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INFLUENCE OF GROWTH RETARDANTS ON GROWTH AND FLOWERING OF CROSSANDRA (*CROSSANDRA INFUNDIBULIFORMIS*) UNDER FIELD CONDITIONS

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ABSTRACT

The present research was carried out in crossandra at ICAR-DFR, Regional Station, Vemagiri, Kadiyam mandal. The experiment was carried out during 2021-22 (September-May). The experiment was laid out in Randomised Block Design (RBD) with ten treatments of plant growth retardants *viz.*, cycocel (500,1000 1500 ppm), paclobutrazol (500, 1000, 1500 ppm) and maleic hydrazide (200, 600, 1000 ppm). The treatments were replicated thrice. Among the growth parameters, the maximum plant height, leaf length and leaf width were recorded with the untreated plants while the minimum was observed with the application of paclobutrazol @ 1500 ppm. The plant spread has increased with the application of cycocel and maleic hydrazide and maximum was recorded with maleic hydrazide @ 600 ppm (T_9) which was on par with cycocel @ 1500 ppm (T_4). Application of paclobutrazol @ 1500 ppm (T_7) recorded the maximum chlorophyll content of the leaves that was succeeded by the treatment T_6 (paclobutrazol @ 1000 ppm). The least chlorophyll content was recorded in the untreated plants. Among the treatments, maleic hydrazide @ 600 ppm recorded the maximum number of branches per plant, leaf area, root-shoot ratio, fresh weight and dry weight of roots. Foliar application of maleic hydrazide @ 600 ppm (T9) significantly improved the flowering parameters *viz.*, number of spikes per plant, number of florets per spike, length of spike, length of the floret, longevity of spike in the field, longevity of florets on the spike, flower yield per plant, hundred florets weight and shelf life of the florets and can be recommended for loose flower production of crossandra.

***Key words*:** Crossandra, cycocel, maleic hydrazide, paclobutrazol

Introduction

Ornamental flowering plants are highly valued for their attractive look and appearance. One such ornamental flowering plant is crossandra that produces bright orange- and yellow-coloured flowers. Crossandra is also known as “fire cracker plant” because the seed pods that are usually formed after flowering tend to explode under high humid conditions. Crossandra plants are generally hardy in nature and can be cultivated as loose flowers or potted plants. It has got considerable importance in comparison to other flower crops due to perennial nature, flowering throughout the year, consumption of minimum amount of fertilizers and higher profitability. There is an adequate scope to enhance the production of crossandra by adopting proper crop management practices. One such approach is application of plant growth retardants. The growth retardants act by blocking the biosynthesis of gibberellins, thereby restricting the activity of cell expansion (Quattrini *et al.*, 1995; Lewis *et al.*, 2004) that results in plants which are compact

Table 1: Effect of growth retardants on various vegetative parameters.

S.	Treatment details	PH	PS	LL	LW	NBPP	CC	LA	RSR	FWR	DWR
1	T_1 Control (water spray)	63.25	67.09	13.19	8.01	12.07	150.03	2741.17	0.22	224.09	56.02
2	T_2 CCC @ 500 ppm	55.51	70.33	12.96	6.02	14.20	160.23	3021.10	0.24	249.13	62.28
3	T_3 CCC @ 1000 ppm	49.14	71.81	12.47	6.14	14.94	163.49	3129.13	0.25	267.18	66.80
4	T_4 CCC @ 1500 ppm	44.19	75.28	11.91	6.22	17.33	167.28	3408.87	0.29	273.29	68.32
5	T_5 Paclobutrazol @ 500 ppm	43.17	66.75	10.73	6.13	10.96	184.69	2660.84	0.19	210.14	52.54
6	T_6 Paclobutrazol @ 1000 ppm	40.56	62.16	10.26	5.84	10.76	189.72	2561.05	0.17	197.62	49.41
7	T_7 Paclobutrazol @ 1500 ppm	37.06	60.24	10.13	5.62	9.26	200.32	2454.63	0.14	186.37	46.59
8	T_8 Maleic hydrazide @ 200 ppm	51.27	70.08	12.14	6.09	17.43	181.26	3774.07	0.26	275.28	68.82
9	T_9 Maleic hydrazide @ 600 ppm	45.19	75.53	11.96	6.18	20.37	184.61	3891.05	0.31	298.31	74.58
10	T_{10} Maleic hydrazide @ 1000 ppm	42.27	72.09	11.67	6.04	14.35	182.71	3567.70	0.22	285.79	71.45
	Mean	**47.16**	**69.13**	**11.74**	**6.21**	**14.47**	**176.43**	**3120.96**	**0.23**	**246.72**	**61.68**
	CD	**0.34**	**0.32**	**0.04**	**0.04**	**0.96**	**0.38**	**13.96**	**0.10**	**1.66**	**0.41**

