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RESPONSE OF *Jacobinia carnea*, NICHOLS PLANTS TO UNICONAZOLE:
II. EFFECT OF APPLICATION METHODS, RATES AND THEIR INTERACTION

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ABSTRACT

Two successive experiments were conducted in plastic house under the natural conditions during the both seasons of 1996-97 and 1997-98. Each experiment included two application methods of uniconazole, as a foliar spray or as a soil drench, on a local cultivar of *Jacobinia camea*, Nichols plants, using the rates of 0,60,90,120,150 and 180 ppm. The experimental design was a split plot with 3 replicates, the main plots represented the application methods, while the uniconazole rates resembled the sub plots. The results can be summarized as follows:

1- In both cases of application methods and comparing with the control, uniconazole rates significantly retarded the plant height, the shoot dry weight, the flowering time and the inflorescence dry weight and decreased the reducing, non-reducing and total soluble sugars and starch contents in the leaves and roots, but significantly increased the internode and shoot numbers and the leaf chlorophyll "a" and "b" concentrations. The general effect of the chemical rates exhibited the same trends.

2- The internode length and the leaf area were evaluated with the foliar spray and they were significantly decreased at the tested rates, compared with the control.

3- Comparing with the control, the number of florets per inflorescence, the inflorescence length, diameter and longevity were significantly increases at the uniconazole rates applied as a foliar spray, while the opposite was noticed with the soil drench. The general effect of uniconazole rates was similar to the effect of the soil drench.

4- The soil drench was more effective than the foliar spray in depressing the plant height, the shoot dry weight, the floret numbers, the inflorescence dimensions, life and dry weight, the root contents of the reducing sugar and starch and the leaf and root contents of the non-reducing and total soluble sugars. The foliar spray gave a lower number of the internodes, a higher number of the shoots and earlier flowering than the soil drench.

5- All studied traits were markedly affected by each of the application methods, the uniconazole rates and the interaction between them, except the leaf contents of the chlorophyll "a" and "b", the reducing sugar and the starch which were not affected by the application methods.

INTRODUCTION

As a result of the popularity of interior landscaping, methods for extending the useful life of foliage plants are needed, especially in suboptimally lighted conditions. Interior plants often exhibited etiolation, chlorosis and leaf

abscission and become unacceptable in the landscape. Plant growth retardants may have potential for use on interior foliage plants by preventing excessive internode elongation, leaf abscission and maintaining dark green foliage after plants have been moved from production to interior environments (Wang *et al.*, 1992). Uniconazole exhibits growth retarding properties an a wide range of interior plants such as *Forsythia intermedia* (Vaigro-Wolff and Warmund, 1987 and Thetford *et al.*, 1995a and b); *Epipremnum aureum* (Wang *et al.*, 1992); *Begonia* X *hiemalis*, *Begonia* X *tuberhybrida* and *Syngonium podophyllum* (Lang and Wilkerson, 1995) and *Rhododendron spp.* (Schuch and Biernaka, 1995). Such growth retarding effects could extent the useful life of plants in the landscape.

Jacobinia carnea, Nichols (Fam. *Acanthaceae*) is hardy flowering foliage plant, sometimes subshrub. The stem is erect and becomes several feet in height if allowed to grow. The plant is used for indoor decoration and is showy greenhouse or conservatory subject. During the vegetative growth, the plant may become elongated with absence of freely branching habit and the leaf loss making it disproportional to pot size and less attractive to the consumer. The effectiveness of uniconazole on *J. carnea*, Nichols plant is unknown. Therefore, the objective of this research was to evaluate the growth retarding potential of uniconazole, through comparative studies of foliar spray and soil drench, on *J. carnea*, Nichols plant in a commercial-like nursery environment trying to improve the vegetative and flowering growth of the plant.

MATERIALS AND METHODS

The present investigation was conducted during the two successive seasons of 1996-97 and 1997-98 in Antoniades Research Gardens, Horticulture Research Institute, Alexandria, Egypt. One-year-old healthy plants of *Jacobinia carnea*, Nichols "Local cultivar" were used and obtained from the Flower and Ornamental Plant Research Gardens of the Faculty of Agriculture, University of Alexandria, Egypt. The plants were grown individually in 25 cm diameter clay pots, filled with a loamy soil of pH 7.4 containing 0.25% N, 0.06% P and 0.13% K, under natural light in plastic house. Plants were pinched to the height of 20 cm and two lateral shoots were left on each plant, while all other shoots or breaks were removed. One week after pinching (on May 7, 1996 and May 11, 1997 in the 1st and 2nd seasons; respectively), uniconazole rates of 0 (tap water), 60, 90, 120, 150 and 180 ppm were prepared and applied using the two methods of the foliar spray or the soil drench. Uniconazole aqueous solutions were applied as a single application in both methods.

For the foliar spray, the pot surface was covered with polyethylene to avoid falling of spray drips on the growing medium and pots were sprayed at 40 cm centers. All rates were applied using a hand sprayer and the wetting agent sodium dodecylsulfate was added to each test solution (0.15%) to increase the wetting power of the plants and enhance the spreading of uniconazole over the plant surface. Each plant was sprayed individually so that all foliage was moistened till the point of run-off and spraying volume was 20 ml per plant. Considering the soil drench, no watering was applied for two days before the

drenching and the drench volume was 90 ml per pot. Two days after uniconazole applications, the treated plants did not receive irrigation. The complete fertilizer of 19-19-19 was top dressed (2.5 g/pot) with 3 weeks intervals. Watering and pests and weed controls were carried out whenever needed.

The pots contained the treated plants were randomly assigned to 3 replicates in a split plot design (Snedecor and Cochran, 1967) in plastic house under the natural day length. Uniconazole application methods (spray and drench) represented the main plots, whereas uniconazole rates resembled the sub-plots. Number of treatments in each replicate was 12 and 6 plants were used for each treatment per replicate. The total number of plants was 216. The trials were terminated on May 9, 1997 and May 14, 1998 in the 1st and 2nd seasons; respectively. Unless otherwise stated, the following parameters were recorded at the end of each experiment using all plants:

I-Vegetative growth:

1- Plant height (in cm) was measured from the soil surface to the uppermost point of the plant.
2- Internode length (in cm) for the foliar spray treatments only, where all internodes that had fully expanded after treatment were undertaken.
3- Internode number per plant, where all internodes, of the first order shoots, that had fully developed after treatment were counted.
4- Number of shoots per plant, where all shoots which had 5 cm at least in length were counted.
5- Leaf area (in cm^2) for the foliar spray treatments only, using the disk methods (Koller, 1972) during the vegetative growth. There were 4 mature leaf blades were sampled from the first two nodes, which had formed primarily after the treatment in each plant.
6- Shoot dry weight (in g), where the top system without the inflorescences was dried in an oven at 70°C for 72 hr.

II-Flowering growth:

1- Number of days to flowering (flowering date) which was expressed as the mean number of days between the beginning of the experiment and the appearance of the first inflorescence per plant at each treatment in each replicate.
2- Number of florets per inflorescence, where all inflorescence were considered in each treatment per replicate.
3- Inflorescence dimensions (in cm) for all fully opened inflorescences, where the length and diameter were measured.
4- Inflorescence longevity, expressed as the days elapsed between the appearance of the inflorescence colour and the fading of it on the plant. All inflorescences which exhibited colour in each treatment per replicate were considered,
5- Inflorescence dry weight (in g), where the fully opened inflorescences in each treatment per replicate were oven dried at 70°C for 48 hr.

III-Chemical analysis: The studied compounds were determined 3 times and the means were calculated for each treatment per replicate in the 2nd season only.

