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RESPONSE OF *Jacobinia carnea*, NICHOLS PLANTS TO UNICONAZOLE:

I. EFFECT OF CUTTING TYPES, UNICONAZALE RATES AND THEIR INTERACTION.

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ABSTRACT

Terminal and subterminal cuttings of *jacobinia carnea*, Nichols "local cultivar" were immersed for two hours in 0, 60, 90, 120, 150 and 180 ppm uniconazole solutions. The experiments were conducted during two successive seasons in a form of a split design, the main plots represented the cutting types, while uniconazole rates resembled the sub-plots. The general effects of the two factors showed that:

1. The terminal cutting derived plants significantly surpassed the subterminal cutting derived ones by the following traits: root numbers and length, plant height and leaf area during both seasons, shoot numbers and dry weight, floret numbers and *early flowering in the* 1st *season and* inflorescence diameter and dry weight in the 2nd one.
2. In both seasons, the uniconazole rates from 60 to 180 ppm significantly reduced the rooting percentage, the root numbers and length, the plant height, the *internode length, the leaf area and the shoot and* inflorescence dry weights and delayed the flowering time, while those of 60 and 90 ppm significantly reduced the inflorescence diameter. Also in both seasons, the number of internodes and shoots and the inflorescence longevity were enhanced with the rates from 60 to *180* ppm, *while the inflorescence length and the number of florets were* significantly increased with those from 60 to 150 ppm and from 90 to 150 ppm; respectively.
3. The leaves of the subterminal cutting derived plants significantly contained higher amounts of chlorophyll "a" and reducing, non-reducing *and total soluble sugers* than those of the terminal cutting derived ones, while the roots of the laters significantly contained higher amounts of non-reducing and total soluble sugars than those of the formers.
4. The uniconazole rates from 60 to 180 ppm significantly increased the *leaf* chlorophyll "a" and "b" and decreased non-reducing and total soluble sugars in the leaves and roots. The reducing sugars were significantly increased in the leaves with the rates of 120 and 150 ppm and in the roots with those of 90 and 150 ppm, but were decreased in both organs with the rate of 60 ppm. The starch was increased in the leaves with the rates from 60 to 180 ppm and in the roots with that of 90 ppm, but those of 60, 120, 150 and 180 ppm decreased it in the roots.

The interaction between the cutting types and the uniconazole rates exhibited significant and highly significant effects on the studied traits except the rooting percentage and the leaf chlorophyll "a".

INTRODUCTION

Keeping the size and shape of some foliage plants used for interior landscapes might be difficult. It is necessary in most cases to substitute the plants, or prune them as a result of undesirable increase in stem length or plant size. Sometimes the pruning fails to keep the plant within a certain space and to maintain a good showy commercial plant as a pot plant. Therefore, the control of the plant size has become important to the growers and customers. Several triazol compounds have been observed to be highly effective as growth retardants. These compounds inhibit gibberellin biosynthesis in plant by inhibiting kaurene oxidase, a cytochrome P-450 oxidase, thus blocking the oxidation of kaurenoic acid (Goldsmith *et al.*, 1983 and Dalziel and Lawrense, 1984). One of these analogs is uniconazole which has shown a growth retarding activity on ornamental species such as *Bryophyllum daigremontiana* and *Hibiscus mutabilis* (Abdel-Maksoud, 1992 a and b); *Pelargonium zonale* and *Cardiospermum halicacabum* (Abdel-Maksoud *et al.*, 1992 and 1993); *Tulipa spp.* (Suh *et al.*, 1994) and *Lilium* sp. (JungMyung *et al*, 1999).

Jacobinia carnea, Nichols (Fam. *Acanthaceae*) is a strong herb, sometimes subshrub. The stem is erect, four-angled and becomes several feet in height if allowed to grow. The leaves are opposite, ovate-lanceolate, attenuate to apex, the upper surface is dark green and the lower one is purplish dark green. Flowers are rose, tubular ascending, arched at the top and the lower lip recurring and borne in a dense terminal spike-like thyrses. The plant is propagated by stem cuttings and used for indoor decoration as a flowering pot plant. However, rapid and excessive growth, unsightly stem elongation, absence of freely branching habit and leaf loss, commonly occur, resulting in limited uses.

