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EFFECT OF SOME GROWTH RETARDANTS AND PINCHING ON GROWTH AND FLOWERING OF POTTED *Jacobinia carnea* PLANT

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ABSTRACT: This work was carried out during the two consecutive seasons of 2016/2017 and 2017/2018 in the Experimental lathe house of Horticulture Dept., Faculty Agric., Benha University, Kalubia Governorate, Egypt to study the effect of paclobutrazol (PP333), cycocel (CCC) and pinching treatments as well as their combinations on growth and flowering of potted *Jacobinia carnea* plant. After one month from repotting process (mid-March during the two seasons), the plants were arranged into two groups; the first one was lifted without pinching, while the second group was subjected to pinching treatment by removing 1cm from the seedling top, then all plants of the two groups were subjected to three sprays with paclobutrazol at 50, 75 and 100 ppm and cycocel at 1000, 2000 and 3000 ppm plus tap water as control at one month intervals. The obtained results showed that all pinched plants received growth retardants treatments were shorter than those received growth retardants without pinching in the two seasons. Anyhow, the highest values of branches number/ plant, leaves number/plant, leaf area/plant, leaves fresh and dry weights/plant, flowers number / plant, fresh and dry weights of flowers / plant and show value were scored by those subjected to pinching treatment and sprayed with pp333 at 100 ppm in the two seasons. Moreover, all tested application of growth retardants and pinching as well as their combinations increased root growth parameters of jacobinia plants, with superior for the high concentration of PP333 or CCC in the two seasons.

Key words: *Jacobina carnea*, paclobutrazol, cycocel, pinching and pot plant**.**

INTRODUCTION

Jacobinia carnea (Lindl) or *Justicia carnea* belonges to family Acanthaceae, it is an upright, evergreen shrub, 3 to 7 feet tall and wide, with large, 6-inch-long, dark green leaves and upwardly facing plumes of tubular, slightly fragrant flower clusters in rose-purple, red, yellow, orange, apricot, or white (depending on the selection), which appear from early Summer until Fall season. It has striking flower with numerous petals erupting from central cluster into crown shape, blooms in summer. Its flowers are placed on a terminal spike and the colour of the individual flower is violet pink. Many stems appear from the center of the plant and rise straight up for several feet before branching. The rapid growth and evergreen nature make jacobinia ideal for use as a foundation or mass planting. It may be used in various containers, or it may even be trained into an attractive espalier. Use it in front of a green shrubbery border to create a color accent throughout the warm months (**Orjiakor *et al.*, 2019).** Controlling plant height is one of the most important aspects of ornamental plants production. Growers can control plant height genetically, environmentally, culturally, or chemically. These techniques can be effective height-suppressing strategies for some plants, but when growers are faced with ornamental plants containing large varieties of genera, species, or cultivars, these techniques may not work equally well for each crop under a common environment. An alternative, effective strategy for controlling plant height is to use chemical plant growth retardants (**Chany, 2005**). Application of growth retardants is a common practice for commercial growers to achieve attractive compact pot-grown plants.

The terms growth retardants are used for all chemicals that retard cell division and cell elongation in shoot tissues and regulate plant height physiologically without formative effects (**PGRSA, 2007**). One of the most widely used growth retardants is paclobutrazol (pp333) [(2RS,3RS) -1-(4-chlorophenyl-4,4 -dimethyl-2-(1H-1,2,4 triazol-1- yl)

pentan-3-ol] is a well-known plant growth retardant (**Davis and Andersen, 1989**). Paclobutrazol is work by inhibiting cytochrome P-450, which mediates oxidative dimethylation reactions, including those which are necessary for the synthesis of ergosterol and the conversion of kaurene to kaurenoic acid in the gibberellins biosynthetic pathway (**Fletcher *et al.*, 2000**). From this function, paclobutrazol has long been used to reduce plant height for potted plant production, particularly ornamental plants (**Abd El-Aal and Mohamed, 2017 and Sharaf-Eldien *et al.*, 2017**). In this concern, **Noor El-Deen (2020)** recommended that treated Mexican petunia plants cultivated in 16-cm-pots filled with peat moss + perlite (1:1 by volume) with single pinch after 1 month from transplanting + 4 applications at one-month interval with PBZ at 100 ppm for optimum stunting with satisfied quality as pot plant.

Cycocel (CCC) (chlormequat; 2-chloroethyltrimethyl ammonium chloride) is a synthetic plant growth retardant used on ornamental plants for inducing dwarfism in plants and shorter internodes, stronger stems and green leaves. It is also utilized in order to produce compact, sturdy potted and bedding plants, enhance the green colour of the foliage, strengthen flower stem and promote resistance of foliage to environmental stresses. Although growth reduction effect of cycocel is common, growth reduction percentage, flowering, leaf area and chlorophyll content, flower shape and colour responses of plants to this chemical can vary depending on the dose or concentration, method, site of application, species and cultivar and also growing season (**Taiz and Zeiger, 2006**). In this regard, **Atteya and El Gendy (2018)** on *Tagetes patula* plant indicated that the application of 50 mg/l CCC scored the shortest plants and the highest length of inflorescence pedicel, but it delayed flowering.

