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Decorative Pot Bougainvillea by Pruning and PP-333 Applications

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Abstract

Potted –bougainvillea plants too tall if not checked, so pruning and growth-retarding paclobutrazol (PP-333) application are used to limit this growth to produce an acceptable and compacted foliage growth covered with dense flowers for a long periods to be a show pot-plant. Plants were pruned to have one or two branches (30 cm long) and sprayed twice with PP-333 at 0, 500 or 1000ppm. Results indicated that the plant with one-branch showed a slight increase in height and significantly increased shoot length up to 24% higher than with two-branches. The later recorded an opposite trend as resulted in higher branch number per plant up to 14.6% over the plant have one-branch. Meanwhile, number of leaves and their areas were not affected. Although number of flower bracts were not affected by branch number, the plant with one-branch significantly increased their fresh weight was 60% higher than with two-branches.

Spraying with PP-333 significantly decreased plant height, shoot length and leaf area with increasing its concentration; thus the great reductions occurred by 1000ppm were 31.8, 51 and 49% lower than control, respectively. The increase in shoot number was apparently associated with PP-333 at 500ppm, but leaf formation was greatly increased with either 500 or 1000ppm. The first produced higher number and heavier fresh weight of flower bracts almost were 33 and 63% higher than a concentration of 1000ppm, respectively. Chlorophylls (a&b) and total carbohydrates content in leaves were greatly accumulated by raising the branching and PP-333 concentration. The interaction effects among treatments declared that the best combination was resulted from the plants with two-branches sprayed twice with PP-333 at 500ppm that led to control the growth habit without losing its ability to grow.

Keywords: *Bougainvillea glabra, Growth retardants, Paclobutrazol, Branching, Pruning.*

Introduction

Bougainvillea shrubs are the most attractive plants for their heavy bright-flowering. They well grown in many warm climate regions and blossom several times throughout the year. The plant can be used as a pot-plant or a hanging-basket. Overly elongated of bougainvillea plants are spindly and unattractive (an important consideration with container-grown woody ornamentals). It is desirable to reduce its over growth with pruning and applying growth retardant to control the growth with the pot size, as well as it makes it easily handling. Kobayashi *et al.* (2007) demonstrated that the regular pruning is necessary to shape the plant and direct its growth because the shoots often grow vigorously and the flowers are borne on new growth. Calatayud *et al*. (2007) stated that the main objective of pruning is to maintain or

develop a desired size or attractive plant shape especially woody ornamental plants.

Using PP-333 as the most attractive growth retarding substances to retard stem elongation, produce dark green leaves and indirectly affect flowering without formative effects. The persistence of the effects of PP-333 on the growth and flowering of many ornamental shrubs were reported by numerous investigators; Karaguzel and Ortacesme (2002), EL-Quesni *et al*. (2007) and Jaini *et al*. (2016) on bougainvilleas, EL-Sallami (2001) on poinsettia, Auda *et al*. (2002) on barleria, Singh (2002) on rose, Matsoukis and Chronopoulou-Sereli (2003) on *Lantana camara*, Ahmed Nazarudin (2012) on *Hibiscus rosa-sinensis*, Hussein (2013) on *Cestrum nocturnum*, and Heikal (2017) on *Sanchezia nobilis*.

The aim of this work was to select a useful technique involved in pruning and PP-333 application for commercial production of bougainvillea as a decorative pot-plant.

Materials and Methods

The present study was carried out at the Floricultural Nursery, Faculty of agriculture, Assiut University during two successive seasons of 2012/2013 and 2013/2014 to define the most suitable combination of branch number and PP-333 concentration to produce a desirable pot-plant of *Bougainvillea glabra* cultivar Snow white.

In the first April of both seasons, healthy and vigorous plants (one-year-old) were carefully selected as being uniform in the size. Plants were grown singly into 25-cm plastic pots filled with clay soil (pH 7.9) and pruned to have one or two-branches; each 30 cm long.