The effectiveness of unoconazole on *J. carnea*, Nichols is unknown. Therefore, the present studies were conducted for the assessment of the response of *J. carnea*, Nichols "local cultivar" to the treatment with uniconazole solutions through the immersion of unrooted terminal and subterminal cuttings in a commercial-like nursery environment trying to improve the vegetative and flowering growth traits of the plant.

MATERIALS AND METHODS

The present work was curried out in two successive seasons of 1996-97 and 1997-98 in the Flowers and Ornamental Plants Research Garunes of the Faculty of Agriculture, University of Alexandria, Egypt. One year old-plants of *Jacobinia carnea*, Nicholas "local cultivar" grown in 25 cm clay pots under the natural light in plastic house, maintained in the mentioned gardens, were the source of the stem cuttings. On the 5th and 10th of May in 1996 and 1997 in the 1st and 2nd seasons; respectively, healthy shoots carrying no flowers, were taken from the mother plants and divided into terminal and subterminal cuttings. The cuttings were prepared in uniform size with 2 eyes and an average length of 15 cm, immersed for 2hr in fresh

uniconazole solutions with the rates of 0 (tap water), 60, 90, 120, 150 and 180 ppm and 60 cuttings from each cutting type were utilized for each rate. Immersion volume solution was 500 ml. The tap water and uniconazole treated cuttings of each type were divided into 2 equal groups, where each group contained 30 cuttings/type/rate. The two groups were directly planted separately in 2 experiments as follows.

Experiment I. the treated cuttings were individually planted in black plastic bags (0.5 l) containing a mixture of 1 sand : 1 clay (by volume). The bags were arranged in a plastic house under natural light according to the experimental design of a split plot design with 3 replicates (Snedecor and Cochran, 1967). The cutting types (terminal and subterminal) represented the main plots, whereas the 6 tested uniconazole rates resembled the sub-plots. The number of treatments/replicate was 12 and 10 cuttings from each type were used/treatment/replicate. The total number of cuttings was 360. On the 10th and 15th of June in 1996 and 1997 for the 1st and 2nd seasons; respectively, the rooted cuttings were transferred to the clay pots of 25 cm diameter (1 plant/pot) containing a loamy soil with pH of 7.5, 0.245% N, 0.056% P and 0.066% K. The pots were distributed in a plastic house under natural light condition in the experimental layout used before. Two weeks later, the complete fertilizer 19-19-19 was top dressed at the rate of 2.5 g/pot and this addition was repeated every 3 weeks. Pests, weed controls and watering were undertaken. The experiments continued for about one year and were terminated on the 7th and 15th of May 1997 and 1998 for the 1st and 2nd seasons; respectively. The studied traits were:

I. Rooting percentage, evaluated after 5 weeks from the planting, as the percentage of the rooted cuttings relative to the number of the inserted cuttings.

II. Vegetative growth: Unless other way was noted traits were recorded at the end of experiments and all plants were used:
   1. Plant height (in cm), measured from the soil surface to the uppermost point of the plant.
   2. Length (in cm) and number of internodes per plant, where all internodes that had fully expanded on the main stem were undertaken.
   3. Number of shoots per plant, where all the main and lateral shoots with at least length of 5 cm were counted.
   4. Leaf area (in cm^2) according to Koller (1972) during the vegetative growth and before flowering. There were 4 employed plants from each treatment in each replicate and 4 mature leaf blades were sampled from the 2nd and 3rd nodes from the base of main stem of each chosen plant.
   5. Shoot dry weight (in g), where the vegetative organs were dried in an oven at 70°C for 72 hr to a constant weight.