Pinching is one of the most common and efficacious tactics for successful cultivation of cut flowers as well as potted plants (**Cline, 1991**). Pinching is the removal of the terminal growing portion, this led to reduce height but promotes auxiliary branches, delays flowering and helps in breaking resting period (**Sehrawat *et al.*, 2003**). When the apical portion of the shoot is removed, large number of auxiliary shoots arise resulting in well-shaped bushy plants bearing great number of uniform flowers as tested on *Chrysanthemum frutescens* (**Ghatas, 2016)**. Pinching plants is used to promote lateral branching, but a secondary effect is the reduction of plant height (**Heins *et al.*, 2000**). A very common industry practice, research has shown confirmation of the desired effect of pinching, as reported by many authors e.g. **Vasoya *et al.* (2015**) on Gaillardia, **Abou-Dahab *et al.* (2015)** on *Russelia equisetiformis*, **El-Sadek (2016)** on *Hibiscus rosa-sinensis*, L. cv. "Yellow" and **Noor El-Deen (2020)** on Mexican petunia plant.

The purpose of this study was to investigate the effects of paclobutrazol, cycocel and pinching on growth and flowering of potted *Jacobinea carnea* plants and to produce stunted commercial pot plants with high quality and aesthetic value of this plant.

MATERIALS AND METHODS

This work was carried out during two successive seasons of 2016/2017 and 2017/2018 in the Experimental lathe house of Horticulture Dept., Faculty Agric., Benha University, Kalubia Governorate, Egypt to study the effect of some growth retardants i.e., paclobutrazol and cycocel and pinching as well as their combinations treatments on growth and flowering of potted *Jacobina carnea*. Uniform cuttings 11-12cm length, with 2-3 leaves and 0.42- 0.48 cm thickness were planted on mid-November, 2016 and 2017 in 8 cm plastic pots containing 1:1 mixture of peat moss and pearlite. Then, were placed under plastic tunnel conditions at the lathe house. On mid-February 2017 and 2018, uniform well rooted cuttings producing 5-6 leaves at 16-18 cm height were re-potted in 20cm diameter plastic pots filled with a mixture of 1 sand :1 peat moss (*v:v*). After one month from repotting process (mid-March during the two seasons), the plants were arranged into two groups; the first one was lifted without pinching, while the second one was subjected to pinching treatment by removing 1 cm from the rooted cutting top, then all plants of the two groups were subjected to four sprays with paclobutrazol at 50, 75 and 100 ppm as well as cycocel at 1000, 2000 and 3000 ppm plus tap water as control at one month intervals. The plants were sprayed with a hand pump mister to the point of runoff. A surfactant (Bio film at a concentration of 0.01%) was added to all tested solutions including the control. The treatments were arranged at randomly at the lathe house in three replicates with 10 pots/ each. After two months from replanting, the plants were fertilized every month with chemical kristalon fertilizer at the rate of 2 g/pot. Common agricultural practices (irrigation, manual weed control, . . . etc.) were carried out when needed.

Recorded data

1- Vegetative growth measurements

Vegetative characteristics were taken at full flowering stage during the two seasons included plant height (measured from surface of the potting medium to the tallest branch), number of branches/ plant, leaf area (cm^2), number of leaves/ plant and fresh and dry weights of leaves/ plant.

2- Flowering growth measurements

Flowering characteristics were taken at full flowering stage during the two seasons involved flowering start (days from planting to start flowering), number of flowers/ plant, fresh and dry weights of flowers/plant and show value (as plant width / plant height ratio) according to **Berghage *et al.* (1989)**.

3- Root growth parameters

Whereas, roots measurements were taken at the end of experiment (30 December during the two seasons) included roots number/ plant as well as fresh and dry weights of roots/plant.

Statistical analysis

Obtained data during the two seasons were subjected to analysis of variance as a factorial experiment in a complete randomize block design. LSD at 5%method was used to difference means according to **Snedecor and Cochran (1989).**

RESULTS AND DISCUSSION

Effect of some growth retardants and pinching as well as their combinations on vegetative growth and flowering of *jacobina carnea*

I.A. Effect on the vegetative growth parameters

1. Plant height (cm)

Data presented in Table, 1 on plant height of *jacobina carnea* as affected by paclobutrazol, cycocel and pinching treatments, concluded that all paclobutrazol, cycocel and pinching treatments as well as their combinations reduced the plant height when compared with control in both seasons. Anyway, the shortest plants were gained by those subjected to pinching treatment and sprayed with pp333 at 100 ppm as it scored 40.6 and 39.2 cm, in the first and second seasons, respectively.

2. Branches number/plant

Data in Table 2 revealed that all tested concentrations of paclobutrazol, cycocel and pinching treatments succeeded in increasing the number of branches / plant as compared with control plants in both seasons of this study. However, the highest number of branches/plant plants was scored by those subjected to pinching treatment and sprayed with pp333 at 100 ppm as it scored 8.76 and 8.92 cm in the first and second seasons, respectively.

