Bull. Fac. Agric., Cairo Univ.,60 (2009).86-98.

EFFICACY OF PACLOBUTRAZOL ON THE GROWTH AND FLOWERING OF *Jacobinia carnea* (LINDL.) NICHOLSON

(Received: 26.8. 2008)

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ABSTRACT

Jacobinia carnea (Lindl.) Nicholson is a plant species belongs to ornamental flowering shrubs (Fam. Acanthaceae).The effect of different methods and rates of paclobutrazol application on *Jacobinia carnea* have not been previously studied under the Egyptian conditions. Therefore, this study was conducted at Sakha, Agricultural Research Station, Kafr El-Sheikh Governorate, Egypt, during two successive seasons of 2005/2006 and 2006/2007 to study the effect of two methods of application of paclobutrazol (Bonzi) and rates on some vegetative and roots growth traits, flowering and some chemical composition of *Jacobinia carnea* plants, aiming to use it as a new flowering indoor pot plant. The first application method of paclobutrazol was foliar spray at the rates of 15, 20, and 25 ppm while the second application method was soil drench at the rates of 1.0, 2.0, and 3.0 mg/pot. Twice foliar spray and soil drench of paclobutrazol at 2 weeks interval were applied to potted plants of *Jacobinia cornea*.

Results indicated that plant height, fresh and dry weights of leaves, leaf area, fresh and dry weights of branches, root length as well as fresh and dry weights of roots were significantly decreased with raising paclobutrazol concentration in both methods of application in both seasons. However, number of branches exhibited a slight and insignificant increment between all treatments. Moreover, number of flower heads/plant was increased. Meanwhile, the application of all concentrations in both methods decreased the number of florets/flower heads and delayed flowering time as compared to the control especially with the high rates in the first and second seasons. The contents of chlorophyll (a), chlorophyll (b), and total chlorophyll, total carbohydrates and indoles in the leaves were linearly decreased with raising paclobutrazol concentration in both methods of application. However, phenols content in leaves was increased as affected by these treatments.

A linear slope regression showed that application of paclobutrazol as soil drench on *Jacobinia cornea* plants was more efficient on reduction of most parameters under study compared with application of foliar spray.

Therefore, it could be recommended to use paclobutrazol as a foliar spray at 20 ppm or as soil drench at 2.0 mg /pot, twice time at fortnight interval, according to user preference, and to obtain good potted flowering indoor plants of *Jacobinia carnea* plantlets should be treated 4-4.5 month old under similar conditions of this investigation.

***Key words**: growth regulators, Jacobinia carnea, paclobutrazol, pot plants.*

1. INTRODUCTION

Jacobinia carnea (Lindl.) Nicholson origin to Columbia, Ecuador, Brazil, it is evergreen shrub and belongs to greenhouse and shade plants. It has striking flower with numerous petals erupting from central cluster into crown shape, blooms in summer.

A potential problem in growing *Jacobinia carnea* as potted flowering plant is it relatively tall natural height (90-150 cm), controlled of height by plant growth regulator treatments may be required to produce high quality potted plants. Paclobutrazol (Bonzi) is one of the most active plant growth regulators (PGRs) and has been commercially available for a number of years, which work by inhibiting gibberellins synthesis within the

plant (anti gibberellins). It is effective in rolling excessive growth of a wide array of plants. The effect of growth control lasts for a long time and leaves become thick and dark green (Fletcher and Hofstra, 1985).It causes the change in cell size as well as the change in the form of the plant (Thetford *et al.*, 1995).

Thus, this study investigated the effects of two application methods of paclobutrazol and its rates to know the appropriate method and concentration aiming to produce a new pot flowering of *Jacobinia carnea* under indoor conditions. Many researches were performed to examine the influence of paclobutrazol on growth control and flowering habit of some ornamental plants ,as Helal (1993) who stated that, spraying poinsettia with paclobutrazol (Bonzi) at the rates of 0, 50, 100 and 200 ppm decreased plant height, leaf area, stem fresh and dry weights compared to untreated plants. Wilfert (1994) applied Bonzi to poinsettia as a foliar spray at the rate of 60 ppm or soil drench at 0.5 or 0.25 mg/pot and reported that the single spray of paclobutrazol at 60 ppm as well as drenching 0.25 mg Bonzi reduced plant height . Spraying poinsettia with 0-200 ppm paclobutrazol twice decreased plant height, leaf area and fresh and dry weights of stems and leaves, (Awad *et al.*, 1994). Moreover, Newman and Tant (1995) applied Bonzi to *Euphorbia pulcherrima* as soil drench and found a marked reduction in shoot elongation. Brazzochi and Giorgioni (1996) found that 0.5,1.0 or 2.0 mg/pot Bonzi reduced plant height of *Gardenia jasmenoides* by 18.5 %-46.9%. In addition, Yewale *et al.*, (1998) applied paclobutrazol at the rate of 25, 75 and 100ppm and they reported that, paclobutrazol was more effective for reducing poinsettia plant height, leaf area, number of internodes and length of internodes, thereby producing more compact plants. However, Singh *et al.*, (1999) studied the effect of paclobutrazol concentration (10, 20, 40 and 60 ppm) and 3 application methods; *i.e.*, root dip, soil drench and foliar spray on *Chrysanthemum morifolium*, and they found that growth was retarded with increasing Bonzi concentration and plant height was the shortest with the soil drench method. Whipker *et al.* (2000) mentioned that drench application of paclobutrazol at the rate of 0.025, 0.005, 0.01, 0.02 or 0.04 mg/ pot on *Pelargonium zonale* decreased plant height. Similar observations were also gained by Anuradha *et al.* (2000) who found that the spray application of paclobutrazol reduced plant height of *Chrysanthemum (Dendranthema × grandiflora).* Banon *et al.* (2001) studied the effect of different doses of paclobutrazol 1, 5, 10, 20, 40 and 80 mg/pot on *Nerium oleander* cv. Ajauque and found that paclobutrazol (more than or equal to 5 mg were seen to have inhibited plant growth since plant height, internode length and the aerial parts, dry weight were substantially reduced. Paclobutrazol (more than or equal to 20 mg) reduced the leaf area and the rates (more than or equal to 40 mg) gave leaves with more elliptic shape. Moreover, Emily *et al.* (2001) found that, three spray applications of paclobutrazol (30 mg L^{-1}) on *Oenothera fruticosa* reduced plant height and rooted stem length as compared with controls. Paclobutrazol at 50 and 100 ppm reduced plant height of *Angelonia angustifolia*, (Miller and Armitage, 2002). Similar observations were also gained by Lee *et al.* (2003). They reported that the optimum concentration which reduced plant size, internodes length, and fresh and dry weights of leaves of *Kalanchoe blessfeldiana* was (10 ppm) of paclobutrazol.