III. Flowering growth traits: Unless other way was noted all plants and all their inflorescence were used.
   1. Number of days to flowering (flowering date) which was expressed as the mean number of days from the beginning of the experiment to the appearance of the 1st inflorescence per plant at different treatments.
   2. Number of florets per inflorescence.

3. Inflorescence length and diameter (in cm).
4. Inflorescence longevity, expressed as the days elapsed between appearance of the inflorescence colour and the fading of it on the plant.
5. Inflorescence dry weight (in g), where the inflorescences were dried in an oven at 70°C for 48 hr to a constant weight.

IV. Chemical analysis (in the 2nd season only): There were 3 measurements for each treatment per each replicate and the mean was calculated.

1. Chlorophyll "a" and "b" contents according to Gavrilenko *et al.* (1975). After calculation of the leaf area, the same leaves were used, where 1.0 g of the leaves was crushed with a known quantity of 99% aceton, then the samples were centrifuged at 4500 cycles/minute for 3 minutes. Equivalent quantity of the filtrate of each sample was taken to determine the optical density (D) as an indication of chlorophyll contents ("a" and "b") as follows: The concentrations of chlorophyll "a" (CA) and "b" (CB), expressed in terms of mg/l were determined by substituting of (D) in the following equations (Gavrilenko *et al.*, 1975):

   CA = 10.3 D663-0.918 D 644 CB = 19.7 D 644-3.870 D 663

2. Sugar and starch contents were determined at the end of the experiment. The plants were removed outside the pots. Roots were taken and cleaned from the soil. Random samples of leaves and roots of each treatment per replicate were taken, washed with tap water, rinsed twice with distilled water and oven dried at 70°C for 72 hr (to constant weight). The dried materials were ground. Surgars were extracted from 5 g of mixed sample of leaves and other of roots. The extraction was carried out using distilled water (Loomis and Shull, 1937). The reducing sugars were determined using the method of Shaffer and Hartman (1921) and the total soluble sugars were determined after hydrolysis with HCl. The non-reducing sugars were calculated by the difference between the total and reducing sugars. In the remaining residue after sugars extraction, starch was determined, 0.1 g of residue was hydrolysed with concentrated HCl for 3 hr under reflex condenser (A.O.A.C., 1950) and its reducing power was determined after Shaffer and Hartman (1921). The starch content was calculated according to Woodman (1941). Sugar and starch contents were expressed as mg/100 g of dry weight.

Experiment II. The 2nd group of the tap water and uniconazole treated cuttings were individually planted in plastic pots of 15 cm diameter containing a mixture of 1 sphagnum peat moss: 1 sand (by volume), and sodium bicarbonate was added to the mixture to raise its pH to 6.5 to be suitable for *J. carnea*, Nicholas. The pots were arranged in the same plastic house mentioned before. The layout of the experimental design and the number of the treatments and cuttings were as mentioned in the experiment I. The experiment II continued for about 3 months and was terminated on the 7th and 11th of August 1996 and 1997 during the 1st and 2nd seasons; respectively. This experiment was designed to determine the effect of the cuttings type, uniconazole rate and their interaction on the total number of

roots and the maximum root length (in cm) at the end of experiment for all rooted cuttings in each treatment per each replicate.

Means of all traits studied in both experiments were calculated and the results were statistically analysed as factorial analysis containing 2 factors; factor A (cutting types, resembled main plots) with 2 types and factor B (uniconazole rates, resembled sub-plots) with 6 levels. The differences between the means were tested by the least significant difference multiple range test (0.01) according to the Statistical Analysis System. "SAS" (SAS Institute, 1988).

RESULTS AND DISCUSSION

I. Rooting traits: Analysis of variance of both seasons indicated that the effect of the cutting type was highly significant on the root numbers and length only, the effect of uniconazole rate was highly significant on all rooting traits and the interaction between the two factors had similar effect to that of the cutting type (Table 1.a).