Table 1. Effect of some growth retardants, pinching and their combinations on plant height of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		68.9	64.3	66.6
PP333	50 ppm	62.5	60.7	61.6
	75 ppm	54.3	52.8	53.6
	100 ppm	42.4	40.6	41.5
CCC	1000ppm	64.3	61.9	63.1
	2000ppm	56.8	53.8	55.3
	3000ppm	51.2	46.9	49.1
Mean		57.2	54.5	
LS.D at 0.5 for		Retardants =6.3	Pinching =2.52	Interaction =10.1
Second Season				
Control		70.2	68.8	69.5
PP333	50 ppm	62.4	58.2	60.3
	75 ppm	51.8	48.3	50.1
	100 ppm	41.3	39.2	40.3
CCC	1000ppm	64.3	61.2	62.8
	2000ppm	56.0	52.3	54.2
	3000ppm	46.2	45.6	45.5
Mean		56.0	53.4	
LS.D at 0.5 for		Retardants =5.35	Pinching =2.14	Interaction =8.56

Table 2. Effect of some growth retardants, pinching and their combinations on branches number/ plant of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		5.62	6.02	5.82
	50 ppm	5.94	6.80	6.37
PP333	**75 ppm**	6.84	7.21	7.03
	100 ppm	7.63	8.76	8.20
	1000ppm	5.80	6.51	6.16
CCC	**2000ppm**	6.29	7.18	6.74
	3000ppm	7.18	8.06	7.62
Mean		6.47	7.22	
LS.D at 0.5 for		Retardants =1.31	Pinching =0.52	Interaction =2.10
Second Season				
Control		5.96	6.82	6.39
	50 ppm	6.24	7.06	6.65
PP333	**75 ppm**	7.36	7.93	7.65
	100 ppm	8.20	8.92	8.56
	1000ppm	6.18	7.21	6.70
CCC	**2000ppm**	7.21	7.80	7.51
	3000ppm	7.96	8.29	8.13
Mean		7.02	7.72	
LS.D at 0.5 for		Retardants =1.08	Pinching =0.43	Interaction =1.72

3. Leaves number / plant

Data presented in Table 3, showed that all examined growth retardants treatments and pinching as well as their combinations increased the leaves number / plant as compared with control in both seasons. Anyway, the highest number of leaves/plant plants was recorded by those subjected to pinching treatment and sprayed with pp333 at 100 ppm as it scored 59.3 and 53.5, followed by those pinched and received cycocel at 3000 ppm as it recorded 83.8 and 50.8 in the first and second seasons, respectively.

4. Leaf area (cm^2)

Data tabulated in Table 4, revealed that all studied concentrations of growth retardants and pinching as well as their interactions decreased leaf area of *jacobina carnea* plant as compared with un-treated control in both seasons. In this concern, the smallest leaf area was gained by those subjected to pinching treatment and sprayed with pp333 at 100 ppm as it scored 28.0 and 21.8 cm2, followed by those pinched and received CCC at 3000 ppm as it recorded 29.4 and 25.6 cm in the first and second seasons, respectively. On the opposite, the greatest leaf area was gained by un-pinched plants and received no growth retardants in both seasons.

5. Leaves fresh and dry weights / plant (g)

Data in Tables, 5 and 6 reveal that all studied treatments of paclobutrazol, cycocel and pinching treatments statistically decreased the fresh and dry weights of leaves per plant as compared with control in both seasons. However, the heaviest fresh and dry weights of leaves/plant were recorded by those pinched and sprayed with tap water in the two seasons. On the reverse the lowest leaves fresh and dry weights per plants were gained by those pinched and received pp333 at 100 ppm in the two seasons.

Table 3. Effect of some growth retardants, pinching and their combinations on leaves number/ plant of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		31.8	36.9	34.4
PP333	50 ppm	36.2	42.5	39.4
	75 ppm	48.0	52.7	50.4
	100 ppm	52.3	59.3	55.8
CCC	1000ppm	37.2	41.6	39.4
	2000ppm	42.8	49.4	46.1
	3000ppm	49.3	53.8	51.6
Mean		42.5	48.0	
LS.D at 0.5 for		Retardants =7.88	Pinching =3.15	Interaction =12.6
Second Season				
Control		29.6	34.2	31.9
PP333	50 ppm	31.8	39.0	35.4
	75 ppm	39.6	48.2	36.9
	100 ppm	47.8	53.5	50.7
CCC	1000ppm	32.7	38.6	35.7
	2000ppm	36.4	45.2	40.8
	3000ppm	43.6	50.8	47.2
Mean		37.4	44.2	
LS.D at 0.5 for		Retardants =7.38	Pinching =2.95	Interaction =11.8

Table 4. Effect of some growth retardants, pinching and their combinations on leaf area of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		52.3	51.2	51.8
PP333	50 ppm	43.2	41.0	42.1
	75 ppm	36.1	32.4	34.3
	100 ppm	31.2	28.0	29.6
CCC	1000ppm	46.8	42.6	44.7
	2000ppm	38.4	34.9	36.7
	3000ppm	32.9	29.4	31.2
Mean		40.1	37.2	
LS.D at 0.5 for		Retardants =3.68	Pinching =1.47	Interaction =5.88
Second Season				
Control		49.3	47.6	48.5
PP333	50 ppm	41.2	38.4	39.8
	75 ppm	32.8	30.0	31.4
	100 ppm	26.2	21.8	24.0
CCC	1000ppm	43.0	39.2	41.1
	2000ppm	36.2	34.2	35.2
	3000ppm	29.8	25.6	27.7
Mean		35.6	33.8	
LS.D at 0.5 for		Retardants =3.23	Pinching =1.29	Interaction =5.16