PH: Plant Height(cm); PS: Plant spread(cm); LL: Leaf length(cm); LW: Leaf width(cm);
NBPP: No. of branches per plant; CC: Chlorophyll content (SPAD units); LA: Leaf area(cm^2);
RSR: Root-shoot ratio; FWR: Fresh weight of roots (g); DWR: Dry weight of roots (g)

with dark green foliage. Synthetic plant growth retardants are becoming more popular in commercial floriculture for their ability in manipulating the growth and development of ornamental crops with a view to develop compact growth habitat by retarding the excessive vegetative growth without having any detrimental effect on the yield of crop, resulting in early and quality blooming.

Materials and Methods

The present research work was carried out at ICAR-DFR, Regional center, Vemagiri, East Godavari District. This location comes under the Agro-Climatic Zone no:10 (Godavari zone) with tropical savanna climate. The average annual rainfall is 1017.67 mm. The mean temperature ranges from a maximum of 51ºC to a minimum of 16ºC. The experiment was carried out in a Randomised Block Design with 10 treatments that were replicated thrice. The treatments comprise of three concentrations of Cycocel (500,1000 and 1500 ppm), paclobutrazol (500, 1000 and 1500 ppm) and maleic hydrazide (200, 600 and 1000 ppm). One month old rooted cuttings of cv. Local Orange were transplanted into the field. Cultural and management practices were attended timely. Spray application of growth retardants was done 45 DAT and 60 DAT. Maleic hydrazide and cycocel were applied through foliar spray, whereas, paclobutrazol was applied through soil drenching followed by foliar application. The data was subjected to statistical analysis and tabulated hereunder.

Results and Discussion

The results of the research and the relevant discussions were summarized under following heads

Growth parameters

The data pertaining to the plant height, plant spread, leaf length, leaf width, number of branches per plant, chlorophyll content and leaf area was shown in the Table 1. Significant variation was observed among various growth parameters with the application of growth retardants. The height of the plant and leaf length were recorded maximum in control plants whereas the minimum was observed with paclobutrazol @ 1500 ppm. It was observed that the suppression in the plant height

Fig. 1: The variations observed in the height of plants treated with paclobutrazol @ 500 ppm (T_5) (right) as compared to control plants (T_1) (left).

Table 2: Effect of growth retardants on various vegetative parameters.

S.	Treatment details	DFSE	NSPP	NFPS	LS	LSF	LFS	FYPP	FW	SLF
1	T_1 Control (water spray)	49.18	11.13	12.13	14.52	7.49	3.60	65.98	4.55	3.18
2	T_2 CCC @ 500 ppm	44.28	12.93	10.96	16.08	8.62	2.98	72.64	4.72	3.25
3	T_3 CCC @ 1000 ppm	43.17	13.30	11.08	16.29	8.17	3.06	79.20	4.86	3.95
4	T_4 CCC @ 1500 ppm	44.11	16.57	12.48	17.10	8.53	3.23	82.53	4.95	3.82
5	T_5 Paclobutrazol @ 500 ppm	41.09	10.18	8.65	10.45	6.47	2.92	46.20	4.23	2.95
6	T_6 Paclobutrazol @ 1000 ppm	39.17	9.56	8.01	9.26	7.24	2.85	40.86	3.91	2.84
7	T_7 Paclobutrazol @ 1500 ppm	40.28	8.21	7.26	8.92	7.01	2.71	35.05	3.34	2.76
8	T_8 Maleic hydrazide @ 200 ppm	43.29	16.03	11.39	12.53	9.02	3.78	83.68	5.12	4.20
9	T_9 Maleic hydrazide @ 600 ppm	38.17	20.86	16.88	18.66	11.24	4.04	125.18	6.52	4.63
10	T_{10} Maleic hydrazide @ 1000 ppm	40.82	17.28	13.25	17.14	9.99	3.82	104.56	6.01	4.19
	Mean	**42.36**	**13.60**	**11.11**	**14.01**	**8.38**	**3.30**	**73.58**	**4.82**	**3.58**
	CD	**0.23**	**0.27**	**0.13**	**0.16**	**0.03**	**0.02**	**1.24**	**0.04**	**0.05**

DFSE: Days to first spike emergence(Days); NSPP: No. of spikes per plant; NFPS: No. of florets per spike; LS: Length of spike(cm); LSF: Longevity of spike in field (Days); LFS: Longevity of florets on spike(Days); FYPP: Flower yield per plant (g); FW: 100 florets weight(g); SLF: Shelf life of florets(days)

was directly proportional to the concentration of the growth retardant sprayed. Grossman (1992) reported that at lower level of growth retardant concentration, the activity of cell elongation is impeded, whereas at higher levels the activity of cell division gets reduced. The peak reduction in the plants that were sprayed with paclobutrazol @ 1500 ppm might be ascribed to its high concentration that had hampered the process of cell division and cell elongation in apical meristematic cells. Corroboratory results were reported by Malik *et al.*, (2021) in Asiatic lilium.