During the two seasons the control treatments of both cutting types had the highest means of rooting percentage and with increasing the uniconazole rate, the rooting percentage significantly decreased. The general effect of the rates, regardless the cutting types, proved that the control significantly achieved the highest mean of the rooting and the rates from 60 to 180 ppm caused significant reduction in the rooting percentage (Table 1.b).

These results are in agreement with those reported by Abdel-Maksoud (1992b) on *Hibiscus mutabilis*. On the contrary, El-Sherbini *et al.* (1988) reported that growth retardants promote the rooting in *Euonymus kiautschovica*. Whitton *et al.* (1988) stated that growth retardants did not affect the rooting of the cuttings of *Chamelaucium uncinatum*.

Table (1.b) shows in both seasons that the maximum means of the root numbers and length were noticed at the treatment of the untreated terminal cuttings which significantly differed with any other treatment, while the lowest means of the root numbers and length were detected at the treatments of the rates of 180 and 150 ppm with the subterminal cuttings; respectively. At any uniconazole rate the means of the root numbers or length of the terminal cuttings significantly surpassed those of the subterminal ones, except at the rates of 60 and 90 ppm in the 1st season, where the two cutting types did not significantly differ.

The general effect of the cutting types in both seasons showed that the terminal cuttings significantly produced more and taller roots, as compared with the subterminal ones (Table 1.b). The general effect of the uniconazole rates in both seasons indicated that the rates from 60 to 180 ppm significantly reduced the root numbers and length, comparing with the control. (Table 1.b).

Table (1.a): Analysis of variance for the rooting percentage, the number of roots and the root length (cm) of *Jacobinia carnea*, Nichols plants as affected by immersion of different unrooted cutting types in uniconazole solutions prior to rooting in the two seasons of 1996-97 and 1997-98.

Source of variation	d.f.	Mean squares					
		% Rooting		No. of roots [1)]		Root length (cm) [1)]	
		1st season	2nd season	1st season	2nd season	1st season	2nd season
Rep.	(r-1) = 2	38.97	23.90	5.58	1.19	0.27	0.09
Cutting types (A)	(a-1) = 1	0.64 N.S	10.24 N.S.	762.22**	2145.54**	18.89**	27.21**
Error "a"	(r-1)(a-1) = 2	25.01	43.51	1.90	1.68	0.09	0.44
Uniconazole rate (B)	(b-1) = 5	701.67**	971.39**	43.82**	71.37**	8.10**	8.07**
AB	(a-1)(b-1) = 5	10.85 N.S.	5.09 N.S	29.94**	28.09**	1.54**	0.91**
Error "b"	(r-1)(ab-a) = 20	16.29	6.49	0.66	0.31	0.06	0.04
Total	(abr-1) = 35						

N.S. = Non- significant effect

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

1) Obtained from the experiment II

The present results of the root numbers are similar to those reported by Abdel-Maksoud (1992 a) on *Bryophyllum daigremontiana* treated with uniconazole. Also, some workers found that triazol analogs have been to be highly effective as root growth retardants (Wang *et al.*, 1992 on apple; and Thetford *et al.*, 1995a on *Forsythia intermedia*). Contrarily, Wieland and Wample (1985) found that paclobutrazol did not affect the root growth in apple.

The present results show that uniconazole may act as a rooting inhibitor. It inhibits gibberellic acid biosynthesis which has a role in the carbohydrate metabolism within the plant (Gayler and Glasziou, 1969 and Palmer and Barker, 1972). As is the case for root initiation in the presence of antigibberellins in the experiments of Desjardins *et al.* (1987) and Gaussion and Branham (1987), it seems to be a need for a supply of substrate to form roots on *J. carnea*, Nicohls cuttings. The possible role of uniconazole could be an alteration of the carbohydrate metabolism. Moreover, if a correlation between invertase activity and growth as mediated by gibberellic acid is assumed (Gayler and Glasziou, 1969 and Palmer and Barker, 1972), the inhibition of gibberellic acid synthesis in the cuttings might decrease the activity of hydrolytic enzymes, which are conductive to root initiation and the products normally made available from carbohydrate metabolism are limited.

