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Influence of Growth Retardants on Growth of Potted Alstroemeria (*Alstroemeria hybrida* L.)

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Authors' contributions

This work was carried out in collaboration between all authors. Authors RAL, ITN and Nelofar designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors IK and MAW managed the analyses of the study. Authors FAK, JA and GG managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted to evaluate the influence of different concentrations of Alar (Diaminozide) and Ethephon (Ethrel) as spray applications on two cultivars of pot grown Alstroemeria to study their effect on different vegetative parameters under shaded conditions during two successive flushes in the year 2016 – 2017 at the Research farm of Division of Floriculture and Landscape Architecture, *Sher-e-Kashmir University of Agricultural Sciences and*

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Technology of Kashmir, Shalimar Campus Srinagar*,* in 2017. Fourteen different treatments with two cultivars (Pluto, New Pink) were used with four concentrations of Alar (0, 500, 1000 and 1500ppm) and Ethephon (0, 1000, 1500, 2000 ppm) were replicated thrice in a Completely Randomized Design. The investigation revealed that with application of Alar at 1500 ppm maximum reduction of height and number of leaves was observed in both cultivars in successive flushes followed by Ethephon 2000 ppm and Alar at1000ppm. Plant spread, diameter of shoots and chlorophyll content increases by application of Alar at1500 ppm. Height reduction of (33.05% and 21.21%) was observed in cultivar New Pink and Pluto respectively.

Keywords: Alstroemeria; pot plant; growth retardants; Alar; Ethephon.

1. INTRODUCTION

Alstroemeria hybrid L. [1] commonly known as the Peruvian Lily or the Lily of the Incas is a native of South America. The genus is a rhizomatous monocot and belongs to family Alstroemeriaceae [2]. Previously, Alstroemeria was assigned to family Amaryllidaceae and Liliaceae [3,4]. Alstroemeria plants are widely cultivated in many countries especially in Western Europe and North America and popularity has increased recently due to its long-vase life, large variety of colours and low energy requirement during cultivation [5]. In Kenya in terms of popularity and foreign exchange Alstroemeria stands third after roses and statice [6]. The popularity of this flower is still growing and has attained the status of one of the ten most important cut flowers in the world.

In the late 1980s, several breeders started work on developing seed propagated Alstroemeria cultivars which would be suitable for pot culture. Konst of Netherlands has been the pioneer breeding company in the world to introduce a series of successful dwarf Alstroemeria cultivars belonging to Inca series which are suitable for pot culture. Earliest dwarf cultivars include Rosalina and Dorotea. Although Alstroemeria cultivars available for pot culture are 50 per cent shorter than cut flower varieties, plant height is still excessive for most markets. Moreover, genetically dwarf plants are still beyond the reach of common grower as they are strictly protected by plant breeder rights. Chemical growth retardants have been known to be useful in manipulating shape, size and form of ornamental crops [7]. They permit a direct approach to growth control by retarding internodal elongation without seriously disrupting growth processes. Most of the commercially available growth retardants are primarily used to retard plant, height regulate flowering and stimulate lateral or basal branches. Major work on standardization of growing media, lighting and use of growth retardants to control growth and flowering has mostly been done on cut flower varieties which are tall in growth habit [8,9]. In Alstroemeria growing regions of India including Kashmir most of the cultivars introduced in 90's are tall cut flower types. In order to explore their potential as potted plants use of growth retardant to control their height is imperative.

2. MATERIALS AND METHODS

The present investigation was carried out at the Research farm of Division of Floriculture and Landscape Architecture, *Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir,* Shalimar Campus Srinagar*,* in 2017. Srinagar district of Jammu and Kashmir state is situated between 34°5`-34°7` North latitude and 74°8`-74°9` East longitude at an altitude of 1558 meters above mean sea level. It is flanked on the South-East and North-East sides by the lofty Himalayan ranges. The SKUAST (K) Campus is situated at the base of these ranges towards the North-East side 15 kms from Srinagar city. The organic carbon of the soil was found to be 0.98 per cent and pH/6.93. The climate of the area in general is temperate-cum Mediterranean and of continental type characterized by hot summers and severe winters. Hottest months are July and August during which temperature shoots up to 32°C. The experiment was conducted in Completely Randomized Design, the total number of treatments were fourteen, two cultivars (Pluto, New Pink) were used with four concentrations of Alar (0, 500, 1000 and 1500 ppm) and Ethephon (0, 1000, 1500, 2000 ppm) to see their effect on growth through spray application. Rhizomes of 3-4cm length, containing 1-2 sprouted shoots, 3-4 fleshy storage roots and sufficient number of fibrous roots were planted in 20 cm diameter pots (1 per pot) in a well prepared potting mixture consisting of equal parts by volume of soil, FYM, sand, cocopeat and vermicompost in November 2016. In all pots the growing shoots were trimmed to 5-cm height to bring uniformity in the

growth pattern and only 10 healthy generative shoots were retained in each pot to avoid overcrowding and competition. Two sprays of each chemical were made, first when the shoots were 10-15cm tall and second 20 days after the first spray. Same set of treatments were repeated in both cultivars as soon as growth resumed after dormancy in August. Thin and weak shoots were periodically removed.