1- Chlorophyll "a" and "b" (mg/g fresh weight of leaves): After calculation of the leaf area, the same leaf blades were used. According to Gavrilenko *et al.* (1975), 1.0 gram of the leaves was crushed with a known quantity of 99% aceton, then samples were centrifuged at 4500 cycles per minute for 3 minutes. Equivalent quantity of the filtrate of each sample was taken to determine the optical density (D) as an indication for chlorophyll contents "a" and "b" as follows:

The concentrations of chlorophyll "a" (CA) and "b" (CB) were determined by substituting of (D) in the following equations Gavrilenko *et al.* (1975):

CA= 10.3 D 663 – 0.918 D 644 CB= 19.7 D 663 - 3.87 D 663

2- Sugars and starch contents (mg/100g dry weight): The plants were removed outside the pots. The roots were separated and cleaned to free it carefully from the residual soil. Samples of leaves and roots of each treatment per replicate were taken, where each plant was represented in the sample. The leaf samples were taken after the shoot dry weights were calculated. Samples were washed with the tap water and rinsed twice with distilled water. The samples were oven dried at 70°C; the leaf samples for 24 hr and the root ones for 72 hr. The dried materials were ground. Sugars were extracted with distilled water from 59 of mixed sample of leaves and other one of roots per treatment per replicate (Loomis and Shull, 1937). The reducing sugar contents were determined using the method of Shaffer and Hartman (1921) and the total soluble sugars were determined after hydrolysis with HCl. The non-reducing sugar amounts were calculated by the difference between the total and reducing sugars. Starch content was determined in the residue remaining after sugars extraction. A 0.1g of residue was hydrolysed with concentrated HCl for 3hr under reflex condenser (A.O.A.C., 1950) and the reducing power was determined after Shaffer and Hartman (1921). The starch content was calculated according to Woodman (1941).

For all traits, means were calculated and the results were statistically analysed as factorial analysis involved two factors; factor "a" with 2 application methods and factor "B" with 6 uniconazole rates. For internode length and leaf area, the results were statistically analysed as a randomized complete block design with one factor involved uniconazole rates applied as a foliar spray. The differences between the means were tested by the least significant difference multiple range test according to statistical analysis system "SAS" (SAS Institute , 1988).

RESULTS AND DISCUSSION

I- **Vegetative growth:** Analysis of variance indicated in both seasons that the appl'ication methods, uniconazole rates and the interaction between them had highly significant effects on the vegetative traits (Table 1.a).

1- Plant height: The results of both seasons showed that the maximum and minimum means of the plant height were recorded with the treatment of the soil drench at 0 (control) and 180 ppm uniconazole rates; respectively. With the both application methods, uniconazole rates from 60 to 180 ppm were

Table (1.a): Analysis of variance for the vegetative growth traits of *Jacobinia carnea*, Nichols plants as affected by the application methods and rates of uniconazole in the two seasons of 1996/97 and 1997/98.

S.O.V		d.f	Mean Squares													
			Plant height		Internode length		Internode numbers		Shoot numbers		Leaf area		Shoot dry weight	
Two application methods (split plot)	Foliar spray (R.C.B.D)	Two application methods (split plot)	Foliar spray (R.C.B.D)	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Rep.		(r-1)=2		1.76	4.86			0.02	0.40	0.44	0.55			0.58	0.51
	Rep.		(r-1)=2			0.23	0.31					0.33	0.06		
Appl Method		(a-1)=1		387.30 **	203.92**			56.86**	37.70**	849.24**	750.12**			1464.85**	1594.14**
	Unic. Rate		(k-1)=5			29.30**	23.07**					121.16**	129.72**		
Error "A"		(r-1)(a-1)=2		0.68	1.04			0.01	0.02	0.21	1.51			0.28	0.56
	Error		(r-1)(k-1)=10			0.19	0.35					0.18	0.15		
Unic. Rate		(b-1)=5		442.27 **	397.53**			10.26**	7.60**	154.73**	151.52**			327.33**	397.69**
Interaction		(a-1)(b-1)=5		22.50**	15.56**			3.16**	1.87**	43.15**	52.85**			43.10**	39.59**
Error "B"		(r-1)(ab-a)=20		0.28	0.41			0.09	0.12	0.35	0.60			0.15	0.30

**= highly significant effect at 0.01 level of probability.

significantly effective in controlling the plant height, comparing with the control, but the effect of the soil drench was significantly more than that of the foliar spray in reducing the plant height at any uniconazole rate. The same result was recorded with the general effect of the application methods, regardless of uniconazole rates (Table 1.b). Several authors reported that the growth retardants application as a soil drench was more effective in depressing the plant height than as a foliar spray (Starman *et al.*, 1994; Wang and Gregg, 1994; Lang and Wilkerson, 1995 and Cramer and Bridgen, 1998).

Soil application was effective since uniconazole is absorbed readily by roots and is xylem- translocated to actively growing tissues (Early and Martin, 1988). In addition, foliar-applied uniconazole must travel through the phloem in leaf tissues before reaching xylem tissue in the stem, but it is more readily transported through the xylem than through the phloem (Cramer and Bridgen, 1998). Differences in plant response to the application methods of uniconazole possibly were due to the amount of compound being applied, absorbed and translocated to the sites of active elongation.

Regardless of the application method, the general effect of the chemical rates showed in both seasons that the rates from 60 to 180 ppm significantly reduced the plant height, comparing with the control and the rate of 180 ppm had the minimum mean. Decreases in the plant height ranged from 33 to 38% and from 31 to 35% of the control in the 1st and 2nd seasons; respectively (Table 1.b). Similar results were mentioned by Abdel-Maksoud (1992 a and b); Abdel-Maksoud *et al.* (1992 and 93); Starman *et al.* (1994); Lang and Wilkerson (1995); Cramer and Bridgen (1998); Yewale *et al.* (1998); Yoon and Lang (1998) and Mostafa (2000).

2- Internode length: in both seasons, uniconazole rates from 60 to 180 ppm applied as a foliar spray significantly reduced the internode length, comparing with the control (Table 1.b). Similar results were reported by Abdel-Maksoud (1992a); Wang *et al.* (1992); Thetford *et al.* (1995a); Yewale *et al.* (1998); Easwaran and Doraipandian (1999) and Mostafa (2000).

Uniconazole as a growth retardant is considered an inhibitor of gibberellin biosynthesis in the apical and sub apical regions of the shoots (Dalziel and Lawrence, 1984) and reduction of plant height and internode length could be expected on the basis of gibberellin biosynthesis inhibition which is related to the rate of decreasing meristemic cell division, possibly cell expansion or both. Also, uniconazole may have induced an inbalance between indogenous auxin and gibberellin levels, resulting in slow secondary growth of the stem (Wang and Gregg, 1989).

3- Internode numbers: In both seasons, the untreated plants significantly had the lowest mean, while the uniconazole treated plants, using the foliar spray or the soil drench, significantly produced more internodes, compared with the control. The largest means was found at the rates of 120 and 180 ppm applied as a soil drench in the 1st and 2nd seasons; respectively. At any uniconazole rate from 60 to 180 ppm, the soil drench was significantly more effective than the foliar spray in increasing the internode numbers and similar trend was found with the general effect of the application methods, regardless of uniconazole rates (Table 1.b). These results were not in accordance with those reported by Hagiladi and Watad (1992).

Table (1.b): Mean values for the plant height (cm), the internode length (cm) and the internode numbers of *Jacobinia carnea*, Nichols plants as affected by the application methods and rates of uniconazole in the two seasons of 1996-97 and 1997-98.(1)

Uniconazole Rate (ppm)	Plant height (cm)						Internode length (cm)			Internode numbers					
	1st season			2nd season			1st season	2nd season		1st season			2nd season		
	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Spray		Spray	Drench	Mean	Spray	Drench	Mean
0	58.88b	59.75a	59.22a	54.88b	56.50a	55.69a	11.81a	11.00a		3.78g	3.44g	3.61d	3.62f	3.56f	3.59c
60	43.66c	35.55f	39.61b	40.97c	35.42fg	38.19b	6.08b	6.21b		4.65f	7.36c	6.00c	5.14de	6.93c	6.04b
90	41.65de	35.47f	38.56c	40.67cd	35.81f	38.24b	4.78c	4.71c		4.44f	8.00b	6.22c	4.86e	7.73ab	6.21b
120	43.56c	34.33g	38.95c	41.24c	34.54gh	37.89b	3.87d	3.75c		5.23e	8.80a	7.02ab	5.01de	7.67ab	6.34ab
150	42.08d	33.48g	37.78d	39.57e	33.55hi	36.56c	3.66d	4.48c		5.83d	8.47ab	7.15a	5.14de	7.37bc	6.25b
180	40.80e	32.58h	36.74e	39.61de	32.77i	36.29c	3.99d	3.73c		5.25e	8.20b	8.73b	5.35d	7.97a	6.66a
Mean	45.09a	38.53b		42.88a	38.10b					4.86b	7.38a		4.82b	6.87a	
L.S.D															
Method	1.18			1.46						0.14			0.23		
Unic. Rate	0.64			0.77			0.78	1.06		0.36			0.41		
Interaction	0.90			1.09						0.51			0.58		

(1)Values marked with the same alphabetical letters, within comparable group of means, do not differ significantly, using L.S.D. at 0.01 level of probability.