The reduction in the roct length may be due to the fact that uniconazole resulted in an alteration of the endogenous hormonal balance of developing root tips. Such changes could result from altered synthesis, metabolism or translocation of one or more hormones or their precursors (Williamson and Coston, 1986). The assimilates redistribution would seem a likely explanation for the overall effect of uniconazole on the root growth traits.

Table (1.b): Mean values for the rooting percentage, the number of roots and the root length (cm) of *Jacobinia carnea*, Nichols plants as affected by immersion of different unrooted cutting types in uniconazole solutions prior to rooting in the two seasons of 1996-97 and 1997-98[1)].

Uniconazole rate (ppm)	Rooting percentage						Number of roots [2)]						Root length (cm) [2)]					
	1st season			2nd season			1st season			2nd season			1st season			2nd season		
	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean
	Term	Subterm		Term	Subterm		Term	Subterm		Term	Subterm		Term	Subterm		Term.	Subterm	
0	68.87a	68.87a	68.87a	71.60a	68.87a	70.23a	47.00a	39.67e	43.34a	52.68a	38.63g	45.66a	17.32a	16.50b	16.91a	18.41a	16.43cd	17.42a
60	59.00b	54.80b	56.90bc	59.00bc	61.20b	60.10b	43.85bc	37.33f	40.59b	48.36c	35.00h	41.68b	15.61c	15.57c	15.59b	16.29cd	15.43e	15.86b
90	59.00b	59.00b	59.00b	56.80c	54.80c	55.80c	41.11d	35.07g	38.09c	44.50e	33.02i	38.76d	15.54cd	14.30cd	14.92cd	16.16d	14.70f	15.43c
120	52.87bc	52.80bc	52.83c	48.87de	46.93d	47.90d	39.68e	34.17g	36.92de	43.11f	31.08j	37.09e	16.12b	13.12d	14.62d	16.61bc	13.72h	15.17d
150	43.07de	46.93cd	45.00d	43.07ef	41.13f	42.10e	45.17b	30.53h	37.85cd	50.33b	28.61k	37.47c	14.19cd	12.56e	13.38e	14.33g	13.33h	13.83e
180	37.20e	39.20e	38.20e	35.20g	35.20g	35.20f	43.61c	28.42i	36.02e	46.17d	26.18i	36.18f	16.13b	14.18cd	15.16c	16.81b	14.55fg	15.68b
Mean	***53.33a***	***53.60a***		***52.42a***	***51.36a***		***43.40a***	***34.20b***		***47.53a***	***32.09b***		***15.82a***	***14.37b***		***16.43a***	***14.70b***	
L.S.D.$_{0.01}$																		
Cutting type	7.17			9.46			1.98			1.86			0.32			0.95		
Uni.rate	4.86			3.07			0.98			0.67			0.30			0.25		
Interaction	6.87			4.34			1.38			0.95			0.43			0.35		

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.

2) obtained from the experiment II

I. Vegetative growth traits; Analysis of variance revealed that the cutting type had highly significant effect on the plant height and the leaf area in both seasons and significant effect on the number and dry weight of shoots in the 1st season. The effect of the uniconazole rate and the interaction was highly significant on all vegetative traits in both seasons, except the number and the length of internodes, where the interaction effect was significant only in the 1st season (Table 2.a).

Regarding the plant height and the internode length during both seasons, it was clear that the uniconazole rates from 60 to 180 ppm were significantly effective in supressing the both traits, as compared to the controls of both cutting types. The greatest depression was detected at the treatment of 120 ppm uniconazol rate with the subterminal cuttings for the plant height and at the treatments involved the rate of 180 ppm for the internode length (Table 2.b). At uniconazole rates from 60 to 180 ppm the subterminal cuttings were significantly more sensitive than the terminal ones considering the plant height and the general effect of the cutting types proved this result in both seasons. At the uniconazole rates of 60 and 90 ppm in both seasons and at that of 180 ppm in the 2nd one, the mean internode length of the terminal cutting derived plants was significantly more than that of the subterminal cutting derived ones (Table 2.b).