Application of maleic hydrazide @ 600 ppm recorded the maximum plant spread (75.53 cm), number of branches (20.37), leaf area (3891.05 cm^2), number of leaves per plant (324.57), fresh weight and dry weight of roots (224.09 g and 56.02 g respectively) whereas, paclobutrazol @ 1500 ppm recorded the minimum plant spread (60.24 cm), leaf length (10.13 cm), number of branches (14.47), leaf area (2454.63 cm^2) and highest chlorophyll content (200.32 SPAD). The intensification in the color of leaves with the application of paclobutrazol might be attributed to the reduced damage caused by reactive oxygen species and change in the levels of peroxidase enzymes (Nivedithadevi *et al.*, 2015). It could also be due to an increase in the number of chloroplasts per unit leaf area as there is reduction in the leaf area of plants that were treated with paclobutrazol as reported

Fig. 2: The performance of plants treated with maleic hydrazide @ 600 ppm (T_9).

Fig. 3: The difference observed in the length of spikes of various treatments (T_1-T_{10}) (From left to right).

by Khalil and Rahman (1995). The results were found to be similar to those of Lailaty and Nurgroho (2021) in chrysanthemum, Singh (2016) in African marigold and Rathore *et al.*, (2011) in marigold.

The differential inhibition as seen can be attributed to the differential mode of action by the growth inhibitor chemicals used in the study. The results obtained can be interpreted that, it might be due the hinderance role of maleic hydrazide on the cell division capacity of apical meristematic cells that resulted in arrested growth of the main axis which accelerated the emergence and growth of lateral buds into new shoots, thereby enhancing the vegetative growth of plants as compared to control plants (Desta and Amare, 2021). Despite decrease in the leaf size as compared to control, there was a gross increase in the leaf area per plant which can be attributed to an increase in the leaf number.

Paclobutrazol at all the concentrations recorded a suppression in the spread of plants when compared to control. This might be attributed to the physiological role of paclobutrazol in altering the gibberellin mediated cell elongation by inhibiting its biosynthesis and due to the application of higher concentrations. Under such conditions, the activity of cell division occurs but the nascent cells do not elongate thereby resulting in shoots with reduced internodal length and leaf area (Desta and Amare, 2021).

Flowering parameters:

Flowering parameters *viz.*, minimum number of days for first spike emergence (38.17 days), number of spikes per plant (20.86), number of florets per spike (16.88), length of spike (18.66 cm), longevity of spike in the field (11.24 days), longevity of florets on the spike (4.04 days), flower yield per plant (125.18 g), hundred florets weight (6.52 g) and shelf life of the florets (4.63 days) were recorded maximum with the foliar application of maleic hydrazide @ 600 ppm (T_9). The plants that were sprayed with water recorded maximum number of days for first spike emergence (49.18 days), whereas, application of paclobutrazol @ 1500 ppm (T_7) resulted in minimum number of spikes per plant (8.21) and florets per spike (7.26), length of the spike (8.92 cm), longevity of florets on the spike (2.71 days), flower yield per plant (35.05 g), 100 florets weight (3.34 g) and shelf life of florets (2.76 days).

Foliar application of maleic hydrazide @ 600 ppm resulted in early flowering by 11.01 days as compared to control. This might be due to the fact that the plants that were sprayed with maleic hydrazide had enough food reserves at the initial stages of growth due to optimum suppression of activity of apical meristematic cells and an increase in the number of leaves that diverts more food reserves from source to sink (Sheetalben *et al.*, 2015). The increase in the leaf number and leaf size contributed in the production of more photosynthates and thus, resulting in more number of spikes per plant. The obtained results were found to be in line with those of Dani *et al.*, (2010) in marigold and Aswath *et al.*, (1994) in china aster.

