
**E-ISSN:** 2618-0618
**P-ISSN:** 2618-060X
© Agronomy
www.agronomyjournals.com
2024; 7(2): 80-84
Received: 14-11-2023
Accepted: 20-12-2023

**Divya KR**
Department of Floriculture and Landscape Architecture, COH, Tamaka, Kolar, Karnataka, India

**Rajesh AM**
Department of Floriculture and Landscape Architecture, COH, Tamaka, Kolar, Karnataka, India

**Seetharamu GK**
Department of Floriculture and Landscape Architecture, COH, Bengaluru, Karnataka, India

**Babu AG**
Department of Biotechnology and Crop improvement, COH, Tamaka, Kolar, Karnataka, India

**Raghunatha Reddy**
Department of Soil Science and Agricultural Chemistry, COH, Bengaluru, Karnataka, India

**Manjunatha Ramanna**
Department of Natural Resource Management, COH, Bengaluru, Karnataka, India

**Corresponding Author:**
**Divya KR**
Department of Floriculture and Landscape Architecture, COH, Tamaka, Kolar, Karnataka, India

# Effect of different levels of growth retardants on growth parameters of *Bougainvillea glabra* var. pink beauty

**Divya KR, Rajesh AM, Seetharamu GK, Babu AG, Raghunatha Reddy and Manjunatha Ramanna**

**DOI:** https://doi.org/10.33545/2618060X.2024.v7.i2b.288

**Abstract**
*Bougainvillea* is a flowering plant genus which belongs to the family of Nyctaginaceae and native to South America. Because of its robust growth, regular pruning is required to maintain its plant architecture. To overcome this and to maintain the plant size consistent, application of growth retardants would be the better alternative for frequent pruning. The research work was conducted during 2022-23 at Department of Floriculture and Landscape Architecture, College of Horticulture, Bengaluru. The experiment was laid out in Randomized Complete Block Design (RCBD) with 13 treatments replicated thrice. The growth retardants *viz*., Paclobutrazol, Maleic Hydrazide and Alar were used and *Bougainvillea glabra* var. Pink Beauty was used as planting material. Where, paclobutrazol applied as soil drench and others as foliar application at thirty days interval thrice. For growth parameters *viz*., minimum plant height (18.93 cm), plant spread (307.60 $cm^2$), internodal length (0.89 cm), leaf area (8.83$cm^2$), specific leaf area (31.25 $cm^2/g$), increased specific leaf weight (0.036$g/cm^2$) and maximum stem girth (4.02 mm) noticed with the soil drenching of Paclobutrazol at 45 ppm. Whereas, foliar application of Alar at 1250 ppm resulted with increased number of primary branches (2.33). However, increased number of secondary branches per plant (2.07) noticed with foliar application of Maleic Hydrazide at 1000 ppm. Therefore, soil drenching of Paclobutrazol at 45 ppm can effectively retard the plant growth and also makes the plant photosynthetically active and draught tolerant.

**Keywords:** Growth retardants, growth parameters, *Bougainvillea glabra* var. pink beauty

## Introduction
The *Bougainvillea* versatility is legendary. *Bougainvillea* is a flowering plant genus which belongs to the family of Nyctaginaceae and native to South America (Saifuddin *et al.*, 2010) [28]. It is a hardy, evergreen and shrubby vine (Kobayashi *et al*., 2007) [15]. It is climbing, evergreen member of the genus, which is native to Brazil. *Bougainvillea* are in great demand by soft landscape architects. *Bougainvillea* has extensive scope in landscape, either used as fixed plant, a potted plant specifically in landscape of semi-tropical areas, or an annual shrub in the temperate regions. But it requires routine pruning by clipping shoots to lower plant height and sustain plant architecture because of their robust growth habit (Patel *et al.*, 2022) [23]. Regular pruning is necessary to shape the plant and direct its growth because the shoots often grow vigorously (Kobayashi *et al*., 2007) [15]. Controlling plant size is one of the most important aspects in floricultural crops which can be achieved genetically, environmentally, culturally or chemically (Gopichand *et al.*, 2014; Kumar *et al.*, 2015) [7, 16]. To keep the plant's size consistent, use of plant growth retardants may be an alternative to frequent trimming. Growth retardants are the synthetic compounds and used to retard shoot length of the plant without evoking phytotoxic effects (Jadhav *et al*., 2015) [10]. The chemical growth retardants may be useful in manipulating the shape, size and form of *Bougainvillea* until improved shorter cultivars can be obtained via breeding and/or through biotechnology. Therefore, plant growth retardants could be an alternative to frequent pruning on *Bougainvillea* to reduce labour costs and to meet the demands of the consumers. Keeping the above in view, the present research work was carried out.