Concerning the effect of paclobutrazol on root growth, Hashim *et al.* (1991) concluded that spraying *Hibiscus rosa-sinensis* with paclobutrazol at the rate of 500 ppm gave the lowest fresh and dry weights of roots as compared to the untreated plants. Ruter (1996) treated *Lantana camara* cv. New Gold with a foliar spray of paclobutrazol or through root medium drench, and found that, paclobutrazol at the concentration of 0.5 or 1.0 mg/pot reduced roots dry weight. Similar observations were also gained by El-Bably (2008) who stated that root length as well as fresh and dry weights of *Anisacanthus wrightii* were significantly decreased due to the application of paclobutrazol especially with raising the concentrations (10, 20 and 30 ppm).

Regarding the effect of paclobutrazol on flowering, Ruter (1996) on *Lantana camara* cv . New Gold found that paclobutrazol at the concentration of 0.5 or 1.0 mg/pot reduced flowering to a greater degree than spray application. In addition, Singh *et al.* (1999) studied the effect of paclobutrazol concentration; *i.e.*, 10, 20, 40 and 60 ppm and 3 application methods; *i.e.*, root dip, soil

drench and foliar spray on *chrysanthemum morifolium* and they found that it delayed flowering with increasing Bonzi concentration. Flower number was highest in drench soil and foliar spray treated plants as compared with root dip treatment. Keever and Foster (1991) studied the response of two cultivars of *Azalia simsii* (*Redwing* and *Gloria)* to Bonzi, and they found that it delayed flower time slightly in *Gloria* but not in *Redwing*. Similar report was also obtained by Auda *et al.* (2002) on *Barleria cristat*. Moreover, Kamoutsis *et al.* (1999), indicated that number of flower buds of *Gardenia jasmenoides* plants which treated with paclobutrazol at 0.0, 1.5. and 2.0 mg/pot, decreased as the rate of paclobutrazol increased. Ahmed (1997) on *Bougainvillea* reported that Bonzi at the rate of 40 ppm as soil drench increased number of flowers/plant. Similar observations were also gained by El-Bably (2008), who found that the application of high concentration of paclobutrazol at the rate of 30 ppm significantly delayed flowering time in *Anisacanthus wrightii* and also decreased the number of florets/plant.

Most of chemical constituents of plants were invariably affected by using some growth retardants, thus the maximum chlorophyll contents in leaves were observed with the plants untreated by paclobutrazol. Similar results were also obtained by Helal (1993) who mentioned that treating *Euphorbia pulcherrima* by Bonzi at concentration of 50,100 and 200 ppm decreased the content of chlorophyll (a) or chlorophyll (b) and reduced total carbohydrates contents. Abdella (2000) reported that using paclobutrazol reduced chlorophyll (a + b) in *Hibiscus rosa-sinensis* leaves and total carbohydrates in different organs. Moreover, Lee *et al.* (2003) on *Kalanchoe blessfeldiana* found similar results. However, Shahin *et al.* (2006) on *Rudbeckia hirta* reported that after the second spray, total indoles and total carbohydrates content were progressively decreased, whereas, total phenol content was increased, with raising growth retardants concentration. On *Anisacanthus wrightii* El-Bably (2008) found similar observations.

The present work was conducted at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, Egypt, during two successive seasons to study the effect of two methods of application of paclobutrazol (Bonzi) and its rates on some vegetative and roots growth, flowering parameters and some chemical constituents of *Jacobinia carnea* aiming to achieve the hope of using it as a new flowering indoor pot plants.

2. MATERIALS AND METHODS

Stem cuttings (tip cuttings) with an average length of 15-18 cm and one year old from *Jacobinia carnea* (Lindl.)Nicholsn were taken from certain mother shrubs grown in Faculty of Agriculture at Kafr El-Sheikh and planted on February 10th 2005/2006-2006/2007 in trays filled with a medium of peatmoss and vermiculite (3: 1 by volume). On April 17th, rooted cuttings were individually transplanted in 15 cm diameter plastic pots filled with peatmoss, sand and vermiculite (2: 1: 1 by volume).The plants were pinched for about 3-5 cm from the shoot tip. Paclobutrazol (Bonzi) at the rate of 15, 20 and 25 ppm were applied as foliar spray twice times with two weeks intervals on the foliage from May 2nd, paclobutrazol was also applied as soil drench at the rate of 1.0, 2.0and 3.0 mg/pot in the same time. Control plants, however, were sprayed with tap water. The transplants were fertilized with 3g/liter Krystalon (19-19-19) every 3 weeks till the end of the experiment.