Paclobutrazol [(2RS, 3RS)-1-(4-chlorophenyl) -4, 4-dimethyl 1-2-(1,2,4-triazole-1-ethanol)] was prepared as aqueous solution by diluting the chemical suspension at different concentrations in water ; 0 (control), 500 and 1000ppm. The plants were sprayed twice with PP-333; the first at 6-weeks after planting and the second at 3-weeks interval. Paclobutrazol solutions were sprayed in the morning to the point of run-off using air compressed hand sprayer. All horticultural practices were similarly done whenever needed. Plants were grown under saran-house conditions (30% light) until the end of experiment.

The experiment consisted of 6 treatments (two branching treatments x three PP-333 levels) were arranged in a split-plot design, branching treatments as main –plots and PP-333 concentrations as sub-plots. Each treatment contained 4 plants (pots) and replicated four times.

At the end of the experiment (mid-March) of both seasons, data were recorded on the vegetative and flowering parameters. Leaf pigments were estimated according to Vernon (1960) and total soluble carbohydrates percentage was determined according to Hansen and Moller (1975).

Data were statistically analyzed using Statistix 8.1 analytical software, and the mean were compared using a least significant difference (L.S.D.) test according to Snedecor and Cochran (1989).

Results and Discussion

Vegetative growth parameters

Results clearly indicated that growth characteristics showed various responses to branching treatments and PP-333 concentrations (Table1). Obviously, number of shoots per plant and their lengths were significantly affected by branching treatments where as plants with two-branches produced higher shoot number than those of with one-branch. Meanwhile, this behavior was in direct contrast to that of shoot length since plants with one –branch produced taller shoots than those of with two-branches during the two seasons. There was a slight decrease in plant height obtained by plants with two-branches. Negligible increments were detected between branching treatments in relation to number of leaves and their areas. These results are in accordance with the findings of Kobayashi *et al*. (2007) who reported that pruning bougainvillea encourages the new growth on which the next flush of flowers will occur and reduce the size of plants, cut them back by about a third, removing all spindly and twiggy growth. Prune suckers from the plant's base to encourage top growth. In addition, Saifuddin *et al*. (2010) demonstrated that frequent pruning can be used to maintain plant growth and flower shoot initiation of bougainvillea.

Concerning the effect of PP-333 application, it was observed that plant height, shoot length and leaf area were significantly decreased with increasing PP-333 level; thus the great reductions occurred by 1000ppm were 31.8, 51 and 49% (average of both seasons) lower than control, respectively. Significant increase in shoot number was apparently associated with PP-333 at 500ppm reached 2.4 and 2.1 -fold when it compared to 1000ppm during the first and second seasons, respectively. Both PP-333 levels of 500 and 1000ppm significantly increased number of leaves resulting in 12.5 and 17.7% higher than control in the first season, as well as 26 and 19% in the second one, respectively. Similar observations were reported by Karaguzel and Ortacesme (2002), EL-Quesni *et al*. (2007) and Jaini *et al*. (2016) on bougainvilleas, EL-Sallami (2001) on poinsettia, Auda *et al*. (2002) on barleria, Singh (2002) on rose, Ahmed Nazarudin (2012) on *Hibiscus rosa-sinensis*, and Heikal (2017) on *Sanchezia nobilis*. They concluded that the inhibitory effect of PP-333 on plant height and shoot length due to slow cell division and inhibit cell elongation.

Numerous researchers explained the mode of action of the growth retardants and their biosynthesis inside the plants. Sachs and Hackett (1972) postulated that in most species only internode length is inhibited as a result of reduced subapical meristematic activity, and others on apical meristematic function have been noted, and leaf and flower initiation may be inhibited nearly equally with stem elongation. In addition, Law and Hamilton (1989) stated that in all species the influence of exogenous growth retardants on shoot system inhibition is nearly completely acting against endogenous gibberellins and cytokinins which can inhibit the gibberellins-stimulated growth or inhibit cytokinin-stimulated growth.