## Materials and Methods

The experimental field located in the Eastern dry zone of Karnataka (Agroclimatic Zone - V) at 12° 50” North Latitude and 77° 35” East longitude and situated at an elevation of 930 meters above mean sea level. The present research conducted at Department of Floriculture and Landscape Architecture, COH, Bengaluru. The planting material, rooted cuttings of *Bougainvillea glabra* var. Pink Beauty was used for the experiment. It was laid out in Randomized Complete Block Design (RCBD) with 13 treatments replicated thrice. The treatment details include $T_1$: PBZ at 15 ppm, $T_2$: PBZ at 25 ppm, $T_3$: PBZ at 35 ppm $T_4$: PBZ at 45 ppm, $T_5$: MH at 1000 ppm, $T_6$: MH at 1500 ppm, $T_7$: MH at 2000 ppm, $T_8$: MH at 2500 ppm, $T_9$: Alar at 500 ppm, $T_{10}$: Alar at 750 ppm, $T_{11}$: Alar at 1000 ppm, $T_{12}$: Alar at 1250 ppm, $T_{13}$: Control. The 9’ polybags were filled with growing media which consists of 2 parts of soil 1 part of FYM. Freshly prepared solutions of PBZ applied as soil drench and MH and Alar as foliar spray. The treatments were applied at 30 days interval for three months. By using "Analysis of Variance" in accordance with the procedures outlined for RCBD at 5 percent level of significance, followed by Duncan’s Multiple Range Test (DMRT) for comparison of mean values. The interpretation of data was followed as outlined by Panse and Sukhatamane (1967) [22].

## Results and Discussion

Growth retardants had a considerable impact on the growth parameters of *Bougainvillea*, according to the analysis of data in Table 1, 2 and 3.

It is evident from the data that, the application of growth retardants at varied concentrations significantly influenced on the growth characteristics *viz.*, plant height, plant spread, internodal length, number of primary and secondary branches per plant, stem girth and the leaf parameters like leaf area, specific leaf area and specific leaf weight.

The maximum retardation of plant height (13.61 and 15.39 cm) was noticed in the plants which were soil drenched with the paclobutrazol at 45 ppm at 60 and 120 DAT respectively and on par results noticed with soil drenching of Paclobutrazol at 35 ppm and 25 ppm respectively.The inhibition of plant height was noticed with the application of growth retardants which results in reduction in the rate of cell division and cell elongation in shoot tissues, which regulated the plant growth physiologically without formative effect (PGRSA, 2007) [24]. With the application of growth retardants, gibberellins biosynthesis is blocked, cell division still occurs but the new cells do not elongate which results in shoots with same or more number of leaves but with compressed internodal length (Chaney, 2003) [5]. The present findings are in line with research work of Nazarudin (2012) [21] in hibiscus; Kim and Lee (2015) [14] in poinsettia; Rajiv *et al*. (2018) [26] in Nerium; Rohit *et al.* (2021) [27] in *Bougainvillea* cv. Parthasarthy.