4- Within the range of tested uniconazole rates, regardless of the application methods, the rates from 60 to 180 ppm significantly increased the internode numbers, comparing with the control in both seasons and the rates of 150 and 180 ppm had the highest means in the 1st and 2nd seasons; respectively (Table 1.b). These results seemed to agree with those noticed by Wang and Gregg (1989) and were on contrary with those mentioned by Yewale *et al* (1998). The increments of internode numbers in the current research may due to the fact the unionazole at the tested rates promoted the early growth of new and short internodes, possibly through the induction of an inbalance between endogenous hormones (Wang *et al.*, 1992).

5- Shoot numbers: Applying uniconazole by foliar spray or soil drench in both seasons resulted in significant increments in the lateral shoot numbers, comparing with the control. The greatest means of the shoot numbers were obtained at the foliar spray rate of 90 ppm in both seasons. Number of shoots was significantly increased in the foliar spray, compared with the soil drench, using the same rate in both seasons and similar trend appeared with the effect of application methods, regardless of uniconazole rates (Table 1.c). Similar results were mentioned by Hagiladi and Watad (1992).

With respect the effect of uniconazole rates, regardless of the application methods, it was found that the rates from 60 to 180 ppm significantly inhanced the shoot formation, compared with the control in both seasons and the rates of 150 and 90 ppm in the 1st and 2nd seasons; respectively, had the highest mean number of shoots (Table 1.c). These results were similar to those reported by Abdel-Maksoud *et al.* (1992 and 93); Thetford *et al.* (1995a) and Mostafa (2000) and were not similar to those mentioned by Abdel-Maksoud (1992 a and b) and Schuch and Biernaka (1995). Increases in the number of shoots in the current research may be due to that uniconazole prcmoted the early growth of the lateral shoots, possibly through r educed a uxin level, which weakened the apical d ominance in the treated plants (Wang *et al.*, 1992).

From the foregoing results, it was clear that uniconazole was able to prevent the undesirable increases in the stem and internode elongation and increased the number of short internodes and lateral shoots with no sign of phytotoxicity. Consequently, the plants became more attractive with compact growth habit. Such growth retarding effects could extent the life of plants in interior landscape.

6- Leaf area: In both seasons, the control plants significantly had the largest mean of the leaf area, comparing with uniconazole treated plants. The leaf area decreased as a function of increasing uniconazole rate applied as a foliar spray (Table 1.c). These results were in agreement with those stated by Abdel-Maksoud (1992 a and b); Abdel-Maskoud *et al.* (1992 and93); Hagiladi and Watad (1992); Schuch and Biernaka (1995); Thetford *et al.* (1995a) and Yewale *et al.* (1998), but were not in line with those stated by Wang and Gregg (1994) and Mostafa (2000). The retardant effect of uniconazole on the leaf area may due to that uniconazole retarded cell division rate, possibly cell expansion or both in lamina tissue by inhibiting gibberellin biosynthesis.

It is important to mention that the results of the current research indicated that the internode numbers increased in the treated plants,

Table (1.c): Mean values for the shoot numbers, the leaf area (cm^2) and the dry weight of shoots (g) of *Jacobinia carnea*, Nichols plants as affected by the application methods and rates of uniconazole in the two seasons of 1996-97 and 1997-98.[1]

Uniconazole Rate (ppm)	Shoot numbers						Leaf area (cm^2)		Dry weight of shoots (g)					
	1st season			2nd season			1st season	2nd season	1st season			2nd season		
	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Spray	Spray	Drench	Mean	Spray	Drench	Mean
0	14.18h	10.67i	12.43d	13.26h	11.88i	12.57d	77.80a	79.72a	33.35a	31.56b	32.49a	37.84a	32.91b	35.38a
60	26.68d	17.08g	21.88c	28.55c	17.34fg	22.95c	68.88b	69.64b	24.03d	8.39i	16.21d	25.24d	8.78h	17.01b
90	33.67a	14.60h	24.08b	35.50a	16.56g	26.03a	64.14c	65.54c	26.14c	7.77i	16.96c	26.71c	6.89i	16.80b
120	28.95c	19.97f	24.31b	27.33cd	18.60f	22.97c	64.02c	65.45c	17.87f	7.03j	12.45e	17.99f	6.72i	12.36c
150	31.33b	20.51f	25.92a	30.45b	21.17e	25.81a	62.08d	63.14d	26.60c	9.75h	18.18b	24.63d	9.39h	17.01b
180	28.56c	22.67e	25.61a	27.08d	21.86e	24.47b	60.35e	61.56e	21.65e	10.60g	16.13d	22.50e	10.37g	16.44b
Mean	27.23a	17.16b		27.03a	17.90b				25.27a	12.25b		25.19a	12.51b	
L.S.D														
Method	0.66			1.76					0.76			1.07		
Unic. Rate	0.71			0.93			0.78	0.69	0.47			0.66		
Interaction	1.01			1.32					0.66			0.93		

1) Values marked with the same alphabetical letters, within comparable group of means, do not differ significantly, using L.S.D. at 0.01 level of probability.

consequently the leaf numbers increased. Similar results were found by Mostafa (2000). Thus the reduction in the leaf area was not due to suppression of the leaf production, but as a result of suppression of the leaf expansion (Viagro-Wolff and Warmund, 1987). There were some alterations of leaf shape at the different uniconazole treatments, except the controls.
These deformities can be attributed to the inhibitory effect of uniconazole on gibberellin biosynthesis, subsequently the leaf premordia had been injured or splitted as a result of irregular cell division and/or cell expansion during the initiation and developing of the leaf (Hagiladi and Watad, 1992).

7- Shoot dry weight: Table (1.c) shows in both seasons that uniconazole rates from 60 to 180 ppm, as a foliar spray or as a soil drench, significantly decreased the shoot dry weight, compared with the control. The lowest mean was recorded at the treatment of 120 ppm uniconazole rate applied as a soil drench. The soil drench was significantly more effective in reducing the shoot dry weight than the foliar spray at any uniconazole tested rates and the similar result was noticed with the general effect of the application methods, regardless of the chemical rates. These results were in accordance with those reported by Ruter (1992).

Regardless of the application methods, the effect of uniconazole rates showed that the rates from 60 to 180 ppm significantly reduced the shoot dry weight, compared with the control in both seasons. The lowest mean was observed at the rate of 120 ppm (Table 1.c). Similar trend of results was found by Wang *et al.* (1992); Abdel-Maksoud *et al.* (1993); Schuch and Biernaka (1995); Thetfored *et al.* (1995a) and JongMyung *et al.* (1999).

It was noticed in the present research that plant height, internode length and leaf area were decreased with increasing uniconazole rates, thereby the reduction in the shoot dry weight was expected as mentioned by Abdel-Maksoud *et al.* (1993); Thetford *et al.* (1995a) and Mostafa (2000).

II- **Flowering growth:** Analysis of variance indicated in both seasons that the effects of the application methods, uniconazole rates and the interaction between them on the flowering traits were highly significant (Table 2.a).

1. Flowering date (Days to flowering): Table (2.b) shows in both seasons that the plants received uniconazole as a foliar spray or as a soil drench were significantly later by flowering, compared with the nontreated plants. The rate of 90 ppm applied as a soil drench was the latest treatment by flowering, where it increased the mean number of days to flowering by 30.2 and 27.3 days more than the mean of the earliest treatment (the control of soil drench) in the 1st and 2nd seasons; respectively. The plants treated with uniconazole as a foliar spray significantly flowered earlier than those treated with uniconazole as a soil drench using the same rate. The effect of application methods, regardless of the chemical rates, exhibited that the foliar spray significantly accelerated the flowering, compared with the soil drench similarly to that reported by Cramer and Bridgen (1998) and against the finding of Starman *et al.* (1994).