The statistical design used was completely randomized block as seven treatments were replicated three times and distributed randomly within each block, each replicate contained 6 pots. Duncan's multiple range test was used for the comparison among means of treatments according to Snedecor and Cochran (1980). The following data were recorded at the end of the experiment on August 29th:Plant height (cm), fresh and dry weights of leaves (g), leaf area (cm^2) fresh and dry weights of branches (g), number of branches, , longest root (cm), fresh and dry weights of roots(g) , flowering date as number of days elapsed from transplanting to the first flowering head showing color, number of flowers head/plant, number of florets/flower head, chlorophyll (a) (mg/g F.W.) chlorophyll (b) (mg/g F.W.) and total chlorophyll contents(mg/g F.W.) in fresh samples of the fifth leaf from the plant top by the method described by Moran (1982), total carbohydrates contents (mg/g D.W) (Herbert

et al., 1971), phenols and indoles content ((ppm) in dry sample of leaves (A.O.A.C.,1990).

3 RESULTS AND DISCUSSION

3.1. Effect of paclobutrazol on some vegetative growth traits

3.1.1.Plant height

Results in Table (1) indicate that the application methods of paclobutrazol either as foliar spray or as soil drench had a significant effect for reducing the plant height in both seasons as compared to the control. This reduction ranged from 13.6% to 39.2% and 18.7% to 41.4%, in the first and second seasons, respectively, by using Bonzi as foliar spray when compared with the control. Whereas, treating plants with Bonzi as soil drench, this reduction ranged from 55 % to 69.9% and 35.5% to 60.9%, respectively, in the first and second seasons as compared to the control. Maximum plant height control was achieved by using soil drench. The low rate of paclobutrazol in both methods did not reduce plant height to optimal suitable height for marketing, in the same time the higher rates had results in excessive growth reduction coupled with some undesirable morphological shape as smaller, darker and crinkle leaves. Such results might be interpreted according to the direct role of some growth retardants in retarding stem elongation by reducing cell division and extension in the subapical meristematic zone of the stem (Huang, 1996). These results are in agreement with those obtained by Wilfert (1994), Awad *et al.* (1994), Yewal *et al.*, (1998) on poinsettia, Singh *et al.* (1999) on *chrysanthemum morifolium* and Latimer and Whipker (2004) on pansy found similar results.

3.1.2. Fresh weight of leaves

Fresh weight of leaves as affected by using different paclobutrazol treatments either foliar spray or soil drench are shown in Table (1). Data reveal that fresh weight of leaves was significantly reduced in all treatments as compared to the control in both seasons. This reduction ranged from 26.0% to 41.0% and 13.3% to 25.9% in the first and second season, respectively, as resulting for spraying plants by paclobutrazol. However, the lowest fresh weight of leaves was obtained from plants treated with Bonzi as soil drench, as it gave 31.3% to 46.5% and 29.8 to 51.8% reduction in the first and second season, respectively, as compared to the control. These results are in parallel with those obtained by Lee *et al.* (2003) on *Kalanchoe blessfeldiana*, Shahin *et al.* (2006) on *Rudbeckia hirta* and El-Bably (2008) on *Anisacanthus* plants.

Table (1): Effect of methods and rates of paclobutrazol application on some vegetative growth traits of *Jacobinia carnea* during the two seasons of 2005/2006 and 2006/2007

Treatments / Traits	Control	Paclobutrazol					
		Foliar spray (ppm)			Soil drench (mg/pot)		
		15	20	25	1.0	2.0	3.0
	First season of 2005/2006						
Plant height (cm)	31.60a	27.30 b	25.60 C	19.20 d	14.20 e	10.90 f	9.50 f
Leaves (F.W, g)	28.70 a	21.23 b	19.40 C	16.86 d	19.70 C	17.86 d	15.66 e
Leaves (D.W., g)	15.96 a	9.30 b	8.63 bc	8.23 bc	8.70 bc	6.73 c	5.93 d
Leaf area (cm^2)	199.53 a	92.46 b	72.00 c	53.13 d	46.46 d	32.47 e	17.96 f
	Second season of 2006/2007						
Plant height (cm)	37.40a	30.40 b	27.10 c	21.90 d	24.10 d	18.60 e	14.60 e
Leaves (F.W. g)	24.43 a	21.16 b	19.26 c	18.10 cd	17.13 cd	15.00 d	11.76 e
Leaves (D.W., (g)	10.87 a	8.11 b	7.38 bc	6.10 bc	7.33 bc	5.09 c	4.08 d
Leaf area (cm^2)	174.86 a	110.63 b	92.76 c	67.10 d	71.33 d	46.40 e	18.73 f

In the same colmn, means followed by the same letter are not significantly different at 0.05 level.