Whereas, minimum plant spread (168.73 and 234.40 $cm^2$) recorded with the soil drenching of Paclobutrazol at 45 ppm and found on par with other concentrations of Paclobutrazol. However, maximum plant spread (401.02 $cm^2$) was noticed with foliar application of Alar at 750 ppm. Decrease in plant spread may be attributed to retarded leaf area and compressed internodes of *Bougainvillea* with the application of paclobutrazol. According to Cathey and Stuart (1961) [3] daminozide promote the formation of lateral vegetative buds by inhibiting apical dominance, thereby which simultaneously increases the number of branches and plant spread. Therefore, this might be attributed for increased plant spread with foliar application of Alar.

With the soil drenching of Paclobutrazol at 45 ppm, the reduction in internodal length of 0.77 cm was noticed and also maximum stem girth (2.95 and 3.32 mm) was noticed with the soil drenching of Paclobutrazol at 45 ppm at 60 and 120 DAT respectively. The significant reduction in internodal length noticed with the drenching of paclobutrazol. This might be due to the inhibition of formation of gibberellins; which are responsible for cell elongation. Since cell elongation was inhibited due to PBZ treatments, the internodal length was reduced. (Cathey, 1964) [4]. The similar results were also observed by Horowitz (1990) [8] and Rohit *et al.* (2021) [27] in *Bougainvillea*. The decrease in shoot length often results to an increase in its thickness. This might be the reason for the increased stem girth or diameter with the drenching of paclobutrazol. These results are in conformity with Jain *et al.* (2016) [11] in *Bougainvillea* cv. Shubra.

Further, the number of primary branches per plant (2.07) at 60 DAT was recorded with the foliar application of Alar at 1250 ppm and was on par with foliar application of Alar at 500 ppm. Whereas, secondary branches per plant recorded with foliar application of MH at 1000 ppm. The increase in number of primary branches was due to the inhibitory effect of alar on the gibberellins due to which it increases the number of lateral branches and make stronger plants and a better size Velasco *et al.* (2022) [29]. The same results noticed by Pobudkiewicz and Treder (2006) [25] in oriental lily. Whereas, the increased secondary branches with foliar application of Maleic Hydrazide, might be due to the inhibitory effect of MH on the cell division in the apical bud which subsequently might have stopped the growth of the main axis. This in turn would have more secondary meristematic activity through movements of nutrients from the primary meristem to secondary meristem which subsequently increased the production of more number of branches per plant (Cathey, 1964) [4]. Similar results were also stated by Nagegowda and Narayanagowda (1990) [20] in jasmine; Aswath *et al*. (1994) [1] in China aster and Meghana *et al*. (2022) [18] in crossandra.

**Table 1:** Vegetative parameters of *Bougainvillea* var. Pink Beauty as influenced by different concentrations of growth retardants