The effect of uniconazole rates, regardless of the methods, proved that the control plants significantly flowered earlier than the treated plants in both seasons. The rate of 90 ppm delayed the flowering more than any other rate. Similar trend was reported by Abdel-Maksoud *et al.* (1993) and JongMyung

Table (2.a): Analysis of variance for the flowering growth traits of *Jacobinia carnea*, Nichols Plants as affected by the application methods and rates of uniconzaole in the two seasons of 1996-97 and 1997-98.

S.O.V	d.f.	Mean squares											
		Flowering date		Floret numbers		Inflorescence length		Inflorescence diameter		Inflorescence longevity		Inflorescence dry weight	
		1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Rep.	(r-1)= 2	0.62	0.55	3.16	0.86	0.04	0.26	0.20	0.43	0.03	0.24	0.0004	0.0003
Appl. Method	(a-1)=1	1267.1**	1220.92**	6379.73**	4403.87**	280.26**	192.19**	80.16**	99.63**	308.06**	317.49**	0.236**	0.199**
Error "A"	(r-1)(a-1)=2	0.44	0.29	0.76	1.65	0.80	0.06	0.04	0.02	0.85	0.09	0.0002	0.0008
Unic. Rate	(b-1)=5	312.12**	263.13**	62.34**	63.86**	6.43**	6.86**	6.12**	4.62**	5.90**	3.36**	0.077**	0.111**
Interaction	(a-1)(b-1)=5	88.69**	67.94**	226.21**	181.87**	10.12**	16.38**	9.80**	6.61**	16.33**	14.46**	0.026**	0.026**
Error "B"	(r-1)(ab-a)=20	0.43	1.09	0.27	0.38	0.57	0.33	0.32	0.38	0.19	0.38	0.0002	0.0002

"*"= Highly significant effect at 0.01 level of probability.

Table (2.b): Mean values for the days to flowering (flowering date), the floret numbers and the inflorescence length (cm) of *Jacobinia carnea*, Nichols plants as affected by the application methods and rates of uniconazole in the two seasons of 1996-97 and 1997-98.[1)]

Unic. Rate (ppm)	Flowering date						Floret numbers						Inflorescence length (cm)					
	1st season			2nd season			1st season			2nd season			1st season			2nd season		
	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean
0	28.11h	26.56i	27.34d	26.56h	26.11h	26.34d	26.75f	25.28g	26.04a	26.49e	25.67e	26.08a	9.67c	9.26c	9.47a	8.60c	9.91b	9.25a
60	37.11f	46.56d	41.383c	34.22f	44.09d	39.56c	29.10e	7.70h	18.44d	29.77d	8.56f	19.16b	10.99ab	4.95d	7.97b	9.44bc	5.55d	7.50bc
90	37.24f	56.78a	47.01a	34.78f	53.44a	44.11a	32.67c	5.89i	19.28c	31.00c	6.07g	18.83b	11.01a	4.97d	8.39b	9.59b	5.02de	7.31c
120	32.78g	51.03c	41.90c	31.44g	47.07c	39.26c	36.93b	4.45j	20.69b	32.07b	5.56h	18.81b	11.22ab	5.03d	8.13b	11.43a	4.38e	7.90bc
150	37.37f	52.55b	44.96b	34.42f	49.56b	41.99b	39.05a	3.45k	21.25b	35.08a	3.44l	19.26b	11.15ab	4.80d	7.98b	11.76a	4.53e	8.15b
180	40.40e	50.78c	45.59b	37.76e	48.00bc	42.89ab	31.11d	2.13l	16.62e	30.56cd	2.35j	16.45c	10.33bc	2.68e	6.51c	9.15bc	2.86f	6.01d
Mean	35.51b	47.37a		33.20b	44.85a		32.61a	8.16b		30.83a	8.71b		10.06a	5.28b		10.00a	5.37b	
L.S.D. Method	0.95			0.77			1.25			1.84			1.11			0.33		
Unic. Rate	0.75			1.25			0.62			0.72			0.91			0.70		
Interaction	1.12			1.77			0.08			1.02			1.28			0.98		

1) Values marked with the same alphabetical letters, within comparable group of means, do not differ significantly, using L.S.D. at 0.01 level of probability.

(1999). On the other side, these results were not on line with those reported by Abdel-Maksoud *et al* (1992); Schuch and Biernaka (1995) and Mostafa (2000).

The retarding effect of uniconazole on the flowering time was probably due to that this chemical at the tested rates delayed the initiation of inflorescences or retarded the flower buds development or both. Also, the possible alteration of the hormonal balance of the plants by uniconazole can not be overlooked, where uniconazole inhibits gibberellic acid biosynthesis and this effect could delay the flower buds formation and development (Cramer and Bridgen, 1998).

2. Floret numbers: Table (2.b) shows in both seasons that the largest and lowest means of the number of florets per inflorescence were noticed at the treatments of uniconazole rate of 150 ppm applied as a foliar spray and at that of 180 ppm applied as a soil drench; respectively. Applying uniconazole rates as a foliar spray led to significant increments in the floret numbers, compared with the control, similar to that mentioned by Nasr (1995). These results were possibly due to that uniconazole may resulted in a diversion of assimilate redistribution which would seem a likely explanation for the overall effect of uniconazole on the flowering response. The advanced floret yield response to uniconazole appears to be related to the suppression of the plant height, which would improve the plant rigidity and support the floret yield (Braun and Garth, 1986).

On the contrary, applying uniconazole rates as a soil drench led to significant and severe decreases in the floret numbers, compared with the control and with the increase of the drench rate the floret number decreased (Table 2.b). These results were similar to those reported by Abdel-Maksoud *et al.* (1992) and were not similar to those reported by Nasr (1995). Floret numbers were significantly reduced in the drench treatments, compared with the foliar spray ones, using the same uniconazole rate. Regardless of the chemical rates, the floret numbers of the soil drench method were extremely reduced, compared with the foliar spray one in both seasons (Table 2.b). Regardless of the application methods, uniconazole rates from 60 to 180 ppm significantly reduced the floret numbers, compared with the control and the rate of 180 ppm had the lowest mean in both seasons (Table 2.b). This trend was similar to that reported by Abdel-Maksoud *et al.* (1992). The reduction of the floret numbers in the present work may due to that uniconazole applied as a soil drench prevented the floret initiation in the inflorescence which was related to the inhibition of gibberellic acid synthesis (Abdel-Maksoud *et al.*, 1992).

3. Inflorescence dimensions (length and diameter): Applying of uniconazole as a foliar spray significantly increased the inflorescence length at the rates from 60 to 150 ppm in the 1st season and at those from 90 to 150 ppm in the 2nd one, compared with the control. These results were not similar to those reported by Starman *et al.* (1994). Uniconazole rates applied as a soil drench significantly decreased the inflorescence length, compared with the control in both seasons similar to that mentioned by Ruter (1992) and Starman *et al.* (1994). The maximum means of the inflorescence length were detected at the rates of 90 and 150 ppm applied as a foliar spray in the 1st and 2nd

seasons; respectively, while the minimum ones were detected with the soil drench rate of 180 ppm in both seasons (Table 2.b).

The inflorescence diameter was significantly increased at uniconazole rate of 120 ppm applied as a foliar spray, compared with the control in both seasons. This notice was similar to that reported by Easawaran and Doraipandian (1999), but was not similar to those reported by Starman *et al.* (1994) and Mostafa (2000). Uniconazole rates applied as a soil drench significantly decreased the inflorescence diameter, compared with the control in both seasons and the decreases were severe at the rates from 120 to 180 ppm. The same trend was mentioned by Starman *et al.* (1994) and Nasr (1995). The maximum and minimum means of the inflorescence diameter were observed in both seasons at the foliar spray rate of 120 ppm and at the soil drench rate of 180 ppm; respectively (Table 2.c).

The inflorescence dimensions were significantly increased at the foliar spray treatments, compared with the soil drench ones, using the same uniconazole rate. Also, the effect of the application methods, regardless of the chemical rates, showed that the foliar spray resulted in significant increases in the inflorescence dimensions, compared with the soil drench (Tables 2. b and c). Similar results were reported by Nasr (1995).