The interaction effects between branching treatments and PP-333 concentrations declared that the plants with two-branches sprayed with PP-333 at 1000ppm were found to be more compactness containing lower shoot number and smaller leaves than the other combinations. However, the plants with two-branches sprayed with PP-333 at 500ppm were more suitable for producing better plant height, more branch formation, and favored increasing the number and size of leaves.

Flowering parameters

It is noticed that number of flower bracts and their fresh weight were greatly responded to branching treatments and PP-333 levels (Table 1). Although number of flower bracts were not affected by branch number, the plants with one-branch significantly increased their fresh weight were 61 and 58% higher than those with two-branches in the first and second seasons, respectively. These results indicated that there was not a direct relationship between number of flower bracts and their weight under branching treatments. Similar trend of these results agree with earlier observations by Saifuddin *et al*. (2010) who found that the maximum flower production per plant was induced after pruning the plants of *Bougainvillea glabra.*

With regard to PP-333 effects, it was noticed that number of flower bracts and their fresh weight were noticeably affected by PP-333. Both concentrations of 500 and 1000ppm significantly increased these flower characters compared to control. The most striking relationship is that associated with PP-333 at 500ppm. This treatment was markedly higher than 1000ppm resulting in 31 and 35% for number, as well as 59 and 68% for weight in the first and second seasons, respectively. These results are in agreement with those obtained by EL-Sallami (2001) on poinsettia, Matsoukis and Chronopoulou-Sereli (2003) on *Lantana camara*, Ahmed Nazarudin (2012) on *Hibiscus rosa-sinensis*, Hussein (2013) on *Cestrum nocturnum*, Jaini *et al*. (2014 and 2016) on bougainvillea and Heikal (2017) on *Sanchezia nobilis*.

In this respect, Sachs and Hackett (1972) found that as a result of treatment with growth retardants, the flowering process may remain unaltered, be accelerated, or be delayed. On a typical woody plant, the time of flower initiation and anthesis were controlled by phytochrome, the photo-reversible pigments, which received the photo control pattern from the environment.

The interaction effects among the treatments cleared that the greatest flowering was resulted from plants with one or two-branches and sprayed with PP-333 at 500 followed by 1000ppm.

Leaf pigment

It is quite clear that chlorophylls (a&b) content in leaves mostly were significantly higher in plant with two-branches than those with one-branch in both seasons (Table 2). Meanwhile, carotenoids content were insignificantly affected. These results are in conformity with those reported by Saifuddin *et al.* (2010) on *Bougainvillea glabra*.

In respect of PP-333 effects, it was found that chlorophylls (a&b)

and carotenoids were significantly increased with increasing PP-333 concentration in the two seasons. These results are in harmony with those reported by EL-Sallami (2001) on poinsettia, Auda *et al*. (2002) on barleria, EL-Quesni *et al*. (2007) on bougainvillea, Ahmed Nazarudin (2012) on *Hibiscus rosa-sinensis*, Hussein (2013) on *Cestrum nocturnum* and Heikal (2017) on *Sanchezia nobilis*.

In this connection, Cathey (1964) attributed the increase in chlorophyll as a results of growth retardants application to their effects on the reduction of cell size by inhibition cell elongation, consequently the amount of leaf pigments were concentrated in a limited size. LeCain *et al*. (1986) concluded that *Ficus benjamina* leaves developing under the influence of PP-333 appeared darker green than in untreated plants by increasing the pigment plastids and maintaining full chlorophyll content in leaves which may be interpreted by a delay in senescence and retarding breakdown of chlorophylls.

The interaction effects indicated that the most effective combination in increasing chlorophylls (a&b) and carotenoids was obtained from plants with two-branches combined with PP-333 at 1000ppm; the increases in these leaf pigments were almost 1.3-times higher than unsprayed ones in both seasons.

Total carbohydrates

Data cleared that total carbohydrates content in leaves of plants with two-branches was significantly higher than those with one-branch in the two seasons (Table 2).