The solutions of Alar (daminozide) 1500 ppm and Ethephon 2000 ppm was prepared by dissolving 1500 milligrams of Alar in 1000 ml distilled water and by dissolving Ethephon 2000 ml in 1000 ml distilled water and rest of concentrations were prepared accordingly. The plants were sprayed until droplet formation on the leaves. The observations were recorded on plant height, plant spread, shoot length, number of leaves/shoots, shoot diameter and chlorophyll content of leaves. The statistical analysis was done using Completely Randomized Design at 5% level of significance.

3. RESULTS

Results presented in Table 1 revealed that plants of cv. New Pink was shorter than those of Pluto in both the flushes. Maximum height reduction was attained by Alar (1500 ppm) spray (64.44 cm) in Pluto from first flush against control plants (81.77 cm). In second flush the height of Pluto with 1500 ppm Alar sprays remain (61.55 cm) while in control plants it was (78.11 cm).

Mean of both flushes indicate (21.21%) reduction in plant height in Pluto. Same trend was observed in New Pink with maximum reduction with Alar (1500 ppm) sprays (33.44 cm and 30.77 cm) as against controlled plants (49.44 cm and 46.44 cm) during first and second flush respectively. Mean of first and second flush depicts (33.05%) height reduction in cultivar New Pink. Plant spread was found to be maximum (34.66 cm) in New Pink and (28.02 cm) in Pluto with Alar sprays (1500 ppm) during second flush. Shoot length shows similar trend as of plant height in both the cultivars with minimum shoot length of (24.72 cm) in New Pink and (55.14 cm) in Pluto.

Perusal of Table 1 reveals that a marked effect of Alar (1500 ppm) spray was noticed on number of leaves, diameter of shoots and chlorophyll content. Maximum reduction in number of leaves was observed in cv. Pluto (28.33) as against control plants (45.44) during second flush. In cv. New Pink number of leaves was also markedly reduced by Alar (1500 ppm) sprays with reduction to (15.66) as against control plants (29.44) in second flush. Mean of two flushes also depicts the similar trend. Alar (1500 ppm) sprays results in maximum diameter of shoots in cv. Pluto (3.24 mm) and New Pink (2.73 mm) followed by Ethephon (2000 ppm) and Alar (1000 ppm) in both the cultivars. Chlorophyll content was found to be maximum in Pluto (22.07) and New Pink (12.55) during first flush by the application of Alar (1500 ppm) followed by Ethephon (2000 ppm) and Alar (1000 ppm). Lowest chlorophyll content was observed in controlled plants in both the cultivars. All the parameters depict some difference during the two flushes.

4. DISCUSSION

All concentrations of Alar and Ethephon used in the experiment have marked effect on reduction of plant height, number of leaves and shoot length. The higher concentration of both results in maximum reduction. Alarat 1500 ppm was the most effective in achieving the desired results followed by Ethephon at 2000 ppm in both the cultivars. However, cultivar Pluto was genetically taller, had thicker stems with more chlorophyll content remain taller with less plant spread than cultivar New Pink in both the flushes. Cultivar New Pink showed better height control, lesser shoot length and plant spread in both the flushes with Alar (1500) sprays. The reduction in vegetative growth due to Alar is its ability to render a key enzyme for GA production useless, thus reducing GA levels and Ethephon is attributed to its conversion to ethylene in plants cells. The increased ethylene causes cells to limit elongation and increase in width instead. The release of ethylene reduces apical dominance, which can increase axillary branching. Our findings are in consent with those of [10] who advocated that spray treatments of B-Nine (Alar) were effective in controlling plant height in Alstroemeria and [11] reported that height reduction of 31.5 per cent in the first flush was recorded with Alar (1500 ppm) spray where as a combination of drench and spray application of Alar (1500 ppm) resulted in 28 per cent height reduction in the second flush.

The reduction in leaf number with growth retardants correlates with the reduction in height and increase in chlorophyll content may be due to increase in number of palside cells which in turn achieved darker green colour correlates with high amount of chlorophyll content.