Table 5. Effect of some growth retardants, pinching and their combinations on leaves fresh weight/ plant of Jacobinia *carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		69.9	99.4	98.2
PP333	50 ppm	92.8	91.3	92.1
	75 ppm	86.2	85.1	85.7
	100 ppm	84.3	82.4	83.4
CCC	1000ppm	93.8	89.6	91.7
	2000ppm	89.2	88.2	88.7
	3000ppm	86.8	83.6	85.2
Mean		90.0	88.1	
LS.D at 0.5 for		Retardants =3.73	Pinching =1.49	Interaction =5.96
Second Season				
Control		92.1	94.3	93.2
PP333	50 ppm	89.3	86.4	87.9
	75 ppm	84.2	82.6	83.4
	100 ppm	80.1	76.4	78.3
CCC	1000ppm	89.8	89.2	89.5
	2000ppm	86.0	86.4	86.2
	3000ppm	84.7	79.3	82.0
Mean		86.6	84.9	
LS.D at 0.5 for		Retardants =4.18	Pinching =1.67	Interaction =6.68

Table 6. Effect of some growth retardants, pinching and their combinations on leaves dry weight/ plant of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		13.4	13.7	13.6
PP333	50 ppm	13.0	12.8	12.9
	75 ppm	12.2	12.0	12.1
	100 ppm	12.0	11.8	11.9
CCC	1000ppm	13.1	12.9	13.0
	2000ppm	12.4	12.3	12.4
	3000ppm	12.3	12.2	12.3
Mean		12.6	12.5	
LS.D at 0.5 for		Retardants =1.14	Pinching =N.S	Interaction =1.82
Second Season				
Control		12.0	12.2	12.1
PP333	50 ppm	11.6	11.2	11.4
	75 ppm	10.9	10.7	10.8
	100 ppm	10.4	9.9	10.2
CCC	1000ppm	11.7	11.6	11.7
	2000ppm	11.2	11.2	11.2
	3000ppm	10.9	10.3	10.6
Mean		11.2	11.0	
LS.D at 0.5 for		Retardants =1.34	Pinching = N.S	Interaction =2.14

6- Plant width

Data in Table (7) revealed that all tested concentrations of paclobutrazol, cycocel and pinching succeeded in increasing the plant width of *jacobina carnea* as compared with control plants in both seasons of this study. In this regard, the widest plants were scored by those pinched and sprayed with pp333 at 100 ppm as it scored 42.6 and 40.2 cm in the first and second seasons, respectively. On the reverse the lowest value of plant width was gained by those received no growth retardants without pinching in the two seasons.

Table 7. Effect of some growth retardants, pinching and their combinations on plant width of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		25.8	28.9	27.4
PP333	**50 ppm**	26.4	31.2	28.8
	75 ppm	31.6	39.4	35.5
	100 ppm	39.2	42.6	40.9
CCC	**1000ppm**	26.1	29.3	27.7
	2000ppm	29.8	34.2	32.0
	3000ppm	34.6	36.8	35.7
Mean		30.5	34.6	
LS.D at 0.5 for		Retardants =4.33	Pinching =1.73	Interaction =6.92
Second Season				
Control		23.4	26.5	25.0
PP333	**50 ppm**	28.0	30.0	29.0
	75 ppm	32.6	38.1	35.4
	100 ppm	38.4	40.2	39.3
CCC	**1000ppm**	25.3	29.0	27.2
	2000ppm	29.1	32.4	30.8
	3000ppm	32.2	34.6	33.4
Mean		29.9	33.0	
LS.D at 0.5 for		Retardants =4.55	Pinching =1.82	Interaction =7.28

The previous results of vegetative growth are in agreement with the results of **Abd El-Kader (2009)** on *Tecoma stans and Cestrum elegans,* **Eissa (2014)** on *Murraya exotica* and *Duranta repens* plants, **Kasem and Abd El-Baset (2015)** on Ryegrass (*Lolium perenne* L.), **Ghatas (2016)** on *Chrysanthemum frutescens* plant**, Sharaf-Eldien, *et al.* (2017)** on *Zinnia elegans*, **Atteya and El Gendy (2018)** on *Tagetes patula* plants and **Noor El-Deen (2020)** on *Ruellia simplex*.

I.B. Effect on the flowering growth parameters

1. Flowering start (days)

Data of time to the first flower showing colour as an indicator of flower development by days determined from the beginning of the planting (mid-March), in the two seasons, are shown in Table (8). Data indicated that all growth retardants and pinching as well as their interaction treatments delayed the flowering (increasing the number of days from planting to start flowering) of *jacobina carnea* plants as compared with untreated control plants in both seasons. In this concerns, the highest number of days to start flowering was recorded by those pinched and received pp333 at 100 ppm as it scored 156 and 159 days, followed by those pinched and received CCC at 3000 ppm as it recorded 151 and 154 days in the first and second seasons, respectively. On the contrast, the earliest flowering was gained by those not pinched and received no growth retardants treatments in the two seasons.