3.1.3. Dry weight of leaves

Data demonstrated in Table (1) indicate that the dry weight of leaves showed the same trend as fresh weight of leaves. In both seasons the dry weight of leaves was steadily reduced by raising the Bonzi concentrations in both methods of application (foliar spray at the rates of 15, 20 and 25 ppm or soil drench at the rates of 1.0, 2.0 and 3.0mg/plant) as compared to untreated plants. This reduction

ranged from 41.7% to 48.4% and 25.3% to 43.8% when plants treated by Bonzi as foliar spray in the first and second season, respectively, as compared with the control. Whereas, treating the plants with paclobutrazol as soil drench this reduction ranged from 45.4% to 62.8% and 23.5% to 62.4% in the first and second seasons, respectively, as compared with untreated plants. These results are confirmed with, Awad *et al.* (1994) on poinsettia plants and El- Bably (2008) on *Anisacanthus wrightii* found similar results.

3.1.4. Leaf area

Regarding the effect of foliar spray or soil drench of Bonzi on leaf area of *Jacobinia cornea*, data in Table (1) show that leaf area significantly decreased as paclobutrazol increased from 15 to 20 and 25 ppm. The decrease percentages ranged from 53.6% to 73.3% and from 36.7% to 61.6% as compared to the control in both seasons respectively. Meanwhile the decrease percentages ranged from 76.7% to 90.9% and from 59.2% to 89.2% in the first and second season respectively compared to the control when *Jacobinia cornea* plants treated by paclobutrazol as soil drench. This finding could be explained by the fact of the role of paclobutrazol in inhibiting cell elongation which reflects on decrease of leaf area (Cathey, 1964). The obtained results are in conformity with Banon *et al.* (2001) on *Nerium oleander*. Ornamental tomato plants exhibited smaller leaf area as the paclobutrazol concentrations increased from 15 to 30, 45, 60 and 75 mg/L (Paulo *et al.*, 2005). In addition, El- Bably (2008) on *Anisacanthus wrightii* observed similar conclusion.

3.1.5. Number of branches/plant

Data in Table (2) show that different paclobutrazol treatments significantly increased number of branches over the control during both seasons, with non significant differences between all treatments.

The increase in number of branches may be due to the inhibition of cell division and elongation of subapical meristem may overcome the apical dominance of the plants by interruption either basipetal auxin transport or auxin biosynthsis. This may give an advantage to the buds to grow and give branches (Philip, 1975). These results are in harmony with those of Abbas (1994) on *Celosia argenta* who found that Bonzi at 50-75 ppm increased number of branches

3.2. Fresh and dry weights of branches

Data in Table (2) indicate that the methods of application by paclobutrazol (either foliar spray or soil drench) had a significant effect for reducing the fresh weight of branches/plant in both seasons. This reduction ranged from 16.6% to 40.8% and from 18.5% to 56.6% respectively, in the first and second season, respectively, by using paclobutrazol as foliar spray compared with the control. Whereas, using paclobutrazol as a soil drench, the reduction ranged from 13.1% to 51.7 % and from 28.2% to 59.7% in both seasons, respectively, as compared to the control. The data in the same Table, also reveal that raising the paclobutrazol concentration, either foliar spray or soil drench resulted in a significant and steady reduction in the dry weight of branches/plant

Table (2): Effect of method and rates of paclobutrazol application on some branches traits of *Jacobinia carnea* during the two seasons of 2005/2006and 2006/2007.

Treatments / Traits	Control	Paclobutrazol					
		Foliar spray (ppm)			Soil drench (mg/pot)		
		15	20	25	1.0	2.0	3.0
	First season of 2005/2006						
No. of branches	5.00 b	6.00 a	6.66 a	6.33 a	7.00 a	7.33 a	6.66 a
Branches (F.W., g)	25.81 a	21.50 b	18.36 c	15.26 a	22.43 ab	18.20 c	12.465 e
Branches (D.W., g)	14.63 a	10.26 b	8.33 c	7.46 cd	9.23 bc	7.40 cd	5.93 d
	Second season of 2006/2007						
No. of branches	5.00 b	6.33 a	7.66 a	6.33 a	7.66 a	7.66 a	73.00 a
Branches (F.W., g)	32.80 a	26.70 b	19.23 d	14.23 e	23.53 c	15.56 e	13.20 e
Branches (D.W., g)	16.20 a	13.83 b	9.00 a	7.49 e	10.36 c	6.63 e	5.20 f

In the same colmn, means followed by the same letter are not significantly different at 0.05 level.

in both seasons. This reduction ranged from 29.8% to 49.0% and from 14.6%-53.7% respectively, in the first and second season by using paclobutrazol as foliar spray when compared with the control. Meanwhile, treating plants with paclobutrazol as a soil drench caused a reduction which ranged from 36.9% to 59.4 %and from 36.0% to 67.9%, as compared to the control in both seasons. respectively. The aforementioned results are in accordance with those of Wilfert (1994) on Poinsettia, Banon *et al.* (2001) on *Nerium oleander*, Auda *et al.* (2002) on *Barleria cristata*, Shahin *et al.* (2006) on *Rudbeckia hirta* and El-Bably (2008) on *Anisacanthus wrightii*.

3.3. Effect of paclobutrazol on some root growth traits

As for the effect of paclobutrazol on root growth, data in Table (3) show that the different foliar spray and different soil drench application significantly decreased some root growth traits ; *i.e.*, root length, as well as fresh and dry weights of roots.