Table 1. Effect of growth retardants on growth of Alstroemeria

Treatment details	Plant height		Mean	Plant spread		Mean	Shoot length		Mean
	First flush	Second flush		First flush	Second flush		First flush	Second flush	
New Pink (Control)	49.44	46.44	**47.94**	23.55	25.51	**24.53**	40.69	39.22	**39.95**
New Pink (Alarat500ppm)	43.44	41.44	**42.44**	26.40	28.69	**27.54**	35.73	33.70	**34.71**
New Pink (Alarat1000ppm)	37.44	34.88	**36.16**	27.83	28.54	**28.18**	29.81	27.80	**28.80**
New Pink (Alarat1500ppm)	33.44	30.77	**32.10**	32.17	34.66	**33.41**	26.46	24.72	**25.59**
New Pink (Ethephonat1000ppm)	46.33	43.44	**44.88**	21.73	23.24	**22.84**	37.95	35.61	**36.78**
New Pink (Ethephonat1500ppm)	41.55	39.55	**40.55**	24.68	25.88	**25.28**	34.11	31.11	**32.61**
New Pink (Ethephon at2000ppm)	36.44	33.55	**34.99**	28.59	32.03	**30.31**	28.88	27.03	**27.95**
Pluto (Control)	81.77	78.11	**79.94**	18.00	19.70	**18.85**	71.24	70.95	**71.09**
Pluto (Alarat500ppm)	74.55	71.44	**72.99**	20.47	22.51	**21.49**	67.07	64.02	**65.54**
Pluto (Alarat1000ppm)	69.55	66.00	**67.77**	22.69	25.10	**23.89**	61.99	59.77	**60.88**
Pluto (Alarat1500ppm)	64.44	61.55	**62.99**	26.47	28.02	**27.24**	57.84	55.14	**56.49**
Pluto (Ethephonat1000ppm)	77.33	75.22	**76.27**	18.92	20.32	**19.62**	69.17	66.96	**68.06**
Pluto (Ethephonat1500ppm)	73.55	69.44	**71.49**	21.04	23.92	**22.48**	66.10	64.21	**65.15**
Pluto (Ethephon at2000ppm)	67.55	63.55	**65.55**	24.43	27.10	**25.76**	61.36	59.32	**60.34**
LSD 0.05	2.314	1.842		1.269	1.159		1.845	2.519	
SEm (±)	**0.795**	**0.632**		**0.436**	**0.398**		**0.634**	**0.865**	

Table 2. Effect of growth retardants on growth of Alstroemeria

Treatment details	No. of leaves		Mean	Dia. of vegetative shoots		Mean	Chlorophyll content		Mean
	First flush	Second flush		First flush	Second flush		First flush	Second flush	
New Pink (Control)	27.89	29.44	**28.66**	2.48	2.46	**2.47**	11.44	11.37	**11.40**
New Pink (Alarat500ppm)	23.77	21.44	**22.60**	2.56	2.54	**2.55**	11.76	11.71	**11.73**
New Pink (Alarat1000ppm)	20.55	18.66	**19.60**	2.65	2.60	**2.62**	11.88	11.79	**11.83**
New Pink (Alarat1500ppm)	18.22	15.66	**16.94**	2.73	2.66	**2.69**	12.55	12.49	**12.52**
NewPink (Ethephonat1000ppm)	26.11	24.44	**25.27**	2.59	2.56	**2.57**	11.55	11.40	**11.47**
New Pink (Ethephonat1500ppm)	24.44	22.00	**23.22**	2.65	2.62	**2.63**	11.65	11.59	**11.62**
New Pink (Ethephon at2000ppm)	20.44	18.00	**19.22**	2.69	2.64	**2.66**	12.25	12.21	**12.23**
Pluto (Control)	43.55	45.44	**44.49**	3.15	3.08	**3.11**	21.75	21.61	**21.68**
Pluto (Alarat500ppm)	38.33	35.33	**36.83**	3.18	3.11	**3.14**	21.95	21.70	**21.82**
Pluto (Alarat1000ppm)	35.77	31.67	**33.72**	3.21	3.16	**3.18**	22.01	21.76	**21.38**
Pluto (Alarat1500ppm)	31.44	28.33	**29.88**	3.24	3.19	**3.21**	22.50	21.89	**22.16**
Pluto (Ethephonat1000ppm)	40.55	38.11	**39.33**	3.16	3.10	**3.13**	21.81	21.14	**21.47**
Pluto (Ethephonat1500ppm)	38.11	34.77	**36.44**	3.18	3.12	**3.15**	21.95	21.51	**21.73**
Pluto (Ethephon at2000ppm)	34.92	31.44	**33.18**	3.22	3.17	**3.19**	22.07	21.81	**21.94**
C.D (0.05)	1.681	1.436		0.254	0.227		0.295	0.718	
SEm (±)	**0.577**	**0.493**		**0.087**	**0.078**		**0.101**	**0.247**	

This results agree with [12,13,14] results showed that leaves treated with Alar were normal in shape but with reduction in the leaves area associated with darker green colour (high amount of chlorophyll content) with respect to the concentrations applied.

The difference in plant height and corresponding shoot length along with other vegetative parameters in the two flushes was primarily a function of temperature and photoperiod. [6] also reported that vegetative shoot production in Alstroemeria is stimulated by high air temperature (25°C) and long photo periods (12 hour to 16 hours) but under decreasing photo periods (8 hour) and low temperatures, plant height and shoot length drastically reduced.

5. CONCLUSION

This study showed that among the two growth retardant Alar was more effective in reducing plant height, shoot length and number of leaves, increases plant spread, stem thickness, and the number of palisade cells which in turn achieved darker green colour correlates with high amount of chlorophyll content.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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