Table 8. Effect of some growth retardants, pinching and their combinations on flowering start of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		118	123	121
	50 ppm	126	132	129
PP333	**75 ppm**	134	140	137
	100 ppm	149	156	153
	1000ppm	123	130	127
CCC	**2000ppm**	131	140	136
	3000ppm	142	151	147
Mean		132	139	
LS.D at 0.5 for		Retardants =7.38	Pinching =2.95	Interaction =11.8
Second Season				
Control		125	129	127
	50 ppm	131	132	132
PP333	**75 ppm**	142	148	145
	100 ppm	153	159	156
	1000ppm	129	134	132
CCC	**2000ppm**	138	141	140
	3000ppm	149	154	152
Mean		138	142	
LS.D at 0.5 for		Retardants =8.02	Pinching =3.21	Interaction =12.84

2. Flowers number / plant

Data in Table (9) indicated that all tested paclobutrazol, cycocel and pinching treatments increased the flowers number of *jacobina carnea* plant when compared with un-treated plants in both seasons. Anyhow, the highest number of flowers per plant was gained by those subjected to pinching treatment and sprayed with pp333 at 100 ppm as it scored 6.42 and 6.92, followed by those not pinched and received pp333 at 100 ppm as it recorded 5.82 and 6.74 flowers/plant in the first and second seasons, respectively. On the opposite, the lowest number of flowers per plant was gained by un-pinched plants and received no growth retardants in both seasons.

3. Flowers fresh and dry weights / plant (g)

The data obtained on fresh and dry weights of the flowers per plant (g) as influenced by paclobutrazol, cycocel and pinching treatments are shown in Tables (10 and 11). In this concern, all pinched plants received growth retardants treatments have more flowers fresh and dry weights than those received growth retardants without pinching in the two seasons. Anyhow, the heaviest fresh and dry weights of flowers per plant was gained by those subjected to pinching treatment and sprayed with pp333 at 100 ppm, followed by those not pinched and received pp333 at 75 ppm in both seasons.

4. Show value (plant width / height ratio)

Data presented in Table (12) showed that all examined treatments of growth retardants and pinching succeeded in increasing the show value of *jacobina carnea* plants when compared with control plants in both seasons of this study. Anyhow, the highest values of show values were scored by those subjected to pinching treatment and sprayed with pp333 at 100 ppm as it scored 1.05 and 1.03, followed by those received pp333 at 100 ppm without pinching as it recorded 0.92 and 0.93 cm in the first and second seasons, respectively. On the reverse the lowest show value was gained by those received no growth retardants without pinching in the two seasons.

Table 9. Effect of some growth retardants, pinching and their combinations on number of flowers/ plant of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		3.82	3.96	3.88
PP333	50 ppm	4.21	4.80	4.51
	75 ppm	4.96	5.74	5.35
	100 ppm	5.82	6.42	6.12
CCC	1000ppm	4.02	4.61	4.14
	2000ppm	4.83	5.28	5.06
	3000ppm	5.14	5.64	5.39
Mean		4.69	5.21	
LS.D at 0.5 for		Retardants =1.23	Pinching =0.49	Interaction =1.96
Second Season				
Control		4.02	4.18	4.10
PP333	50 ppm	5.43	5.39	5.41
	75 ppm	6.21	6.40	6.31
	100 ppm	6.74	6.92	6.83
CCC	1000ppm	5.13	5.22	5.18
	2000ppm	6.04	6.12	6.08
	3000ppm	6.12	6.48	6.30
Mean		5.67	5.82	
LS.D at 0.5 for		Retardants =0.93	Pinching =0.37	Interaction =1.48

Table 10. Effect of some growth retardants, pinching and their combinations on fresh weight of flowers/ plant of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		45.6	46.8	46.2
PP333	50 ppm	50.4	57.6	54.0
	75 ppm	58.8	68.4	63.6
	100 ppm	69.9	76.8	73.4
CCC	1000ppm	47.8	55.2	51.5
	2000ppm	57.6	62.4	60.0
	3000ppm	61.2	67.2	64.2
Mean		55.9	62.1	
LS.D at 0.5 for		Retardants =7.88	Pinching =3.15	Interaction =12.6
Second Season				
Control		52.6	53.3	53.0
PP333	50 ppm	70.2	70.0	70.1
	75 ppm	80.6	83.2	81.9
	100 ppm	87.1	89.7	88.4
CCC	1000ppm	71.6	67.6	69.6
	2000ppm	77.8	79.3	78.6
	3000ppm	79.3	83.2	81.3
Mean		74.2	75.2	
LS.D at 0.5 for		Retardants =6.24	Pinching = N.S	Interaction =9.98