| | Treatments | Plant height (cm) | | Plant spread ($cm^2$) | | Internodal length (cm) | |
|---|---|---|---|---|---|---|---|
| | | 60 DAT | 120 DAT | 60 DAT | 120 DAT | 60 DAT | 120 DAT |
| $T_1$ | PBZ @ 15 ppm | 15.07 $^{cde}$ | 19.83 $^{cde}$ | 178.33 $^{d}$ | 244.10 $^{e}$ | 1.24 | 1.30 $^{abc}$ |
| $T_2$ | PBZ @ 25 ppm | 13.86 $^{de}$ | 16.79 $^{de}$ | 188.40 $^{d}$ | 238.78 $^{e}$ | 1.20 | 1.22 $^{ab}$ |
| $T_3$ | PBZ @ 35 ppm | 14.28 $^{de}$ | 16.71$^{de}$ | 170.22 $^{d}$ | 238.03 $^{e}$ | 0.98 | 1.18 $^{abc}$ |
| $T_4$ | PBZ @ 45 ppm | 13.61 $^{e}$ | 15.39 $^{e}$ | 168.73 $^{d}$ | 234.40 $^{e}$ | 0.93 | 0.77 $^{d}$ |
| $T_5$ | MH @1000 ppm | 17.73 $^{bc}$ | 23.71 $^{abc}$ | 240.73 $^{bc}$ | 328.33 $^{cd}$ | 1.16 | 1.37 $^{a}$ |
| $T_6$ | MH @ 1500 ppm | 16.83 $^{cd}$ | 22.67 $^{bcd}$ | 241.03 $^{bc}$ | 347.00 $^{bc}$ | 1.11 | 1.04 $^{bcd}$ |
| $T_7$ | MH @ 2000 ppm | 15.43 $^{cde}$ | 18.47 $^{cde}$ | 206.43 $^{cd}$ | 216.66 $^{e}$ | 1.07 | 0.93 $^{cd}$ |
| $T_8$ | MH @ 2500 ppm | 16.27 $^{cde}$ | 20.17 $^{de}$ | 203.80 $^{cd}$ | 241.66 $^{e}$ | 1.24 | 0.84 $^{d}$ |
| $T_9$ | Alar @ 500 ppm | 20.74 $^{ab}$ | 27.89 $^{ab}$ | 236.53 $^{bc}$ | 309.90 $^{cd}$ | 1.17 | 1.42 $^{a}$ |
| $T_{10}$ | Alar @ 750 ppm | 22.13 $^{a}$ | 29.51 $^{a}$ | 312.23 $^{a}$ | 401.02 $^{a}$ | 1.10 | 1.33 $^{a}$ |
| $T_{11}$ | Alar @ 1000 ppm | 20.83 $^{ab}$ | 27.97 $^{ab}$ | 279.30 $^{ab}$ | 381.93 $^{ab}$ | 1.21 | 1.32 $^{a}$ |
| $T_{12}$ | Alar @ 1250 ppm | 22.12 $^{a}$ | 29.60 $^{a}$ | 254.66 $^{b}$ | 293.96 $^{d}$ | 1.04 | 1.30 $^{ab}$ |
| $T_{13}$ | Control | 22.68 $^{a}$ | 29.78 $^{a}$ | 315.87 $^{a}$ | 400.50 $^{a}$ | 1.45 | 1.45 $^{a}$ |
| | SE m ± | 1.08 | 1.80 | 14.20 | 15.15 | 0.12 | 0.09 |
| | CD at 5% | 3.15 | 5.25 | 44.36 | 44.22 | NS | 0.28 |