3.3.1. Root length

The application of paclobutrazol especially at higher concentrations significantly reduced root length. This reduction in the root length percentage ranged from 28 % to 42.1 % and from 15.1 % to 49.3 % in the first and second season, respectively, with using paclobutrazol as foliar spray, while with soil drench method gave a reduction ranged from 42% to 68.6 % and from 65.5 % to 74.2% respectively, in the first and second season when compared with untreated plants. The effect of paclobutrazol on shortening root length may be due to inhibition of root formation and function as a result of either anti gibberellins or anti metabolites and led to decreased root length. This result was in agreement with Auda *et al.* (2002) on *Barleria cristata*, El-Maadawy *et al.* (2001) on *Begonia*, and El-Bably (2008) on *Anisacanthus wrightii* plants.

3.3.2. Fresh weight of roots

Data in Table (3) indicate that fresh weight of roots was negatively influenced by all treatments of foliar spray, in the first and second seasons. The significantly decrement was the highest for the treatment at 25 ppm. There was no significant difference between the 15 ppm and 20 ppm treatments in this concern. However treating plants by all concentrations of paclobutrazol as soil drench significantly decreased the fresh weight of roots as compared to foliar spray in both seasons. The decrement was the highest for the treatment of 3.0 mg/plant. Similar results were attained by Hashim *et al.* (1991) who found that spraying *Hibiscus rosa- sinensis* with Bonzi at the rate of 500 ppm gave the lowest fresh and dry weights of roots as compared to the untreated plants. Also, Auda *et al.* (2002) on *Barleria cristat.* El-Maadawy *et al.* (2001) on *Begonia semperflorens*, noticed similar observations.

3.3.3. Dry weight of roots

A somewhat similar trend in dry weight of roots (Table 3). Both applications at all concentrations gradually decreased dry weight of roots as compared with the control in both seasons, the highest significantly reductions resulted from the application of 3.0mg/pot followed by the treatment of 2.0 mg/plant. The aforementioned results are in accordance

Table(3): Effect of method and rates of paclobutrazol application on some root growth traits of *Jacobinia carnea* during the two seasons of 2005/2006 and 2006/2007.

Traits \ Treatments	Control	Paclobutrazol					
		Foliar spray (ppm)			Soil drench (mg/pot)		
		15	20	25	1.0	2.0	3.0
	First season of 2005/2006						
Root length (cm)	28.90 a	20.80 b	19.70 b	16.70 c	16.00 c	13.70 d	9.0 e
Roots (F.W., g)	24.44 a	19.97 b	18.38 b	14.98 c	12.50 cd	10.68 d	7.14 e
Roots (D.W., g)	9.06 a	7.42 b	7.32 b	6.19 b	6.16 b	2.80 c	2.05 c
	Second season of 2006/2007						
Root length (cm)	29.80 a	25.3 b	17.90 c	15.00 a	10.3 e	9.80 ef	7.70 f
Roots (F.W, g)	27.24 a	22.32 b	19.16 bc	17.90 c	12.42 d	8.20 e	7.03 f
Roots (D.W, g)	9.32 a	8.91 a	6.83 b	5.57 c	4.55 d	3.52 e	2.17 f

In the same clom, means followed by the same letter are not significantly different at 0.05 level.

with those of Hashim *et al.* (1991) on *Hibiscus rosa- sinensis*, Ruter (1996) on *Lantana camara* and El-Bably (2008) on *Anisacanthus wrightii*. In general, data in Table (3) and Fig.(1) show that, maximum reduction was achieved by using soil drench compared to foliar spray method especially with high concentrations.

highest values in both seasons, while the lowest ones were obtained from the treatments of using Bonzi at the rate of 3.0 mg/pot in the first and second season. The increment of flower heads/plants is considered reasonable because they took a parallel line to that of number of branches which is responsible with the aforementioned reason as

Foliar spray at the rate of 25 ppm **Soil drench at the rate of 3 mg/pot.**

Fig. (1): Effect of methods and rates of paclobutrazol application on root growth of *Jacobinia*

3.4. Effect of paclobutrazol on some flowering traits

3.4.1. Number of flower heads /plant

Data in Table (4) indicate that the application of Bonzi treatments as a foliar spray increased the number of flower heads plant over the control in both seasons with non-significantly differences between themselves .However, using Bonzi as a soil drench at the rate of 2.0 mg/pot gave the given by Philip (1975). These results are parallel with those obtained by Singh *et al.* (1999) on *Chrysanthemum morifolium*, and Adham (2001) reported that treating *Althea rosea* by Bonzi at the rate of 0.5 and 1.0 mg/pot had a significant effect on increasing the total number of flowers.

3.4.2. Number of florets/flower head

Data in Table (4) indicate that using the two methods of paclobutrazol at different

Table (4): Effect of method and rates of paclobutrazol application on some flowering traits of *Jacobinia carnea* **during the two seasons of 2005/2006 and 2006/2007.**

Traits \ Treatments	Control	Paclobutrazol					
		Foliar spray (ppm)			Soil drench (mg/pot)		
		15	20	25	1.0	2.0	3.0
	First season (2005/2006)						
No. of flower heads	3.33 ab	4.00 a	3.66 ab	3.66 ab	3.33 ab	4.00 a	3.00 b
No. of florets	18.66 a	14.66 b	14.00 b	11.00 c	15.33 b	15.00 b	14.33 c
No. of days from transplanting to flowering	95.3 a	97.3 bc	98.0 b	98.3 b	97.0 b	99.0 b	101.6 a
	Second season (2006/2007)						
No. of flower heads	3.66 ab	4.00 a	4.00 a	3.66 ab	3.66 ab	4.00 a	3.33 b
No. of florets	19.66 a	16.00 b	13.33 c	13.33 c	17.66 ab	16.33 b	13.33 c
No. of days from transplanting to flowering	92.6 a	95.6 c	96.0 c	96.6 c	95.3 c	98.0 b	104.3 a