The application of higher concentration of paclobutrazol might have resulted in poor development of plants with minimum number of branches and leaves, which led to a reduction in the canopy of the plant. This further resulted in minimum light interception that might have hampered the process of photosynthesis, thereby resulting in minimum number of spikes per plant and florets per spike. The results were in confirmation with the research findings Mao *et al.*, (1990) in Salvia and Singh (2002) in rose.

Foliar application of maleic hydrazide @ 600 ppm (T_9) recorded the better results regarding various vegetative parameters that has led to the highest flower yield per plant as compared to the other treatments and paclobutrazol @ 1500 ppm (T_7) recorded the least performance in crossandra. Maleic hydrazide @ 600 ppm can be recommended for loose flower production of crossandra.

Declaration of Competing Interest: The authors declare that they have no competing interests

Author Contribution statement: The authors confirm the contribution to paper as follows; study, conception, design, data collection, analysis, data interpretation: Meghana. K and Dr. DVS Raju; data analysis, draft manuscript corrections and finalising: Dr. AVD Doarajeerao; physiological data analysis and interpretation of results: Dr. P. Subbaramamma. All authors reviewed the results and approved the final version of the manuscript.

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References

Aswath, S., Gowda J.V.N. and Murthy G.M.A. (1994). Effect of growth retardants on growth, flowering and nutrients contents in China aster (*Callestephus chinensis* L.) cv. Powder Puff Mixed. *Journal of Ornamental Horticulture*. **2(1-2)**, 9-13.

Dani, K.N., Patil S.J., Patel R.G., and Patel N.A. (2010). Effect of growth retardants on flowering and yield of African marigold (*Tagetes erecta* L.) cv. Double Orange under South Gujarat conditions. *Asian Journal of Horticulture.* **5(2)**, 287-290.

Desta, B. and Amare G. (2021). Paclobutrazol as a plant growth regulator. *Chemical and Biological Technologies in Agriculture*. **8(1)**, 1-15.

Grossman, K. (1992). Plant growth retardants, their mode of action and benefit for physiological research. *Kluwer Academic Publishers*, Dodrecht, Neatherland. 788-797.

Khalil, I.A. and Rahman H. (1995). Effect of paclobutrazol on growth, chloroplast pigments and sterol biosynthesis of maize (*Zea mays* L.). *Plant Sciences*. **105**, 15-21.

Lailaty, I.Q. and Nugroho L.H. (2021). Vegetative anatomy of three potted chrysanthemum varieties under various paclobutrazol concentrations. *Biodiversitas Journal of Biological Diversity*. **22(2)**, 563-570.

Lewis, P.K., Faust J.E., Sparkman J.D. and Grimes L.W. (2004). The effect of daminozide and chlormequat on the growth and flowering of Poinsettia and Pansy. *Horticulture Science*. **39(6)**, 1315-1318.

Malik, K.M., Wani A.H. and Nazki I.T. (2021). Effect of growth retardants on growth, flowering and bulb yield of Asiatic lilium. *International Journal of Scientific and Research Publications*. **11(4)**, 448-452.

Mao, L.S., Gao Y., Gian Y. and Tang Y.L. (1990). Dwarfing effects of paclobutrazol, daminozide and chloromequat on potted scarlet sages. *Acta Horticulturae Sinica*. **18(2)**, 177-179.

Nivedithadevi, D., Somasundaram R. and Pannerselvam R. (2015). Effect of abscisic acid, paclobutrazol and salicylic acid on the growth and pigment variation in *Solanum trilobatum.International Journal of Drug Developments Researcher*. **4**, 236-246.

Quattrini, E., Venezia A. and Casarotti D. (1995). Dwarfing effect of chlormequat on gardenia (*Gardenia jasminoides* Ellis). *Colture Protette*. **24(7-8)**, 75-78.

Rathore, I., Mishra A., Moond S.K. and Bhatnagar P. (2011). Studies on effect of pinching and plant bioregulators on growth and flowering of marigold (*Tagetes erecta* L.) cv. Pusa Basanti Gainda. *Progressive Horticulture*. **43(1)**, 52-55.

Sheetalben, K., Jadhav S.K., Chawla S.L., Agnihotri R. and Gurjar R.A. (2015). Effect of growth retardants on the vegetative growth, flowering and yield of Heliconia (*Heliconia psittacorum)* var. Red Torch under 50 percent shade net condition. *The Bioscan*. **10(4)**, 1509-1513.

Singh, A.K. (2002). Growth and flowering in rose influenced by application of paclobutrazol. *South Indian Horticulture*. **50(1)**, 124-127.

Singh, A.K. (2016). Influence of paclobutrazol on growth and seed yield in African marigold. *Environment and Ecology*. **34(4)**, 1900-1902.