Applying of uniconazole as a foliar spray caused an extension in the inflorescence dimensions in the treated *J. carnea* plants. These results probably due to the nature of the treatments being with specific rates, led to stimulate photosynthesis process in the treated plants, consequently the inflorescence dimensions would be increased. Thetford *et al.* (1995a) mentioned that triazol compounds sometimes increase photosythetic rates of leaves. Also, uniconazole as a foliar spray may resulted in diversion of assimilates into floret formation and development which reflected on increased inflorescence dimensions (Braun and Garth, 1986). The reductive effects of uniconazole applied as a soil drench on the inflorescence dimensions could be expected on the basis of that uniconazole acting as antigibberellins. These reductive effects could be related to the adverse effect of prolonged exposure to uniconazole residues in the tissues. Soil application was effective since uniconazole is absorbed readily by roots and is xylem-translocated to actively growing sites (Early and Martin, 1988 and Cramer and Bridgen, 1998). Thetford *et al.* (1995b) stated that these reductions may be related to the inhibition of photosynthesis and they mentioned that triazol compound caused different effects on the same trait ranged from inhibition to stimulation to no effect. However, uniconazole as a soil drench using the tested rates decreased the floret numbers in the inflorescence, thereby the inflorescence diameter was reduced.

Regardless of the application methods, the effect of uniconazole rates showed that the inflorescence dimensions were significantly reduced at the rates from 60 to 180 ppm, compared with the control in both seasons. The most dwarfed inflorescences were observed at the rate 180 ppm in both seasons (Table 2.b and c). The results were supported by starman *et al.* (1994).

4. Inflorescence longevity: The maximum and minimum means of the inflorescence life were noted at uniconazole rate of 150 ppm when applied as

Table (2.c): Mean values for the inflorescence diameter (cm), the inflorescence longevity (d) and the inflorescence dry weight (g) of *Jacobinia carnea*, Nichols plants as affected by the application methods and rates of uniconazole in the two seasons of 1996-97 and 1997-98.[1)]

Unic Rate (ppm)	Inflorescence diameter (cm)						Inflorescence longevity (d)						Inflorescence dry weight (g)					
	1st season			2nd season			1st season			2nd season			1st season			2nd season		
	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean
0	5.98b	7.58a	6.78a	6.24bc	6.43bc	6.33a	12.72e	12.55e	12.64a	12.93de	12.44e	12.69c	0.41b	0.46a	0.44a	0.44b	0.52a	0.48a
60	6.04b	3.84cd	4.94bc	6.39bc	4.13d	5.26b	13.17de	6.52gh	9.85e	13.56cd	7.33g	10.45c	0.39c	0.11g	0.25b	0.40c	0.14gh	0.27b
90	6.82ab	3.95c	5.39b	6.69abc	3.38de	5.04b	14.08bc	7.11fg	10.59cd	14.33bc	8.49f	11.41b	0.37d	0.11g	0.24bc	0.37d	0.13h	0.25c
120	7.46a	2.95de	5.21bc	7.48a	2.83e	5.16b	14.67b	7.77f	11.22b	14.22bc	8.47f	11.35b	0.36d	0.09h	0.23c	0.33e	0.08i	0.21d
150	6.75ab	2.44e	4.60cd	5.95c	1.72f	3.84c	15.67a	5.99h	10.83bc	16.11a	6.11h	11.11bc	0.20e	0.08h	0.14d	0.19f	0.06j	0.13e
180	6.87ab	1.25f	4.06d	7.05ab	1.33f	4.19c	13.83cd	6.44gh	10.14de	14.67b	7.33g	11.00bc	0.16f	0.06i	0.11e	0.15g	0.05j	0.10f
Mean	6.65a	3.67b		6.63a	3.30b		14.02a	7.73b		14.30a	8.36b		0.32a	0.15b		0.31a	0.16b	
L.S.D Method	0.27			0.22			1.40			0.34			0.02			0.01		
Unic. Rate	0.68			0.74			0.53			0.74			0.02			0.02		
Interaction	0.96			1.05			0.74			1.05			0.02			0.02		

1) Values marked with the same alphabetical letters, within comparable group of means, do not differ significantly, using L.S.D. at 0.01 level of probability.

5. a foliar spray and as a soil drench; respectively, in both seasons. Application method of the foliar spray using the rates from 90 to 180 ppm significantly prolonged the inflorescence duration, compared with the control in both seasons (Table 2.c). This prolongation ranged from 0.45 to 2.95 days and from 0.63 to 3.19 ones in the 1st and 2nd seasons; respectively. Similar trend was mentioned by Mostafa (2000), but the results reported by Khattab *et al.* (1988) were not similar to the present ones. During the both seasons, all tested uniconazole rates applied as a soil drench significantly reduced the inflorescence life, compared with the control, which was similar to the results reported by Khattab *et al.* (1988).

As shown in Table (2.c), applying of uniconazole as a foliar spray significantly increased the inflorescence life, compared with the soil drench, using the same rate. Regardless of the chemical rates, the foliar spray method was significantly able to increase the inflorescence life by means of 6.39 and 5.94 days in the 1st and 2nd seasons; respectively, compared with the soil drench method. The effect of uniconazole rates, regardless of the application methods, revealed that the rates from 60 to 180 ppm significantly shortened the inflorescence longevity, compared with the control in both seasons.

Prolongation of the inflorescence life at the foliar spray treatments probably due to that uniconazole at the tested rates was capable to retard the senescence of the treated plant tissues (Mostafa, 2000) by maintaing a high level of chlorophyll (as shown hereafter) and slowing down degradation rate of it. Also, the resistance of the treated plants to the environmental stress was increased (Vaigro-wolff and Warmund, 1987). In addition, the role of uniconazole in keeping the water potential of the treated inflorescence cells at high value (Mostafa, 2000) and reducing the transpiration which is correlated with the reduced leaf area. With uniconazole soil drenching, the leaf and shoot carbohydrate metabolism may altered, thus carbohydrate became limited, which resulted in restrain the inflorescence duration on the treated plants.

6. Inflorescence dry weight: Table (2.c) shows in both seasons that the maximum and minimum means of the inflorescence dry weight were recorded in the case of the soil drench method at the rates of 0 (control) and 180 ppm; respectively. In both application methods, uniconazole rates from 60 to 180 ppm significantly decreased the inflorescence dry weights, compared with the control and these dry weights decreased as a function of increasing uniconazole rate. Similar results were reported by JongMyung *et al.* (1999). The inflorescence dry weight in the case of the foliar spray was significantly higher than that in the case of the soil drench, using the same rate of uniconazole. Also, the effect of the application methods, regardless of the chemical rates, revealed the same result. The effect of uniconazole rates, regardless of the application methods, showed the same results observed with each of the foliar spray and the soil drench, which was similar with the results of JongMyung *et al.* (1999) and was not similar to those reported by Mostafa (2000).

It was observed in the current work that the floret number per inflorescence and the inflorescence dimensions at the foliar spray treatments were significantly higher than those at the soil drench ones, consequently the inflorescence dry weight at the former treatments was higher than that at the

Table (3.a): Analysis of variance for the leaf contents of chlorophyll "a" and "b", the leaf and root contents of reducing, non-reducing and total soluble sugars and the leaf and root contents of starch of *Jacobinia carnea*, Nichols plants as affected by the application methods and rates of uniconazole in the 2nd season of 1997-98.

S.O.V.	d.f.	Mean squares									
		Leaf chlorophyll		Reducing sugar		Non-reducing suger		Total soluble sugars		Starch	
		"a"	"b"	Leaves	Roots	Leaves	Roots	Leaves	Roots	Leaves	Roots
Rep.	(r-1)= 2	14.36	42.26	$6x10^{-4}$	$3x10^{-4}$	0.01	0.004	0.01	0.11	0.53	0.01
Appl. Method	(a-1)=1	32.22^{**}	338.56^{**}	$286x10^{-3**}$	0.01^{**}	0.93^{*}	11.81^{**}	1.07^{**}	12.93^{**}	0.31^{**}	78.58^{**}
Error "A"	(r-1)(a-1)=2	38.41	91.27	$18x10^{-4}$	$19x10^{-4}$	0.01	0.005	$7x10^{-4}$	0.011	2.21	0.14
Unic. Rate	(b-1)=5	1068.63^{**}	230.39^{**}	$227x10^{-3**}$	0.011^{**}	0.46^{**}	0.83^{**}	0.47^{**}	0.87^{**}	9.55^{**}	18.89^{**}
Interaction	(a-1)(b-1)=5	271.01^{**}	55.92^{*}	$220x10^{-3**}$	$2x10^{-3**}$	2.08^{**}	0.98^{**}	2.12^{**}	1.09^{**}	11.59^{**}	8.52^{**}
Error "B"	(r-1)(ab-a)=20	35.37	21.02	$3x10^{-4}$	$15x10^{-4}$	0.02	0.003	0.01	0.004	0.56	0.07

N.S.= Non-significant effect.