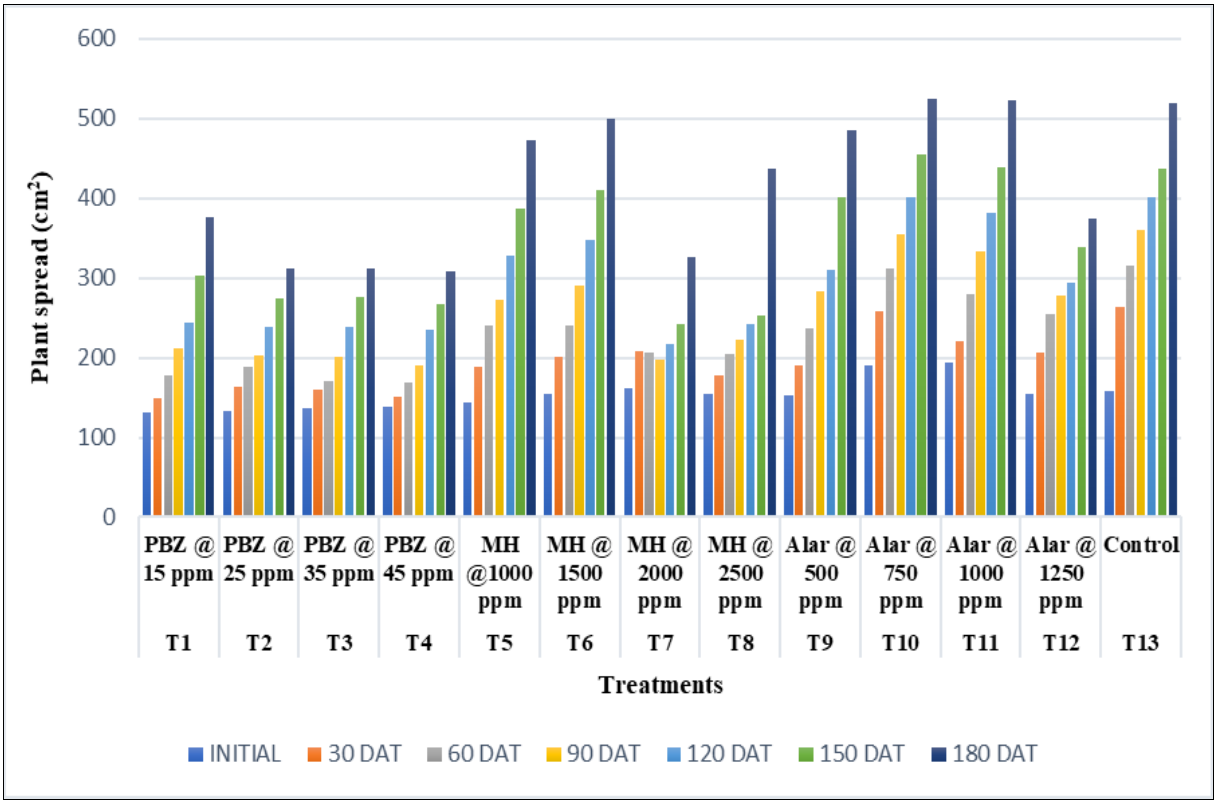


**Fig 1:** Effect of different levels of growth retardants on the plant spread (N-S and E- W) in *Bougainvillea* var. Pink Beauty

**Table 2:** Effect of different levels of growth retardants on number of branches and stem girth of *Bougainvillea* var. Pink Beauty

| | Treatments | Primary branches | | Secondary branches | | Stem girth (mm) | |
|---|---|---|---|---|---|---|---|
| | | 60 DAT | 120 DAT | 60 DAT | 120 DAT | 60 DAT | 120 DAT |
| $T_1$ | PBZ @ 15 ppm | 1.67 $^{abc}$ | 1.67 | 0.20 | 0.40 $^{bc}$ | 2.49 $^{bcde}$ | 2.73 $^{c}$ |
| $T_2$ | PBZ @ 25 ppm | 1.80 $^{ab}$ | 1.87 | 0.13 | 0.27 $^{bc}$ | 2.69 $^{abc}$ | 3.05 $^{ab}$ |
| $T_3$ | PBZ @ 35 ppm | 1.80 $^{ab}$ | 1.80 | 0.07 | 0.20 $^{bc}$ | 2.76 $^{ab}$ | 3.07 $^{ab}$ |
| $T_4$ | PBZ @ 45 ppm | 1.40 $^{bc}$ | 1.60 | 0.07 | 0.13 $^{c}$ | 2.95 $^{a}$ | 3.32 $^{a}$ |
| $T_5$ | MH @1000 ppm | 1.66 $^{abc}$ | 1.73 | 0.00 | 1.00 $^{a}$ | 2.38 $^{bcde}$ | 2.70 $^{c}$ |
| $T_6$ | MH @ 1500 ppm | 1.67 $^{abc}$ | 1.80 | 0.20 | 0.60 $^{abc}$ | 2.31 $^{cde}$ | 2.67 $^{c}$ |
| $T_7$ | MH @ 2000 ppm | 1.40 $^{bc}$ | 1.47 | 0.00 | 0.33 $^{bc}$ | 2.56 $^{abcde}$ | 2.73 $^{c}$ |
| $T_8$ | MH @ 2500 ppm | 1.40 $^{bc}$ | 1.33 | 0.13 | 0.20 $^{bc}$ | 2.65 $^{abcd}$ | 2.85 $^{bc}$ |
| $T_9$ | Alar @ 500 ppm | 1.93 $^{a}$ | 1.93 | 0.07 | 0.13 $^{c}$ | 2.21 $^{e}$ | 2.72 $^{c}$ |
| $T_{10}$ | Alar @ 750 ppm | 1.67 $^{abc}$ | 1.67 | 0.27 | 0.67 $^{ab}$ | 2.22 $^{e}$ | 2.62 $^{c}$ |
| $T_{11}$ | Alar @ 1000 ppm | 1.80 $^{ab}$ | 1.80 | 0.27 | 0.47 $^{bc}$ | 2.27 $^{de}$ | 2.68 $^{c}$ |
| $T_{12}$ | Alar @ 1250 ppm | 2.07 $^{a}$ | 2.13 | 0.26 | 0.40 $^{bc}$ | 2.36 $^{bcde}$ | 2.81 $^{bc}$ |
| $T_{13}$ | Control | 1.33 $^{c}$ | 1.80 | 0.13 | 0.20 $^{bc}$ | 2.18 $^{e}$ | 2.58 $^{c}$ |
| | SE m ± | 0.15 | 0.15 | 0.09 | 0.17 | 0.14 | 0.11 |
| | CD at 5% | 0.43 | NS | NS | 0.48 | 0.42 | 0.30 |