Table 11. Effect of some growth retardants, pinching and their combinations on dry weight of flowers/ plant of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		5.41	5.62	5.52
PP333	50 ppm	6.03	6.92	6.48
	75 ppm	7.12	8.19	7.66
	100 ppm	8.40	9.26	8.83
CCC	1000ppm	5.74	6.68	6.21
	2000ppm	6.84	7.42	7.13
	3000ppm	7.32	8.00	7.66
Mean		6.69	7.44	
LS.D at 0.5 for		Retardants =1.20	Pinching =0.48	Interaction =1.92
Second Season				
Control		5.76	5.83	5.80
PP333	50 ppm	7.62	7.58	7.60
	75 ppm	8.89	9.12	9.01
	100 ppm	9.58	9.88	9.73
CCC	1000ppm	7.89	7.40	7.65
	2000ppm	8.47	8.68	8.58
	3000ppm	8.69	9.14	8.92
Mean		8.13	8.23	
LS.D at 0.5 for		Retardants =1.10	Pinching =0.43	Interaction =1.72

Table 12. Effect of some growth retardants, pinching and their combinations on show value of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		0.37	0.45	0.41
PP333	50 ppm	0.42	0.51	0.47
	75 ppm	0.58	0.75	0.67
	100 ppm	0.92	1.05	0.99
CCC	1000ppm	0.41	0.47	0.44
	2000ppm	0.52	0.64	0.58
	3000ppm	0.68	0.78	0.73
Mean		0.56	0.66	
LS.D at 0.5 for		Retardants =0.18	Pinching =0.07	Interaction =0.28
Second Season				
Control		0.33	0.39	0.36
PP333	50 ppm	0.45	0.52	0.49
	75 ppm	0.63	0.79	0.71
	100 ppm	0.93	1.03	0.98
CCC	1000ppm	0.39	0.47	0.43
	2000ppm	0.52	0.62	0.57
	3000ppm	0.67	0.76	0.72
Mean		0.56	0.65	
LS.D at 0.5 for		Retardants =0.15	Pinching =0.06	Interaction =0.24

Flowering retardation that existed with the growth retardant treatments could be attributed to the obtained stimulation of cytokinins synthesis. Thereby, the vegetative and reproductive growth periods were prolonged as cytokinin is known as a true shooting hormone (**Opik and Rolf, 2005**). Supporting for our discussion the previously mentioned note of the nature of PP333 and CCC effects on the prolongation of the vegetative and reproductive growth of Jacobinia plants. Since, increasing the endogenous level of cytokinins led to increasing the formation of leaves as well as the number of branches per plant. This effect was reflected on the increase in the formation of the number of flowers/ plant.

The results of flowering growth parameters as affected by PP333, CCC and pinching are coincided with those of **Matsoukis *et al*. (2001)** on *Lantana camara* subsp. Camara**, Saker (2004)** on *Hibiscus rosa-sinensis and Tabernaemontana coronaria*, **Youssef (2004)** on *Strelitzia reginae*, **Abd El-Kader (2009)** on *Cestrum elegans* and *Tecoma stans*, **Mansuroglu *et al*. (2009)** on *Consolida orientalis* and Jungklang. **Youssef and Abd El-Aal (2013)** on *Tabernaemontana coronaria* ,**Eissa (2014)** on *Murraya exotica*, **Ghatas (2016)** on *Chrysanthemum frutescens* plant**, Sharaf-Eldien *et al.* (2017)** on *Zinnia elegans*, **Atteya and El Gendy (2018)** on *Tagetes patula* plants and **Noor El-Deen (2020)** on *Ruellia simplex*.

I.C. Effect on the root growth parameters

Data in Tables 13-15 showed that the mean number, fresh and dry weights of roots per plant increased progressively with the increasing of paclobutrazol or cycocel concentrations in both seasons. In this concern, all pinched plants received growth retardants treatments have more roots number with high fresh and dry weights than those received growth retardants without pinching in the two seasons. In this respect, the highest roots number / plant and the heaviest fresh and dry weights of roots per plant were gained by those subjected to pinching treatment and sprayed with pp333 at 100 ppm in both seasons. On the opposite, the lowest values of roots parameters were gained by un-pinched plants and received no growth retardants in both seasons.

Table 13. Effect of some growth retardants, pinching and their combinations on roots number/ plant of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		11.3	12.6	12.0
	50 ppm	12.4	13.7	13.1
PP333	**75 ppm**	13.6	14.8	14.2
	100 ppm	15.1	15.7	15.4
	1000ppm	11.7	13.2	12.5
CCC	**2000ppm**	12.3	14.1	13.2
	3000ppm	13.9	14.9	14.4
Mean		12.9	14.1	
LS.D at 0.5 for		Retardants =2.55	Pinching =1.02	Interaction =4.08
Second Season				
Control		12.1	13.8	13.0
	50 ppm	12.7	14.6	13.3
PP333	**75 ppm**	14.2	15.8	15.0
	100 ppm	15.6	16.7	16.2
	1000ppm	12.8	14.2	13.5
CCC	**2000ppm**	13.6	15.1	14.4
	3000ppm	14.2	15.4	14.8
Mean		13.6	15.0	
LS.D at 0.5 for		Retardants =2.85	Pinching =1.14	Interaction =4.56