*,** = significant and highly significant effect at 0.05 and 0.01 levels of probability; respectively.

later ones. Also, at the soil drench treatments as well as for the general effect of uniconazole rates, the floret number and the inflorescence dimensions were reduced, therefore, the inflorescence dry weights were reduced.

It was noticed at the foliar spray treatments that the floret number and the inflorescence dimensions were increased. It was expected that the inflorescence dry weight would increase, but it was decreased. This may due to that during the extended life of the inflorescences they used a great amounts of carbohydrates, consequently the dry weight was decreased.

III- **Chemical analysis:** Analysis of variance indicated that the application methods had insignificant effects on the amounts of the leaf chlorophyll "a" and "b" and the leaf reducing sugar and starch, significant effects on the amounts of the leaf non-reducing sugar and highly significant effects on the amounts of the root reducing and non- reducing sugars and starch and on the leaf and root total soluble sugars. Uniconazole rates and the interaction between the methods and rates had highly significant effects on the amounts of the mentioned compounds, except the chlorophyll "b:, where the effect of the interaction on it was significant (Table 3.a).

- Leaf chlorophyll "a" and "b" contents: Table (3.b) shows that the leaf chlorophyll "a" and "b" contents were significantly increased in the treated plants, compared with the nontreated ones in the both application methods, except at the foliar spray rate of 60 ppm for chlorophyll "b". The highest amounts of chlorophyll "a" and "b" were noticed at the foliar spray rates of 150 and 120 ppm; respectively. The foliar spray significantly increased the amounts of chlorophyll "a" and "b", compared with the soil drench, using the rates of 150 and 120 ppm; respectively. The general effect of the application methods exhibited insignificant effects. The general effect of uniconazole rates exhibited significant increments in chlorophyll "a" and "b" contents from 60 to 180 ppm, compared with the control and the highest amounts of both chlorophyll pigments were at the rate of 90 ppm. The results of spray treatments were supported with those reported by Nasr (1995); Thetford *et al.* (1995b); Yoon and Lang (1998) and Mostafa (2000).

Table (3.b): Mean values for the leaf contents of chlorophyll "a" and "b" (mg/g f.w.) of *Jaconbinia carnea*, Nichols plants as affected by the application methods and rates of uniconazole in the 2nd season of 1997-98[1)].

Uniconazole rate (ppm)	Chlorophyll "a" (mg/g f.w.)			Chlorophyll "b" (mg/g f.w.)		
	Spray	Drench	Mean	Spray	Drench	Mean
0	36.50d	39.67d	38.09d	37.96ef	30.62f	34.29c
60	58.84bc	65.62b	62.23c	42.55cde	40.66e	41.61b
90	75.47a	80.41a	77.94a	50.73b	51.16ab	50.94a
120	62.95bc	61.02bc	61.98c	58.67a	41.46de	50.06a
150	84.10a	55.43c	69.76b	49.31bc	43.88bcde	46.60ab
180	57.58bc	61.93bc	59.76c	49.21bcd	43.85bcde	46.53ab
Mean	62.57a	60.68a		48.07a	41.94a	
L.S.D. Method	8.89			13.70		
Uniconazole rate	7.18			5.52		
Interaction	10.16			7.81		

[1)] **Values marked with the same alphabetical letters, within comparable group of mean, do not differ significantly, using L.S.D. at 0.01 level of probability.**

Table (3.c): Mean values for the reducing, non-reducing and total soluble sugars contents (mg/100g d.w.) in the leaves and roots of *Jacobinia carnea*, Nichols plants as affected by the application methods and rates of uniconazole in the 2nd season of 1997-98. [1)]

Unic Rate (ppm)	Reducing sugar (mg/100 g d.w.)						Non-reducing sugar (mg/100 g d.w.)						Total soluble sugars (mg/100 g d.w.)					
	Leaves			Roots			Leaves			Roots			Leaves			Roots		
	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean	Spray	Drench	Mean
0	0.079a	0.063b	0.071a	0.129a	0.117b	0.123a	2.75a	2.88a	2.81a	1.68c	1.61c	1.65a	2.82a	2.94a	2.88a	1.81c	1.73c	1.77a
60	0.035de	0.009h	0.022d	0.110c	0.009h	0.060b	1.26d	1.77bc	1.51b	2.00b	0.47g	1.23c	1.30d	1.78b	1.54b	2.12b	0.46g	1.30c
90	0.019i	0.061b	0.040b	0.038e	0.007i	0.023d	1.65bc	1.05de	1.35bc	2.68a	0.40g	1.54b	1.92b	1.11e	1.51bc	2.71a	0.41g	1.56b
120	0.011gh	0.036d	0.024d	0.012g	0.011g	0.012e	1.88b	0.85e	1.36bc	1.52d	0.25h	0.88d	1.89b	0.88f	1.39d	1.63d	0.26h	0.95d
150	0.017fg	0.049c	0.033c	0.055d	0.006i	0.030c	1.61c	1.09de	1.35bc	1.02f	0.26h	0.64e	1.63c	1.19de	1.41cd	1.07f	0.26h	0.67f
180	0.028e	0.014fg h	0.021d	0.023f	0.004j	0.013e	1.53c	1.11d	1.32c	1.35e	0.39g	0.87d	1.56c	1.15e	1.35d	1.37e	0.31h	0.84e
Mean	0.031a	0.044a		0.061a	0.026b		1.78a	1.46b		1.71a	0.56b		1.85a	1.51b		1.79a	0.59b	
L.S.D Method	0.019			0.002			0.16			0.10			0.004			0.15		
Unic Rate	0.006			0.001			0.18			0.07			0.11			0.07		
Interaction	0.008			0.002			0.26			0.09			0.15			0.10		

1) Values marked with the same alphabetical letters, within comparable group of means, do not differ significantly, using L.S.D. at 0.01 level of probability

The results of drench treatments were similar to those mentioned by Wang and Gregg (1989); Abdel-Maksoud *et al.* (1992 and 93) and Nasr (1995).

The chlorophyll pigments increments in uniconazole treated plants were probably due to the effect of uniconazole causing reduction in the leaf cell size and inhibition of its elongation. Consequently, the amounts of chlorophyll in the leaves were concentrated in a limited size as stated by Khattab *et al.* (1988); Abdel-Maksoud (1992b) and Abdel-Maksoud *et al.* (1992 and 93). Also, these increments in the leaf chlorophyll may be due to the influence of the growth retardant on delaying the leaf senescence and hence keeping the green pigments from degradation (Mostafa, 2000).

2. Sugar contents: Applying uniconazole as a faliar spray or as a soil drench using the rates from 60 to 180 ppm significantly decreased the leaf amounts of reducing, non-reducing and total soluble sugars, compared with the control, except the soil drench rate of 90 ppm, which did not significantly decrease the leaf reducing sugar (Table 3.c). The lowest amounts of the leaf sugars were detected at the soil drench rates, i.e. 60 ppm for reducing sugar and 120 ppm for non-reducing and total soluble sugars. The amounts of the leaf reducing sugar at the rates from 90 to 150 ppm, applied as a soil drench, were significantly higher than those at the same rates applied as a faliar spray and the opposite was noticed at the rates of 60 and 180 ppm. The amounts of the non-reducing and total soluble sugars at the foliar spray rates from 90 to 180 ppm were significantly higher than those at the soil drench rates form 90 to 180 ppm, while the opposite situation was observed at the rate of 60 ppm (Table 3.c). Regardless of uniconazole rates, the application methods exhibited insignificant effect on the leaf reducing sugar, while the faliar spray method significantly increased the amounts of the leaf non-reducing and total soluble sugars, compared with the soil drench one. The effect of uniconazole rates, regardless of the application methods, showed that the amounts of each leaf sugar type were significantly decreased at the rates from 60 to 180 ppm, compared with the control and the lowest amounts were detected at the rate of 180 ppm (Table 3.c).