In the same colmn, means followed by the same letter are not significantly different at 0.05 level

rates led to significantly decrease the number of florets per flower head as compared to the control in both seasons, in the first season the treatments of low and medium concentrations of paclobutrazol as well as in both methods of applications had not significant differences between themselves as compared with untreated plants .The high concentration either foliar spray or soil drench recorded the least number of florets. However, in the second season, only spraying plants by paclobutrazol at the rate of 15 ppm or treating plants as a soil drench at the rate of 1.0 or 2.0 mg/pot revealed insignificant differences between themselves as compared to the control. Meanwhile, the high concentration gave the least number of florets. Moreover, the reduction in florets number by increasing the concentrations of paclobutrazol as foliar spray ranged from 24.1% to 41.0% and from 18.6% to 32.1% in the first and second season, respectively, overcome the reduction of florets number by increasing the concentrations of paclobutrazol as soil drench which gave 17.8% to 25.5% or from 10.1% to 32.1% in the first and second season, respectively. Similar results were observed by Singh *et al.* (1999), who studied the effect of paclobutrazol concentration (10, 20, 40 and 60 ppm) and 3 application methods, *i.e*., root dip, soil drench and foliar spray on *Chrysanthemum* and found that flower number was highest in drench soil as compared with foliar spray treated plants and root dip treatments. In this connection El-Maadawy *et al.* (2001) on, *Begonia semperflorens*, Shahin *et al.* (2006) on *Rudbeckia hirta* and El–Bably (2008) on *Anisacanthus* plants obtained similar results. conclusions.

3.4.3. Flowering date

Data in Table (4) indicated that, using both methods of application at different rates led to an increase of the days elapsed from planting transplants to flowering time with non significant differences between the treatments of low concentration of Bonzi as foliar spray and the control in the first season. However, in the second one all treatments revealed significant differences as compared to the control. foliar spray significantly delayed the flowering time from 2 to 3 days and from 3 to 4 days compared to the control in the first and second seasons, respectively. Whereas paclobutrazol application as a soil drench significantly delayed the flowering time from 1.7 to 6.3 days and from 2.7 to 11.7 days compared to the control in the first and second seasons, respectively. The obtained results are in conformity with Yewale *et al.* (1998) and Wei and Han (1997) on *Chrysanthemum grandiflora*. They also reported that paclobutrazol at the rate of 25, 50, 75 and 100 ppm progressively, delayed flowering as the concentration was increased. Moreover, Starman and Williams (2000) on *Scaevola aemula*, Shahin *et al*. (2006) on *Rudbeckia hirta* and El-Bably (2008) on *Anisacanthus wrightii* found similar results.

3.5. Effect paclobutrazol on some chemical composition

3.5.1. Chlorophyll (a) content

Data in Table (5) indicate that using both methods of application of paclobutrazol at different rates led to decrease chlorophyll (a) with non significant differences between the treatments of low, medium and high concentrations as paclobutrazol applied as foliar spray as compared to the control in the first season. Whereas in the second one, showed insignificant differences the application of low level between the control

Table (5): Effect of method and rates of paclobutrazol application on chlorophyll (a), (b) and total chlorophyll of *Jacobinia carnea,* **during the two seasons of 2005/2006 and 2006/2007.**

Treatments / Traits	Control	Paclobutrazol					
		Foliar spray (ppm)			Soil drench (mg/pot)		
		15	20	25	1.0	2.0	3.0
	First season						
Chl. (a) (mg/g F.W.)	1.045 a	0.979 b	0.969 b	0.936 bc	0.932 bc	0.888 c	0.889 c
Chl. (b) (mg/g F.W.)	0.612 a	0.496 b	0.471 b	0.383 c	0.310 d	0.304 d	0.293 d
Total chl. (mg/g F.W.)	1.657a	1.475 b	1.440 b	1.319	1.242 d	1.192 d	1.182 d
	Second season						
Chl. (a) (mg/g F.W.)	1.110 a	1.054 ab	1.006 b	0.937 c	0.945 c	0.943 c	0.938 c
Chl. (b) (mg/g F.W.)	0.602 a	0.541 b	0.495 bc	0.478 c	0.425 de	0.398 d	0.328 e
Total chl. (mg/g F.W.)	1.712 a	1.595 b	1.501 c	1.415d	1.370 de	1.341 e	1.266 f

In the same colmn, means followed by the same letter are not significantly different at 0.05 level.

and between the medium levels. As for the effect of using paclobutrazol as soil drench, the results showed that all treatments significantly decreased chlorophyll (a) as compared to the control in both seasons. The growth retardants treatments caused leaves to be thick and dark green (Fletcher and Hofstra, 1985). It causes the change in cell size as well as the change in the form of the plant (Thetford *et al.,* 1995). This result was in agreement with, Lee *et al.* (2003) on *Kalanchoe blessfeldiana*. They found that chlorophyll concentration was decreased with using plant growth regulators, and Abdella (2000) who stated that, paclobutrazol reduced chlorophyll (a) in *Hibiscus rosa-sinensis* leaves. El-Bably (2008) on *Anisacanthus wrightii* also found similar results.