Table 14. Effect of some growth retardants, pinching and their combinations on roots fresh weight/ plant of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		16.8	19.3	18.1
PP333	50 ppm	21.8	23.9	22.9
	75 ppm	23.4	26.7	25.1
	100 ppm	27.8	28.9	28.4
CCC	1000ppm	19.9	22.8	21.4
	2000ppm	21.8	25.3	23.6
	3000ppm	25.2	28.1	26.7
Mean		22.4	25.0	
LS.D at 0.5 for		Retardants =5.34	Pinching =2.13	Interaction =8.52
Second Season				
Control		19.7	22.4	21.1
PP333	50 ppm	22.9	26.8	24.9
	75 ppm	27.1	31.0	29.1
	100 ppm	29.8	32.2	31.0
CCC	1000ppm	23.0	25.6	24.3
	2000ppm	25.8	28.9	27.4
	3000ppm	27.0	29.6	28.3
Mean		25.0	28.1	
LS.D at 0.5 for		Retardants =5.48	Pinching =2.19	Interaction =8.76

Table 15. Effect of some growth retardants, pinching and their combinations on roots dry weight/ plant of *Jacobinia carnea* plants during 2016/2017 and 2017/2018 seasons

Parameter / Treatments		First season		Mean
		Not Pinched	Pinched	
Control		1.98	2.32	2.15
PP333	50 ppm	2.61	2.91	2.76
	75 ppm	2.88	3.31	3.10
	100 ppm	3.42	3.72	3.57
CCC	1000ppm	2.36	2.71	2.54
	2000ppm	2.62	3.16	2.89
	3000ppm	3.10	3.48	3.29
Mean		2.71	3.09	
LS.D at 0.5 for		Retardants =0.73	Pinching =0.29	Interaction =1.16
Second Season				
Control		2.36	2.69	2.53
PP333	50 ppm	2.98	3.49	3.24
	75 ppm	3.52	4.02	3.77
	100 ppm	4.02	4.39	4.21
CCC	1000ppm	2.99	3.33	3.16
	2000ppm	3.36	3.84	3.60
	3000ppm	3.66	4.00	3.83
Mean		3.27	3.68	
LS.D at 0.5 for		Retardants =0.60	Pinching =0.24	Interaction =0.96

The previous mentioned findings of root traits could be interpreted on the basis of the physiological role of the nature of growth retardants action. Since, PP333 and CCC treatments alter the endogenous levels of different determined phytohormones i.e. auxin, gibberellins, ABA and cytokinins level that tended to increase the size of root system of *jacobina carnea* plants. It is well established that cytokinins stimulate lateral roots initiation and thus increasing the size (number, thickness, fresh and dry weights) (**Devlin and Witham, 1983**). Such results are in agreement with those obtained by **Youssef (2004)** on *Strelitzia reginae*, **Adham (2001)** on *Althaea rosea*, **Saker (2004)** on *Hibiscus rosea-sinensis* and *Tabernaemontana coronaria* plants, **Abd El-Kader (2009)** on *Cestrum elegans* and *Tecoma stans*, **Ribeiro *et al*. (2011)** on sunflower. **Youssef and Abd El-Aal (2013)** on *Tabernaemontana coronaria*, **Eissa (2014)** on *Murraya exotica* and *Duranta repens* plants, **Ghatas (2016)** on *Chrysanthemum frutescens* plant**, Sharaf-Eldien *et al.* (2017)** on *Zinnia elegans*, **Atteya and El Gendy (2018)** on *Tagetes patula* plant and **Noor El-Deen (2020)** on *Ruellia simplex*.

Conclusively, of all obtained results; those of achieving more dwarf plants of *Jacobinia carnea* with many formed flowers could be considered as pioneer results in this respect. Since, treatments of PP333 at 100 ppm or CCC at 3000 ppm gave a good display (show value) of flowering pot of Jacobinia plant with optimum vegetative and flowering characteristics from the commercial point of view when compared with other treatments or control.

REFERENCES

Abd El-Aal, M.A. and Mohamed, Y.F.Y. (2017). Effect of pinching and paclobutrazol on growth, flowering, anatomy and chemical compositions of potted geranium (*Pelargonium zonal* L.) plant. International Journal of Plant & Soil Science, 17(6): 1-22.

Abd El-Kader, S.F.A. (2009) Physiological studies on growth and flowering of some shrubs. Ph.D. Thesis, Fac. Agric., Moshtohor, Benha Univ., Egypt.

Abou-Dahab, M.A.; Khella, E.A. and Emam, K.A. (2015). Effect of pinching and paclobutrazol (Pbz) on vegetative growth of Russelia equisetiformis for using as a pot plant. Egyptian Journal of Horticulture, 42(2): 913-930.

Adham, H.E.I. (2001). Effect of some growth retardants, pinching and planting date on growth, flowering and chemical composition of *Althaea rosea*, L. Ph.D. Thesis, Fac. Agric., Cairo Univ., Egypt.

Atteya, Amira K. G.; and El Gendy A. G. (2018). Modification of growth, flowering and chemical composition of *Tagetes patula* plants. Middle East Journal of Agriculture Research, 7 (2): 534-547

Berghage, R.D.; Heins, R.D.; Karlsson, M.; Erwin, J. and Carlson, W. (1989). Pinching technique influences lateral shoot development in poinsettia. J. Amer. Soc. Hort. Sci., 114(6): 909-914.