**Table 3:** Effect of different levels of growth retardants on leaf parameters of *Bougainvillea* var. Pink Beauty

| | Treatments | Leaf area ($cm^2$) | | Specific leaf area ($cm^2/g$) | Specific leaf weight ($g/cm^2$) |
|---|---|---|---|---|---|
| | | 60 DAT | 120 DAT | | |
| $T_1$ | PBZ @ 15 ppm | 9.34 ef | 11.97 bc | 37.44 def | 0.024 c |
| $T_2$ | PBZ @ 25 ppm | 8.97 ef | 11.73 bc | 35.19 def | 0.025 c |
| $T_3$ | PBZ @ 35 ppm | 8.07 f | 8.90 c | 31.93 ef | 0.034 b |
| $T_4$ | PBZ @ 45 ppm | 6.90 f | 8.17 c | 31.25 f | 0.036 a |
| $T_5$ | MH @1000 ppm | 12.83 cd | 22.70 a | 57.88 c | 0.013 fg |
| $T_6$ | MH @ 1500 ppm | 13.63 bcd | 14.63 b | 73.85 b | 0.014 f |
| $T_7$ | MH @ 2000 ppm | 12.06 cd | 11.60 bc | 79.40 b | 0.011 gh |
| $T_8$ | MH @ 2500 ppm | 12.10 cd | 15.10 b | 83.29 b | 0.013 fg |
| $T_9$ | Alar @ 500 ppm | 16.17 b | 14.57 b | 46.07 cd | 0.023 d |
| $T_{10}$ | Alar @ 750 ppm | 14.27 bc | 15.33 b | 45.57 cde | 0.022 d |
| $T_{11}$ | Alar @ 1000 ppm | 11.23 de | 14.43 b | 46.64 cd | 0.021 d |
| $T_{12}$ | Alar @ 1250 ppm | 14.60 bc | 12.10 bc | 40.03 def | 0.023 d |
| $T_{13}$ | Control | 21.56 a | 24.00 a | 98.34 a | 0.009 h |
| | SE m ± | 0.89 | 1.45 | 4.69 | 0.0007 |
| | CD at 5% | 2.61 | 4.22 | 13.69 | 0.002 |

Considering the leaf parameters, the significant reduction in the leaf area (6.90 and 8.17 $cm^2$) was noticed with soil drenching of Paclobutrazol at 45 ppm. The significant reduction in Specific leaf area of 31.25 $cm^2/g$ was also reported with soil drenching of Paclobutrazol at 45 ppm. The positive effect on specific leaf weight (0.036 $g/cm^2$) was recorded with the drenching of Paclobutrazol at 45 ppm.