3.5.2. Chlorophyll (b) content

A somewhat similar trend was as the previous parameter as shown in Table (5) chlorophyll (b) was significantly decreased with increasing the concentration of paclobutrazol in both seasons. The lowest record resulted from treating plants with paclobutrazol as a soil drench as compared to using as foliar spray treatments. Moreover, it is noticed that the only insignificant effect on chlorophyll (b) content in *Jacobinia cornea* leaves was recorded with the application of paclobutrazol by spraying plants by paclobutrazol at the rate of 15 ppm only in the second season. Plants typically appeared darker green which might be due to reduced leaf expansion (Davis *et al.,* 1988). Several results were also indicated by Abdella (2000) on *Hibiscus rosa-sinensis*, Lee *et al.* (2003) on *Kalanchoe blessfeldiana* and Shahin *et al.* (2006) on *Rudbeckia hirta***.**

3.5.3. Total chlorophyll content

Data in Table (5) show that the application of paclobutrazol either foliar spray or soil drench especially at higher concentrations at the rate of 25 ppm and 0.3 mg/pot ; respectively, had significant effect for reducing total chlorophyll content in the leaves of *Jacobinia cornea* These results are reasonable, since, chlorophyll a and chlorophyll b content was decreased with increasing the concentration.

3.5.4. Total carbohydrates content

Data in Table (6) indicate that the reduction of total carbohydrates is considered reasonable because they took a parallel line to that of pigments content which is responsible of biosynthesis processes in the plant.The aforementioned results are in accordance with those of Nasr(1995) who found that the application of paclobutrazol at the rate of 15 or 30 ppm as soaking, immersion, soil drench and 20 or 40 ppm as spray to *Pelargonium zonal*e decreased total carbohydrates. Several results were also indicated by Hashim *et al.* (1991) and Abdella (2000) *on Hibiscus sinensis,* Helal (1993) on *Euphorbia pulcherrima,* Auda *et al.* (2002) on *Barleria cristata*, and Shahin *et al.* (2006) on *Rudbeckia hirta.*

3.5.5. Phenols contents

A somewhat different trend in phenols content Table (6) record that both methods of application at all concentrations increased gradually phenols contents as compared with the control in both seasons. Similar results were attained by Shahin *el al*. (2006) on *Rudbeckia hirta* plants and El-Bably (2008) on *Anisacanthus wrightii.*

Table (6): Effect of method and rates of paclobutrazol application on total carbohydrate, phenols and indoles content of *Jacobinia carnea*, during the two seasons of 2005/2006 and 2006/2007.

Traits \ Treatments	Control	Paclobutrazol					
		Foliar spray (ppm)			Soil drench (mg/pot)		
		15	20	25	1.0	2.0	3.0
		First season					
Total carbohydrates content (mg/g D.W.)	13.95 a	13.60 ab	13.12 b	12.82 b	12.80 bc	12.30 c	11.69 d
Total phenols content (ppm)	7.94 d	10.38 c	11.21 d	12.77 ab	13.66 a	13.88 a	14.19 a
Total indoles content (ppm)	14.83	12.79	12.07	11.96	12.90	13.13	12.44
		Second season					
Total carbohydrates content (mg/g D.W.)	12.59 a	12.27 b	12.06 bc	11.74c	11.97 bc	11.58 d	11.32 e
Total phenols content (ppm)	7.48 e	9.17 d	11.96 b	13.35 a	10.28 c	12.22 b	12.51 ab
Total indoles content (ppm)	11.14 a	10.98 a	9.79 bc	9.19c	10.02 b	9.25 c	8.70 d

In the same clomn, means followed by the same letter are not significantly different at 0.05 levels.

3.5.6. Indoles content

Data in Table (6) indicate that total indoles content in *Jacobinia cornea* leaves was linearly decreased with increasing the concentration of Bonzi application either foliar spray or drench soil. This result was in agreement with Auda *et al.* (2002) on *Barleria cristat* and Shahin *el al*. (2006) on *Rudbeckia hirta* plants.

translocation pattern of trizole compounds, which are xylem mobile. When trizole compounds applied to roots, young stem, and the youngest leaves, they quickly enter the plant and are translocated acropetally via the xylem to the leaves (Sterrett, 1988 and Reed *et al.,* 1989). Paclobutrazol blocks an early step in the gibberellins biosynthetic pathway (Coolbaugh and Hamilton, 1976), thus

Table (7): Regression equations adjusted to evaluate parameters (y) of *Jacobinia carnea* as variables of paclobutrazol concentration (x).

Evaluation parameter (Y)	Paclobutrazol			
	Foliar spray (ppm)		Soil drench mg/pot	
		R_2		R_2
Plant height (cm)	Y = 32-042 x (1)	0.85**	Y = 24-9.58 x (2)	62**
Leaf area (cm^2)	Y = 194-6.02 x (3)	0.98**	Y = 141-76.7 x (4)	66**
Longest root (cm)	Y = 28.7-0.48 x (5)	0.98**	Y = 24.2-7.02 x (6)	66**
D.W of roots (g)	Y = 8.65-0.09 x (7)	0.72**	Y = 8.05-3.47 (8)	85**
D.W. of branches (g)	Y = 14.6-0.29 x (9)	0.98**	Y = 12.8-3.96 x (10)	96**
D.W. of leaves (g)	Y = 15.4-0.33 x (11)	0.92**	Y = 13.4-4.38 x (12)	71**
Carbohydrates content (mg/D.W.)	Y = 14.1-0.04 x (13)	0.91**	Y = 13.6-1.06 x (14)	91**