Chany, W.R. (2005). Growth retardants: A promising tool for managing urban trees. Env. Toxicol. Chem., 29: 1224-1236.

Cline, M.G. (1991). Apical dominance. Bot. Rev., 57: 318-358.

Davis, T.D. and Andersen, A.S. (1989). Growth retardants as aids in adapting new floricultural crops to pot culture. Acta Horticulturae, 252: 77-85.

Devlin, M. and Witham, H. (1983). Plant Physiology, 4th Ed. Publishers Willard, Grant Press, Boston.

Eissa, Eman A.T. (2014). Production of *Murraya exotica* L. and Duranta repens L. as pot plants by CCC and PP333. Ms. Thesis. Kafrelsheikh University Faculty of Agriculture Horticulture Department.

El-Sadek, Z.H. (2016). Effect of pinching and paclobutrazol on Hibiscus rosa-sinensis, L. cv. "Yellow" plant. Scientific Journal of Flowers and Ornamental Plants, 3(4): 233-244.

Fletcher, R.A.; Gill, A.; Davis, T.D. and Sankhla, N. (2000). Triazoles as plant growth regulators and stress protectants. Horticulture Review, 24: 55-138.

Ghatas, Y.A.A. (2016) Influence of paclobutrazol and cycocel sprays on the growth, flowering and chemical composition of potted *Chrysanthemum frutescens* plant. Annals of Agric. Sci., Moshtohor, 54(2): 355-364.

Heins, RD.; Liu, B. and Runkle, E.S. (2000). Regulation of crop growth and development based on environmental factors. Acta Horticulturae, 513: 17-26.

Kasem, M.M. and Abd El-Baset, M.M. (2015). Studding the influence of some growth retardants as a chemical mower on ryegrass (*Lolium perenne* L.). Journal of Plant Sciences, 3(5): 255-258.

Mansuroglu, S.; Karaguzel, O.; Ortacesme, V. and Sayan, M.S. (2009). Effect of paclobutrazol on flowering, leaf and flower colour of *Consolida orientalis*. Pakistan Journal of Botany, 41(5): 2323-2332.

Matsoukis, A.S.; Sereli-Chronopoulou, A.; Dimopoulus, I.D. and Kamoutsis, A. (2001). Responses of *Lantana camara* subsp. camara to paclobutrazol and shading. Canadian Journal of Plant Science, 81(4): 761-764.

Noor El-Deen, T.M. (2020). Production of stunted pot plants from *Ruellia simplex*. Middle East Journal of Agriculture Research, 9: 308-320.

Opik, H. and Rolfe, S. (2005). The Physiology of Flowering Plants. Cambridge Univ. Press, 5: plant growth hormones, pp: 177-194.

Orjiakor, C.A.; Uroko, R.I.; Njoku, O.U. and Ezeanyika, L.U.S. (2019). Nutritive properties of aqueous extract *Justicia carnea* leaves and its effects on haematological and some biochemical indices of anemia induced male wistar albino rats. Biomedical Research; 30 (4): 645-654

PGRSA (2007). Plant growth regulation handbook of the Plant Growth Regulation Society of America. 4th Edition. The Plant Growth Regulation Society of America, Athens.

Ribeiro, D.M.; Caroline, M.; Jackson, B.; Glayton, B.R. and Barros, R.S. (2011). Effects of autoclaving on the physiological action of Paclobutrazol. Agricultural Sciences, 2(3): 191-197.

Saker, A.M.I. (2004). Physiological studies on growth and flowering of some ornamental shrubs. M.Sc. Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Egypt.

Sehrawat, S.K.; Dahiya, D.S.; Singh, S. and Rana, G.S. (2003). Effect of nitrogen and pinching on the growth, flowering and yield of marigold (*Tagetes erecta* L.) cv. African Giant Double Orange. Haryana Journal of Horticultural Science, 32(1/2): 59-61

Sharaf-Eldien, M.N.; Samia, Z. El-Bably and Magouz. M. R. (2017). Effect of pinching and spraying of paclobutrazol on vegetative growth, flowering and chemical composition of *Zinnia elegans*, Jacq. J. Plant Production, Mansoura Univ., 8(5): 587-592.

Snedecor, G.W. and Cochran, W.G. (1989). Statistical methods. 7th Ed. Iowa state Univ. Press. Ames Iowa, USA.

Taiz, L. and Zeiger, E. (2006). Plant Physiology. 4th edition. Sinauer Associates, Inc., Publishers, Sunderland.

Vasoya, N.; Ramesh, V.; Nitesh, P. and Dilip, K. (2015). Response of gaillardia to plant growth regulators and pinching. Trends in Biosci., 8(16): 4090-4095.

Youssef, A.S.M. and Abd El-Aal, M.M.M. (2013). Effect of paclobutrazol and cycocel on growth, flowering, chemical composition and histological features of potted *Tabernaemontana coronaria* Stapf plant. Journal of Applied Sciences Research, 9(11): 5953-5963.

Youssef, A.S.M. (2004). Physiological studies on growth and flowering of *Sterilitizia reginae* Ait. Plant. Ph.D. Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Egypt.