Reduced leaf area with drenching of Paclobutrazol might be due to the morphological modifications of leaves induced by paclobutrazol such as smaller stomatal pores; thicker leaves would have resulted in the production of low leaf area (Chaney, 2003) [5]. These results are in line with the findings of Jill and David (2007) [13] in poinsettia; Nazarudin *et al.* (2012) [21] in hibiscus and Youssef *et al*. (2013) [30] in *Tabernaemontana coronaria* plants. The specific leaf area related to drought tolerance. The reduction in specific leaf area in Paclobutrazol treated plant was due to the leaf structural adaptation and also helping in higher chlorophyll index and higher rate of photosynthesis. Lower specific leaf area indicates thicker leaves which contributes to long leaf survival, nutrient retention and protection from desiccation (Mooney and Dunn, 1970) [19]. These results are in agreement with Jaleel *et al*. (2007) [12] in *Catharanthus roseus*. The specific leaf weight was found to increase with application of growth retardants. This might due to increase in the palisade mesophyll cell density of treated plants which causes thickening of leaf and thereby leads to increases in specific leaf weight (Kumaresan *et al.*, 2017) [17]. This also indicates the increased photosynthesis capacity of the plants. Similar findings were reported by Intrieri *et al.* (1986) [9]; Clingeleffer (1985) [6] in grapes; Bailey (2016) [2] in Hydrangeas.

## Conclusion

The inferences about the application of different levels of growth retardants can be drawn from the current experiment that, soil drenching of Paclobutrazol at 45 ppm can effectively retard the plant height and also makes the plant photosynthetically active and draught tolerant.

## References


1. Narayanagowda SAJV, Anandamurthy GM. Effect of growth retardants on growth, flowering and nutrient contents in China aster (*Callistephus chinensis* L.) cv. Powder Puff mixed. J Ornamental Hortic. 1994;2(1-2):9-13.
2. Bailey DA. Chemical height control of florists' hydrangeas turfgrass. Ornamentals Research Summary; c2016.
3. Cathey MH, Stuart NW. Comparative plant growth retarding activity of AMO-1618, phosphorus and CCC. Botanical Gazette. 1961;123:51-57.
4. Cathey MH. Physiology of growth retarding chemicals. Annual Review of Plant Physiology. 1964;15:271-302.
5. Chaney WR. Tree growth retardants: Arborists discovering new uses for old tool. Tree Care Industry. 2003;14:54-59.
6. Clingeleffer PR. Use of plant growth regulating chemicals in viticulture. Chemicals in the vineyard. Australian Society of Viticulture and Oenology, Inc., Mildura; c1985. p. 95-100.
7. Gopichand YMNV, Padmalatha T, Pratap M, Sankar S. Effect of bioregulators and stage harvesting on seed maturity and quality in African marigold (*Tagetes erecta* L.). Indian Journal of Agricultural Research. 2014;48(5):342-351.
8. Horowitz M. Comparison of paclobutrazol and uniconazole applied as a foliar spray and soil drench. Journal Announcements from the Faculty of Agricultural Sciences. 1990;55:241-258.
9. Intrieri CI, Silvestroni O, Poni S. Preliminary experiments on paclobutrazol effects on potted grapevines (*V. vinifera* cv. Trebbiano). Acta Horticulture. 1986;179:589-592.
10. Jadhav SK, Chawla SL, Agnihotri R, Gurjar RA. Effect of growth retardants on the vegetative growth, flowering and yield of heliconia (*Heliconia psittacorum*) var. Red Torch under 50 per cent shade net condition. The Bioscan. 2015;10(4):1509-1513.
11. Jain R, Janakiram T, Kumawat GL. Effect of growth retardants on growth and flowering of *Bougainvillea* (*Bougainvillea spectabilis*) cv. Shubra. Indian Journal of Agricultural Sciences. 2016;86(9):1145-1150.
12. Jaleel SB, Manivannan P, Kishorekumar A, Somasundaram R, Panneerselvam R. Effect of paclobutrazol on water stress amelioration through antioxidants and free radical scavenging enzymes in *Arachis hypogaea* L. Colloids and Surfaces B: Biointerfaces. 2007;60:229-235.
13. Jill E, David T. Ornamental plant production: The use of chemical plant growth regulators on protected crops. Protected Ornamentals. 2007;25:234-248.
14. Kim YH, Lee IJ. Identification of appropriate plant growth retardant to suppression piosettia growth. Flower Research Journal. 2015;23:63-71.
15. Kobayashi KD, McConnel J, Griggis J. Proceeding Ornamental and Flowers Cooperative Extension Service.