Decreases in the leaf reducing sugar in the present research were similar to those reported by Nasr (1995), but were not in line with the results reported by El-Sabrout (1996). Also, decreases in the leaf non-reducing sugar were on the contrary with the findings mentioned by El-Sabrout (1996). Reduction in the total soluble sugars in the current research was supported by Nasr (1995) and on the contrary with the results stated by El-Sabrout (1996).

In respect of the sugars of the roots, Table (3.c) shows that the amounts of the three sugar types were significantly decreased at uniconazole rates from 60 to 180 ppm applied either as a foliar spray or as a soil drench, compared with the control, except at the faliar spray rates of 60 and 90 ppm, where the non-reducing and total soluble sugars were significantly increased and the rate of 90 ppm had the highest amounts of both sugar types. The lowest amounts of the root sugars were detected at the soil drench rates, i.e. 180 ppm for the reducing sugar and 120 and 150 ppm for the both non-reducing and total soluble sugars. The amount of each root sugar type with the foliar spray was significantly higher than that with the soil drench, using the same uniconazole

rate, except the amounts of the reducing sugar at the rate of 120 ppm. The effect of the application methods, regardless of the chemical rates, proved that using the foliar spray significantly increased the amounts of the studied sugar types in the roots, compared with the soil drench. Regardless of the application methods, the effect of uniconazole rates exhibited significant decreases in the amounts of the root sugars, compared with the control.

The lowering of the reducing, non-reducing and total soluble sugars in uniconazole treated *Jacobinia* plants could be explained basing on much of available sugars may have been utilized for growth process. The treated plants, using the foliar spray or the soil drench, seem to have a greater number of the internodes and shoots. Also, the treated plants, using the foliar spray, seem to have a greater number of the florets and longer and wider inflorescences with prolonged life. Therefore, the reduction in their sugar types contents may be attributed to continuous use of photosynthate for supporting the mentioned growth traits. This declaration is supported by El-Sabrout (1996) and Han *et al.* (1998). The increases in the non-reducing and total soluble sugar amounts in the roots at the foliar spray rates of 60 and 90 ppm may be transient and also may indicate suppression of lengthwise growth not of photosynthetic activity (Han *et al.* 1998).

3. Starch contents: Applying of uniconazole as a foliar spray or as a soil drench, generally reduced the leaf starch contents and comparing with the controls, the reduction was significant at the foliar spray rates of 60, 90 and 150 ppm and at the soil drench rates of 60,90 and 120 ppm. The rate of 150 ppm applied as a soil drench caused a slight increase in the leaf starch content (Table 3.d). Similar results were mentioned by El-Sabrout (1996). The highest and lowest means of the leaf starch content were detected at the soil drench rates of 150 and 120 ppm; respectively. The soil drench rates of 60 and 150 ppm significantly had higher amounts of the leaf starch, compared with the same rates of the foliar spray, while the opposite was noticed at the rate of 120 ppm (Table 3.d).

Table (3.d): Mean values for the starch contents (mg/100 g d.w.) in the leaves and roots of *Jacobinia carnea*, Nichols plants as affected by the application methods and rates of uniconazole in the 2nd season of 1997-98.[1)]

Uniconazole rate (ppm)	Leaves			Roots		
	Spray	Drench	Mean	Spray	Drench	Mean
0	9.05ab	8.99ab	8.99a	6.47b	5.64c	6.06a
60	5.07f	7.64cd	6.36c	3.81d	1.14h	2.48d
90	6.79de	5.88ef	6.34c	7.96a	3.17e	5.57b
120	8.29abc	3.27g	5.78c	8.17a	1.68g	4.93c
150	6.79de	9.26a	8.03b	2.21f	2.09fg	2.15e
180	8.04abcd	7.94bcd	7.99b	3.84d	1.01h	2.43de
Mean	7.34a	7.15a		5.41a	2.46b	
L.S.D.						
Method		2.13			0.53	
Uniconazole rate		0.90			0.31	
Interaction		1.28			0.44	

1)Values marked with the same alphabetical letters, within comparable group of mean, do not differ significantly, using L.S.D. at 0.01 level of probability.

For the root starch contents, the foliar spray rates of 90 and 120 ppm significantly increased the starch content, compared with the control, while those of 60, 150 and 180 ppm significantly decreased it. The soil drench rates from 60 to 180 ppm significantly reduced the root starch contents, compared with the control (Table 3.d). the highest and lowest means of the root starch content were observed at the foliar spray rate of 120 ppm and at the soil drench rate of 180 ppm; respectively. With the exception of 150 ppm uniconazole rate, the root starch content with the foliar spray was significantly higher than that with the soil drench, using the same rate (Table 3.d). These results were not in accordance with those reported by El-Gamal (1994).

The effect of the application methods, regardless of uniconazole rates, showed that there was insignificant difference between the effect of the two application methods on the leaf starch contents, but the folia spray method significantly increased the root starch contents, compared with the soil drench one. Regardless of the application methods, uniconazole rates from 60 to 180 ppm significantly decreased the starch contents of the leaves and roots, compared with the control (Table 3.d).

It was evident from the present results that the starch contents were higher than the sugar contents in the leaves and roots of *Jocobinia* plants. Similar observation was mentioned by El-Sabrout (1996) and was due to that the starch is the major storage carbohydrate in plants and resembles the major component of the leaf or root dry matter. Most of uniconazole treatments decreased the accumulation of the starch in the leaves or roots and decreased the plant height, the leaf area and the dry weight. This may indicate suppression of the growth but not of the photosynthetic activity and much starch was directed toward the formation of the new shoots and internodes in both cases of the application methods. Also, much starch was directed toward increasing the floret number and the inflorescence dimensions and life at the foliar spray treatments. These events led to the lowering of the manufactured starch (Han *et al.*, 1998). The foliar spray rates of 60 and 90 ppm increased the root starch contents which supported the opinion that photosynthetic activity was not suppressed and the photosynthesis process occurred at high rate (Han *et al.* 1998).

REFERENCES

Abdel-Maksoud, B.A. (1992)a. Sensitivity of *Bryophyllum daigremontiana,* H.&P. to soil application of uniconazole plant growth retardant. Alex. J. Agric. Res. 37: 179-203.

Abdel-Maksoud, B.A. (1992)b. Prepropagation immersion of *Hibiscus mutabilis, L.* cuttings in chlormequate or uniconazole to retard subsequent growth. Alex. J. Agric. Res. 37:205-225.

Abdel-Maksoud, B.A.; E.M. El-Mahrouk and F.A. Menesy. (1992). Outstanding results with uniconazole on growth control of cutting-propagated *Pelargonium zonale,* L. cultivars. J. Agric. Res. Tanta Univ. 18: 715-727.

Abdel-Maksoud, B.A.; E.M.El-Mahrouk and F.A. Menesy. (1993). Growth and fruiting of *Cardiospermum halicacabum,* L. in response to paclobutrazol cr uniconazole. J. Agric. Res. Tanta Univ. 19: 179-190.

A.O.A.C. (1950). Official Methods and Tentative Methods of Analysis. Association of Official Agricultural Chemists. 7th ed. p. 910, Washington, D.C., U.S.A.

Braun, J.W. ad J.K.L. Garth.(1986). Growth and fruiting of "Heritage" primocane fruting red raspberry in response to paclobutrazol. HortScience, 21: 437-439.

Cramer, C.S. and M.P. Bridgen. (1998). Growth regulator effects on plant height of potted *Mussaenda* "Queen Sirikit". HortScience, 33: 78-81.

Dalziel, J. and D.K. Lawrence. (1984). Biochemical and biological effects of kaurene oxidase inhibitors, such as paclobutrazol. P. 43-57. In: R.Menhentt and D.K. Lawrence (eds). Biochemical Aspects of Synthetic and Naturally Occurring Plant Growth Regulators. Managor. 11. Brit. Plant Growth Group, London.

Early, J.D. and G.C. Martin.(1988). Translocation and breakdown of ^{14}C-labeled paclobutrazeol in "Nemagard" peach seedlings. HortScience, 23: 196-200.

Easwaran, S. and A. Doraipandian. (1999). Influence of nitrogen and growth retardants on growth, development and yield components of cocksconb (*Celosia cristate*, L.Roxb.) Hort. Absts. 69:1295. Abst. No. 9720.

El-Gamal, A.M. (1994). Effect of paclobutrazol, a plant growth retardant, levels on sweet potato yield and root quality. Alex. J. Agric. Res., 39: 385-397.