With refer to PP-333 effect on leaf carbohydrates, the content was significantly increased with increasing PP-333 level. Accordingly, the increase occurred by 1000ppm reached 1.4-times higher than in control plants during both seasons. Clearly, these results also followed a similar pattern to chlorophyll results. These results are parallel to the results of EL-Sallami (2001) on poinsettia, Auda *et al*. (2002) on barleria, EL-Quesni *et al*. (2007) on bougainvillea and Hussein (2013) on *Cestrum nocturnum*. They concluded that the increase in total carbohydrates as a result of PP-333 application might be attributed to increase in photosynthesis activity, consequently producing more photosynthetic products leading to more carbohydrates accumulation.

The interaction effects among the treatments declared that the best combination in increasing leaf pigments (plant with two-branch + PP-333 at 1000ppm) was also positively reflected that on raising leaf carbohydrates to 1.4-times higher than unsprayed ones in the two seasons.

From the above mentioned results it could be noticed that there was a close relationship between the best growth and quality with compact growth and dense flowers, and the adequate level of PP-333 (500ppm) and the suitable branching (two-branches). So this combined treatment proved to be the best for producing plant of high quality of *Bougainvillea glabra* as a flowering potplant is considered commercially acceptable.

Table 1. Effect of branch number and PP333 on vegetative growth and flowering parameters of bougainvillea plants during 2012/2013 and 2013 /2014 seasons

Branch/plant (B)	1st Season				2nd Season			
	Paclobutrazol ppm (P)							
	0	500	1000	Mean	0	500	1000	Mean
	Plant Height (cm)							
One	99.0	89.5	70.3	86.3	96.8	85.3	63.9	82.0
Two	97.4	82.3	68.6	82.6	92.4	74.9	61.6	76.3
Mean	98.3	85.9	69.5		94.6	80.1	62.8	
L.S.D. 0.05	B:N.S.	P: 5.2	BxP:7.3		B:N.S.	P:2.9	BxP:4.1	
Shoot length (cm)								
One	34.0	26.4	17.5	26.0	38.8	28.4	18.4	28.5
Two	26.0	19.9	15.1	20.3	35.0	21.7	14.4	23.7
Mean	30.0	23.2	16.3		36.9	25.1	16.4	
L.S.D. 0.05	B:1.4	P:2.2	BxP:2.9		B:0.7	P:1.2	BxP: 1.5	
No of shoots/plant								
One	4.8	9.2	3.2	5.7	5.5	9.9	4.4	6.6
Two	5.7	9.6	4.5	6.6	6.5	10.6	5.3	7.5
Mean	5.3	9.4	3.9		6.0	10.3	4.9	
L.S.D. 0.05	B: 0.1	P: 0.2	BxP: 0.3		B:0.1	P: 0.3	BxP: 0.4	
No. of leaves/plant								
One	130	153	167	150	114	150	144	136
Two	144	153	154	150	125	150	141	139
Mean	137	153	160		119	150	142	
L.S.D. 0.05	B: N.S	P:5	BxP:7		B: N.S	P: 4	BxP: 5	
Leaf area (cm^2)								
One	21.4	16.5	11.0	16.3	22.4	17.0	10.8	16.7
Two	20.9	16.4	11.4	16.2	21.1	17.1	10.9	16.4
Mean	21.2	16. 5	11.2		21.8	17.0	10.9	
L.S.D. 0.05	B: N.S	P: 0.5	BxP: 0.8		B:N.S	P: 0.8	BxP: 1.1	
No. of flower bracts/plant								
One	123	211	159	164	85	173	121	126
Two	104	211	162	159	89	162	127	126
Mean	114	211	161		87	168	124	
L.S.D. 0.05	B: N.S	P: 9	BxP: 11		B:N.S	P: 5	BxP: 7	
Fresh weight of flower bracts /plant (g)								
One	18.5	46.0	29.8	31.4	12.8	38.0	22.7	24.5
Two	11.4	29.5	17.5	19.5	9.5	23.1	13.8	15.5
Mean	14.9	37.7	23.7		11.1	30.6	18.2	
L.S.D. 0.05	B: 0.7	P: 1.4	BxP:		B: 1.1	P: 1.0	BxP: 1.5	