Univ. of Hawaii at Manoa, OF- 38; c2007.
16. Kumar KP, Padmalatha T, Pratap M, Reddy SN. Effect of plant bioregulators on growth, flowering and seed yield in china aster (*Callistephus chinensis* L. Nees) cv. Kamini. Indian Journal of Agricultural Research. 2015;49(4):348-352.
17. Kumaresan M, Rajadurai KR, Ganga M, Sivakumar R. Effect of pruning and paclobutrazol application on physiological and flowering characters of Jasmine (*Jasminum sambac* L.) during off Season. International Journal of Chemical Studies. 2017;5(5):2374-2378.
18. Meghana K, Raju DVS, Rao AD, Babu MR, Subbramamma P. Influence of growth retardants on growth and flowering of Crossandra (*Crossandra infundibuliformis*) under potted conditions. The Pharma Innovation Journal. 2022;11(8):1302-1304.
19. Mooney HA, Dunn EL. Convergent evolution of Mediterranean-climate evergreen sclerophyllous shrubs. Evolution. 1970;24:292-303.
20. Nagegowda V, Narayanagowda JV. Effect of cycocel and maleic hydraxide spray on flowering and seasonal pattern of yield in gundumallige (*Jasminum sambac* Ait.). Indian Perfumer. 1990;34(4):243-246.
21. Nazarudin AMR. Plant growth retardants effect on growth and flowering of potted Hibiscus *rosa-sinensis* L. Journal of Plant Physiology. 2012;4:29-40.
22. Panse VS, Sukhatamane PV. Statistical methods for Agriculture Workers. ICAR, New Delhi. 1967:152-155.
23. Patel T, Bhatt DS, Patel J, Tandel BM, Singh A, Patil S, *et al*. Influence of growth retardants on dwarfism in *Bougainvillea* (*Bougainvillea spectabilis*). Biological Forum–An International Journal. 2022;14(4a):211-215.
24. PGRSA. Plant growth regulation handbook of Plant Growth Regulation Society of America. $4^{th}$ ed. The Plant growth Regulation Society of America Athens; c2007.
25. Pobudkiewicz A, Treder J. Effect of florprimidol and daminoide on growth and flowering of oriental liliy Monalisa. Scientia Horticulturae. 2006;110:328-333.
26. Rajiv G, Jawaharlal M, Subramanian S, Sudhakar S, Uma D. Effect of plant growth retardants on the growth and flowering of nerium (*Nerium oleander* L.) cv. Red. Chemical Science Review and Letters. 2018;7(28):875-879.
27. Rohit R, Sindhu SS, Swaroop K, Singh B, Jain R, Arora A, *et al*. Standardization of growth retardants for production of potted *Bougainvillea*. Chemical Science Review and Letters. 2021;10(38):214-220.
28. Saifuddin M, Hossain ABMS, Osman N. Impacts of shading on flower formation and longevity, leaf chlorophyll and growth of *Bougainvillea* glabra. Asian Journal of Plant Science. 2010;9(1):20-27.
29. Velasco RA, Villegas LM, Velasco RAP, Hernández HRM, Hernández PAR, García SML, *et al*. Effect of daminozide on the growth and flowering of *Eustoma grandiflorum* propagated in potted. Acta Scientiarum Polonorum Hortorum Cultus. 2022;21(3):75-82.
30. Youssef ASM, Abd El- Aal MMM. Effect of paclobutrazol and cycocel on growth, flowering, chemical composition of potted *Tabernaemontana coronaria*. Research Journal of Applied Science. 2013;9(11):5953-5963.