El-Sabrout, M.B. (1996). Effect of some growth retardants on the physiological and biochemical aspects in Washingtonia Navel Organe trees. Alex. J. Agric. Res., 41: 257-273.

Gavrilenko, B.; M. Ladepina and L. Khardopina. (1975). Bolsoy paracticum phyziologeya. reteneye (Practices in Plant Physiology) chapter 1, pp 1. 197. Izd "Vishya Shkola" Gbt Gw.

Hagiladi, A. and A.A. Watad. (1992). *Cordyline terminalis* plants respond to foliar spray and medium drenches of paclobutrazol. HortScience, 27: 128-130.

Han, S.W.; T.W. Fermanian; J.A. Juvik and L.A. Spomer. (1998). Growth retardant effect on visual quality and nonstructural carbohydrates of creeping bentagrass. HortScience 33: 1197-1199.

JongMyung, C.; C. JongJin; C. HaeJoon and C. JongSeung. (1999). Growth of oriental hybrid lily "Star Gazer" affected by application method and concentration of uniconazole in pot plant production. Hort. Absts. 69: 571, Abst. No. 4254.

Khattab, M.; M.R. Hassan; M.Y. Ghitany and A.Hashim. (1988). Effect of cycocel on the vegetative growth and flowering of two local cultivars of *Pelargonium zonale* (L.). Alex. J. Agric. Res., 33: 91-102.

Koller, H.B. (1972). Leaf area-leaf weight relationship in the soybean. Crop Sci. 12: 180-183.

Lang, H.J. and D.C. Wilkerson. (1995). Comparison of paclobutrazol drench, spray and spike application for height control of foliage and flowering baskets. HortScience 30: 566, Abst. No.517.

Loomis, W.E. and C.A. Shull. (1937). Methods in Plant Physiology. McGrow-Hill Book Co. Inc., N.Y.

Mostafa, M.M. (2000). Effect of cycocel and potassium on the growth and flowering of *Senecio cruentus* plant. Alex. J. Agric. Res., 45: 149-164.

Nasr, M.N. (1995). Effect of methods of application and concentration of paclobutrazol on *Pelargonium zonale* (L.) L'Her. ex Ait. As a pot plant. Alex. J. Agric. Res., 40: 261-279.

Ruter, J.M. (1992). Growth and flowering response of Butterfly-bush to paclobutrazol formulation and rate of application. HortScience 27: 929.

SAS Institute. (1988). SAS/STAT Uer's, Release 6.03 Edition. SAS Institute, Inc. Cary, N.C.

Schuch, U.K. and B.Biernacka. (1995). Controlling vegetative growth and flowering of four azalea cultivars with uniconazole and GA. HortScience,30: 854, 724.

Shaffer, P.A. and A.F. Hartman. (1921). The iodometric determination of copper and its use in sugar analysis. J. Biol. Chem. 45: 390.

Snedecor, G.W. and W.G. Cochran. 1967. Statistical Methods, 6th Edition. Iowa State Univ. Press, U.S.A.

Starman, T.W.; T.A. Cerny and T.L. Gridstaff. (1994). Seed geranium growth and flowering response to uniconazole. HortScience 29: 865-867.

Thetford, M.; S.L. Warren and f.A. Blazich. (1995)a. Response of *Forsythia intermedia* "Spectabilis" to uniconazole. I. Growth, dry-matter distribution and mineral nutrient contnet concentration and partitioning. J. Amer. Soc. Hort. Sci., 120: 977-982.

Thetford, M.; S.L. Warren; F.A. Blazich and J.F. Thomas. (1995)b. Response of *Forsythia intermedia* "Spectabilis" to uniconazole. II. Leaf and stem anatomy, chlorophyll and photosynthesis. J. Amer. Soc. Hort. Sci., 120: 983-988.

Vaigro-Wolff, A.L. and M.R. Warmund. (1987). Suppression of growth and plant moisture stress of *Forsythia* with flurprimidol and XE-1019. HortScience, 22: 884-885.

Wang, Y.T.; K.H. Hsiao and L.L. Gregg.(1992). Antitranspirant, water stress and growth retardant influence growth of Golden Pothos. HortScience, 27: 222-225.

Wang, Y.T. and L.L. Gregg. (1989). Uniconazole affects vegetative growth, flowering and stem anatomy of *Hibiscus*. J. Amer. Soc. Hort. Sci., 114: 927-932.

Wang, Y.T. and L.L. Gregg. (1994). Chemical regulators affect growth, postproduction performance and propagation of Golden Pothos. HortScience, 29: 183-185.

Woddman, A.G. (1941). Food Analysis. McGrow-Hill Book Co. Inc., N.Y.

Yewale, A.K.; P.V. Belorkar; M.A. Chanekar; J. Bhattacharya and B.S. Chimurkar. (1998). Effect of growth retardant-paclobutrazol on growth parameter of *Chrysanthemum*. J. Soils & Crops, 8: 82-84.

Yoon, B. and H. J. Lang.(1998). Effect of irradiance level and paclobutrazol on reduction of leaf damage in *Begonia* x *Cheimantha*. HortScience 33: 446, 017.

إستجابة نباتات الجاكوبينيا لليونيكونازول

٢. تأثير طرق إضافة اليونيكونازول و تركيزاته و التفاعل بينهما

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تم إجراء تجربتان متتاليتان فى صوبة بلاستيك تحت الظروف الطبيعية خلال موسمى ١٩٩٦-١٩٩٧، ١٩٩٧-١٩٩٨ فى حدائق أبحاث معهد البساتين بأنطونيادس بالإسكندرية. أختبر فى كل تجربة طريقتى الرش و تبليل التربة بمؤخر النمو يونيكونازول بتركيزات صفر، ٦٠، ٩٠، ١٢٠، ١٥٠، ١٨٠ جزء فى المليون على نباتات الجاكوبينيا. أستخدم تصميم القطع المنشقة بثلاثة مكررات حيث مثلت القطع الكبيرة طريقة الإضافة أما القطع الصغيرة فكانت تمثل التركيزات و يمكن تلخيص النتائج فيما يلى:

١. فى كلا طريقتى الإضافة أدت تركيزات اليونيكونازول إلى خفض معنوى فى إرتفاع النبات و الوزن الجاف للفروع و النورات - تأخير التزهير معنويا - نقص معنوى لمحتوى الأوراق و الجذور من السكريات المختزلة و الغير مختزلة و الكلية الذائبة و أيضا النشا - زيادة معنوية فى أعداد السلاميات و الفروع و محتوى الأوراق من الكلوروفيل أ،ب وذلك مقارنة بالكنترول، و قد أعطى التأثير العام لتركيزات اليونيكونازول نتائجا مشابهة بغض النظر عن طريقة التطبيق.

٢. درست أطوال السلاميات و المساحة الورقية مع طريقة الرش فقط و قد حدث لها إنخفاض معنوى عند كل تركيزات اليونيكونازول المختبرة مقارنة بالكنترول.

٣. باستخدام تركيزات اليونيكونازول رشا على الأوراق حدثت زيادة معنوية لكل من عدد الزهيرات فى النورة - طول و قطر النورة و فترة بقائها على النبات و ذلك مقارنة بالكنترول بينما حدث العكس عند إستخدام طريقة تبليل التربة و عند دراسة التأثير العام لتركيزات اليونيكونازول.

٤. كانت طريقة تبليل التربة أكثر تأثيرا مقارنة بطريقة الرش فى خفض كل من إرتفاع النبات - الوزن الجاف للفروع - عدد زهيرات النورة - طول و قطر النورة ووزنها الجاف و فترة بقائها على النبات - محتوى الأوراق و الجذور من السكريات الغير مختزلة و السكريات الكلية الذائبة - محتوى الجذور من السكر المختزل و النشا. بينما أدت طريقة الرش إلى نقص عدد السلاميات - زيادة عدد الفروع - تزهير مبكر مقارنة بطريقة تبليل التربة.

٥. تأثرت جميع الصفات المدروسة بصورة مؤكدة بطريقة التطبيق و بتركيزات اليونيكونازول وبالتفاعل بينهما باستثناء محتوى الأوراق من كل من كلوروفيل أ،ب- السكريات المختزلة- النشا والتى لم تتأثر معنويا بطريقة التطبيق.