** Significant at $P < 0.01$; R^2 coefficient of determination

Equations (1, 3, 5, 7, 9, 11 and 13) showed that each one part per million of paclobutrazol as foliar spray application under the condition of study decreased plant height, leaf area, longest root, dry weight of roots, dry weight of branches dry weight of leaves and total carbohydrates by 0.42 cm, 6.02 cm^2, 0.48 cm, 0.09 g, 0.29 g, 0.33 g and 0.04 m/g D.W., respectively, as shown in Table (7). On the other hand, application of 1mg/pot of Paclobutrazol as a soil drench decreased plant height, leaf area, longest root, dry weight of roots, dry weight of branches dry weight of leaves and total carbohydrates by 9.58 cm, 76.7 cm^2, 7.02 cm, 3.47 g, 3.96 g, 4.38 g and 1.06 m/g D.W., respectively, (Equations 2, 4, 6, 8, 10 and 12).It means that application of paclobutrazol as soil drench on *Jacobinia cornea* plants was more efficient on reduction of all parameters under study compared with application foliar spray Table (7) and the reduction in all traits under study was linearly decreased with increasing the concentration of paclobutrazol .In general, both methods were effectiveness in controlling plant growth. Lee *et al*. (2003) reported that plants treated with 5 mg L-1 uniconazole had xylem vessel and phloem cell suppressed in both length and width. The preferential suppression of xylem tissues may be related directly to the reducing the gibberlic acid content in the treated plant.

It could be concluded that the production of the decorative value of pot plant of *Jacobinia carnea* was the best in the 20 ppm as foliar spray and 2.0 mg/pot as soil drench application of paclobutrazol as well as according to user preference.

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فعالية الباكلوبترازول علي نمو وإزهار نبات الجاكوبنيا كارنيا *Jacobinia carnea* **(Lindl.) Nicholson**

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ملخص

نبات الجاكوبنيا كارنيا أحد شجيرات الزينة المزهرة وينتمي لفصيلة Acanthaceae ولم يتم من قبل دراسة تاثيرالطرق و المعدلات المختلفة للباكلوبترازول علي هذا النبات تحت الظروف المصرية. لذا اجريت هذه الدراسة في محطة البحوث الزراعية بسخا بمحافظة كفر الشيخ بمصرفي الموسمين المتعاقبين (2005/ 2006و2006/2007) وذلك لدراسة تأثير طريقتين لإضافة الباكلوبترازول وأيضا معدلاته علي بعض صفات النمو الخضرية والجذرية وكذا بعض الصفات الزهرية بالإضافة إلي بعض المكونات الكيميائية لنبات الجاكوبنيا كارنيا بهدف الحصول علي نبات اصص جديد مزهر من أجل التنسيق الداخلي. الطريقه الأولي الرش الورقي بتركيزات 15و20و25جزء في المليون والطريقة الثانية الإضافه للتربه بتركيزات 1.0 و 2 و3 ملجرام لكل

اصيص ولقد تم رش النباتات بالباكلوبترازول واضافته للتربة مرتين بفاصل اسبوعين لكل اصيص جاكوبنيا كارنيا.
وقد أوضحت النتائج نقصا معنويا يزداد بزيادة تركيزات الباكلوبترازول في ارتفاع النبات والوزن الطازج والجاف للأوراق وكذا الوزن الطازج والجاف للأفرع الخضرية وطول الجذور وكذا وزن الجذور الطازج والجاف نتيجة لزيادة التركيزات المستخدمة في كلا الطريقتين. بينما أظهر عدد الأفرع زيادة طفيفة غير معنوية بين كل المعاملات المستخدمة .كما أن كل التركيزات في كلا من الطريقتين نتج عنها زياده في عدد الرؤوس الزهريه بينما حدث نقص في عدد الزهيرات في الرؤوس المزهره و إلي حدوث تأخير معنوي في موعد الإزهار في الموسمين وذلك عند المقارنة بالكنترول خاصة مع زيادة التركيزات المرتفعة في كلا الطريقتين. وقد حدث مع زيادة تركيزات الباكلوبترازو ل في كلا من الطريقتين نقص في كلا من كلوروفيل (أ) وكلوروفيل (ب) ومحتوي الكلوروفيل الكلي بالأوراق وكذا محتوي الكربوهيدرات الكلية في الأوراق وأيضا محتواها من الاندولات وذلك بإزدياد تركيز الباكلوبترازول في كلا من الطريقتين . بينما حدث زياده في محتوي أوراق الجاكوبنيا كارنيا من الفينولات تأثرا بهذه المعاملات.وقد اتضح من انحدار ميل الخط المستقيم انه يمكن استخدام الباكلوبترازول بإضافته للتربة حيث إنه كان أكثر كفاءه في تقليل معظم الصفات تحت الدراسة مقارنة بإستخدامه بالرش. ولهذا فإن الباكلوبترازول يمكن استخدامه بالرش الورقي بتركيز 20 جزء في المليون أو اضافته للتربة بتركيز 2 ملجرام لكل اصيص مرتين بفاصل اسبوعين حسبما يفضل المستخدم .وللحصول علي نبات جيد مزهر يصلح للتنسيق الداخلي يجب معاملة الشتلات عمر 4-4.5 شهر تحت ظروف مشابهة لظروف البحث المستخدم.