.33	23.56	8.78		6.15	5.17	7.21	
	S. Em±		C. D at 5%		S. Em±		C. D at 5%	
Pinching (P)	0.22		0.66		0.02		0.08	
Paclobutrazol (R)	0.26		0.76		0.03		0.09	
P X R	0.45		1.32		0.05		NS	

Table 4: Effect of pinching levels and paclobutrazol on days taken to flower bud initiation (DAT) and days taken to full bloom (DAT) of potted annual - *Zinnia elegans*.

Treatments	Pinching levels (P)				Pinching levels (P)			
	Days taken to flower bud initiation (DAT)				Days taken to full bloom (DAT)			
PBZ concentrations (R)	Single pinch	Double pinch	No pinch	Mean	Single pinch	Double pinch	No pinch	Mean
50 ppm	26.57	47.24	13.67	29.16	37.25	58.84	23.31	39.80
100ppm	27.86	47.67	14.19	29.90	38.85	59.21	24.91	40.99
150 ppm	27.64	48.36	14.59	30.19	39.01	59.89	25.71	41.53
0 ppm	25.34	46.65	12.31	28.10	35.68	57.65	21.36	38.23
Mean	26.85	47.48	13.69		37.69	58.89	23.82	
	S. Em±		C. D at 5%		S. Em±		C. D at 5%	
Pinching (P)	0.28		0.82		0.19		0.57	
Paclobutrazol (R)	0.32		0.95		0.22		0.66	
P X R	0.56		NS		0.39		NS	

Days taken to flower bud initiations (DAT)

Among the pinching levels, it is obvious that double pinched plants took significantly longer duration to flower than that of single pinched and unpinched plants. Similar results were also reported by Sehrawat *et al.* (2003) [10] in African marigold and Kumar *et al.* (2002) [11] in carnation. Concerning the paclobutrazol concentrations, higher concentration i.e., at 150 ppm concentration delayed the flower budding initiation. Similar results were also reported by Currey *et al.* (2010) [12] in Easter lilies. The treatment combination with double pinching and 150 ppm concentration resulted in maximum

days to flower bud initiation.

Days taken to full bloom (DAT)

According to results presented, double pinching resulted in maximum days taken for full bloom. Delay in number of days to bud initiation and full bloom due to pinching might be attributed to the fact that, during the process of pinching mature portion of the shoot was removed and new shoots which emerged out from pinched plants took more time to become physiologically mature and produce flowering buds as explained by Wainwright and Irwin (1987) [13].

Paclobutrazol application at 150 ppm concentration resulted in maximum number of days to full bloom. This delay in days to flower bud initiation and days to full bloom may be attributed to the reduced GA synthesis and prolonged vegetative phase by paclobutrazol application according to Chauhan *et al.* (2021)^[9]. Pertaining to interactional effect, the combination of double pinching with 150 ppm paclobutrazol took maximum days to full bloom.

Number of flowers per plant

The significant effects of pinching revealed that double pinching produced maximum number of flowers. This increase in number of flowers may be due to fact that pinched

plant induced production of larger number of axillary shoots resulting in well-shaped bushy plants bearing more number of uniform flowers. Among paclobutrazol concentrations, 100 ppm was noticed to produce maximum number of flowers per plant.

The increase in number of flowers may due to the reason that paclobutrazol alters the source-sink relation in the plant and directly or indirectly relocate carbohydrate resource, further, suppressed the vegetative growth (plant height, internodal length) and increased branching thereby yield. Combinational effects revealed that double pinching with 100 ppm concentration of paclobutrazol produced maximum flowers per plant.

Table 5: Effect of pinching levels and paclobutrazol on number of flowers per plant and pot presentability (score) of potted annual - *Zinnia elegans*.

Treatments	Pinching levels (P)				Pinching levels (P)			
	Number of flowers per plant				Pot presentability (score)			
PBZ Concentrations (R)	Single pinch	Double pinch	No pinch	Mean	Single pinch	Double pinch	No pinch	Mean
50 ppm	12.61	18.91	7.41	12.98	80.78	85.31	77.26	81.12
100ppm	14.80	20.61	8.56	14.66	82.16	87.41	79.13	82.90
150 ppm	13.92	19.82	7.82	13.85	70.36	75.37	67.42	71.05
0 ppm	10.50	16.32	6.71	11.18	68.26	73.28	60.33	67.29
Mean	12.96	18.91	7.63		75.39	80.34	71.04	
	S. Em±		C. D at 5%		S. Em±		C. D at 5%	
Pinching (P)	0.19		0.57		0.27		0.80	
Paclobutrazol (R)	0.22		0.66		0.31		0.92	
P X R	0.39		1.15		0.54		1.60	

Pot presentability (score)

Pot presentability score is an important parameter for a potted plant. According to Conner (1986), pot presentability score was given by considering various shape, form and flowering characters. Stem and foliage parameters were checked under shape; parameters like plant height, spread, and appearance as a whole plant were considered under form and number of flowers per plant, flower size and colour were categorized under flowering characters. For a total score of 100, maximum score was scored by double pinching (80.34) among pinching levels, 100 ppm among paclobutrazol concentration (82.90) and combination of double pinching with 100 ppm concentration (87.41) among interactions (Table 5) as they were observed to have good shape, form and flowering characters.

Conclusion

Based on the study conducted, it could be concluded that, among pinching levels, double pinching was found best and among the paclobutrazol concentrations, 100 ppm was best for all growth, flower yield and pot presentability. Among the interactions, double pinching with 150 ppm reduced the plant height, internodal length and flower diameter to maximum extent but desirable measure for growth, yield and pot presentability characters was found in treatment double pinching with 100 ppm paclobutrazol for potted zinnia.

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