Table 2. Effect of branch number and PP-333 on photosynthetic pigments and total carbohydrates% in leaves of bougainvillea plants during 2012/2013 and 2013/2014 seasons

Branch/plant (B)	1st Season				2nd Season			
	Paclobutrazol ppm (P)							
	0	500	1000	Mean	0	500	1000	Mean
	Chlorophyll a (mg/g)							
One	4.66	5.37	5.88	5.30	4.89	5.41	6.05	5.45
Two	4.75	5.50	6.33	5.53	5.02	5.72	6.60	5.78
Mean	4.71	5.44	6.11		4.95	5.57	6.33	
L.S.D. 0.05	B:0.04	P: 0.09	BxP: 0.01		B:0.02	P:0.10	BxP:0.12	
	Chlorophyll b (mg/g)							
One	3.25	3.60	3.97	3.61	3.31	3.66	4.17	3.71
Two	3.47	3.66	4.10	3.74	3.31	3.69	4..20	3.72
Mean	3.36	3.63	4.04		3.31	3.68	4.19	
L.S.D. 0.05	B: 0.02	P: 0.06			B:N.S.	P:0.07	BxP: 0.11	
	Carotenoids (mg/g)							
One	1.34	1.54	1.69	1.52	1.38	1.61	1.77	1.59
Two	1.25	1.55	1.78	1.53	1.31	1.57	1.80	1.56
Mean	1.29	1.55	1.74		1.35	1.59	1.79	
L.S.D. 0.05	B:N.S.	P: 0.07	BxP: 0.21		B:N.S.	P:0.37	BxP: 0.07	
	Total carbohydrates %							
One	11.7	14.8	16.7	14.4	11.4	14.7	17.4	14.5
Two	12.4	15.1	17.1	14.9	13.3	15.9	18.6	15.9
Mean	12.1	14.9	16.9		12.4	15.3	17.9	
L.S.D. 0.05	B:0.1	P: 0.7	BxP: 0.9		B:0.4	P:0.1	BxP:1.3	

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نبات اصص زخرفى من الجهنمية بالتقليم والمعاملة ب PP-333

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الملخص

أجريت الدراسة بمزرعة ابحاث نباتات الزينة - كلية الزراعة – جامعة أسيوط خلال موسمى ٢٠١٣/١٢ و ٢٠١٤/١٣ على نباتات الجهنمية جلابرا صنف سنووايت للحصول على نبات اصص مزهر زخرفى الشكل. ولتحقيق هذا الهدف قلمت النباتات لكى تحتوى على فرع او فرعين ورشت مرتين ب PP-333 (باكلوبيوترازول) بتركيز صفر (ماء مقطر)، ٥٠٠، ١٠٠٠جزء فى المليون.

وكانت اهم النتائج ما يلى:

- كانت النباتات ذات الفرعين أقصر ارتفاعا مع زيادة عدد أفرعها ومحتوى أوراقها من الكلوروفيلات (أ،ب) والكربوهيدرات الكلية.
- زيادة تركيز PP-333 أدى الى قصر النباتات مع زيادة عدد أوراقها ومحتواها من الكلوروفيل والكربوهيدرات كما زادت الازهار وقل وزنها.
- أوضح التأثير المتبادل بين المعاملات أن أفضل معاملة مشتركة لإنتاج نبات اصص مزهرة ذو صفات تسويقية جيده من الجهنمية هى تقليم النبات على فرعين ورش PP-333 بتركيز ٥٠٠ جزء فى المليون.

فيما أدى الرش بتركيز ١٠٠٠جزء فى المليون الى انتاج نباتات مندمجة بشدة مما قلل من شكلها الجمالى.