The general effect of the uniconazole rates, regardless of the cutting types, indicated in both seasons that the rates from 60 to 180 ppm caused significant reduction in the plant height and internode length, as compared to the control. There was an apparent trend towards decreasing both traits with increasing the chemical rate (Table 2.b). The reduction in the plant height ranged from 27 to 36% and from 25% to 40% of the control in the 1st and 2nd seasons; respectively.

The present results of the plant height are supported with those obtained from experiments of dipping or soaking in plant growth retardants and reported by Sanderson *et al.* (1987) on some *Acanthaceae* plants; Abel-Maksoud (1992b) on *Hibiscus mutabilis*; Suh *et al.* (1994) on *Tulipa;* Nasr (1995) on *Pelargonium zonale* and JongMyung *et al.* (1999) on *Lilium.* Also, the results of the internode length are similar to those stated by Adriansen (1989) on *Pelargonium zonale* and Suh *et al.* (1994) on *Tulipa.* The reduction of the plant height and internode length could be expected on the basis of gibberellin biosynthesis inhibition, caused by uniconazole in the apical and sub apical regions of the cuttings (Dalziel and Lawrence, 1984 and Abdel-Maksoud *et al.* 1992 and 1993) and this inhibition is related to the rate of decreasing meristemic cell division, possibly cell expansion or both.

From tables (2.b and c) it is evident that the controls of the terminal and subterminal cutting derived plants had the smallest means of the internode and shoot numbers, while the largest ones were observed at the rate of 180 ppm and there were significant differences between the controls and the other treatments in both seasons. The control of the subterminal cuttings significantly produced higher number of the internodes, in the 1st season and higher number of the shoots in the 2nd one, compared with the control of the terminal ones.

Table (2.a): Analysis of variance for the vegetative growth characters of *Jacobinia carnea*, Nichols plants as affected by immersion of different cutting types in uniconazole solutions prior to rooting in the two seasons of 1996-97 and 1997-98.

Source of variation	d.f.	Mean squares											
		Plant height (cm)		Internode length (cm)		No. of internodes		No. of shoots		Leaf area (cm2)		Shoot dry weight (g)	
		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	0.63	0.17	0.53	0.23	0.01	0.03	0.10	0.59	13.08	145.71	0.29	0.04
Cutting type (A)	(a-1)=1	387.43**	319.58**	1.89 N.S	1.54 N.S	0.03 N.S	0.26 N.S	18.18*	0.01 N.S	159298.11**	137356.71**	8.70*	0.61 N.S.
Error "a"	(r-1) (a-1) =2	0.43	0.18	0.23	0.23	0.33	0.06	0.65	0.05	82.93	204.70	0.21	0.04
Uniconazole rate (B)	(b-1) = 5	300.04**	338.65**	43.28**	51.63**	7.94**	11.68**	51.24**	52.08**	451743.31**	456163.51**	37.01**	28.07**
AB	(a-1) (b-1) =5	69.43**	103.72**	0.51*	0.77**	0.04*	0.22**	1.75**	1.28**	22970.91**	16239.80**	5.51**	1.24**
Error "b"	(r-1) (ab-a) =20	0.63	0.65	0.16	0.17	0.01	0.04	0.15	0.17	35.36	71.76	0.92	0.26
Total	(abr-1) = 35												

N.S. = Non- significant effect

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

Table (2.b): Mean values for the plant height (cm), the internode length (cm) and the number of internodes of *Jacobinia carnea*, Nichols plants as affected by immersion of different unrooted cutting types in uniconazole solutions prior to rooting in the two seasons of 1996-97 and 1997-98[1)] .

Uniconazole rate (ppm)	Plant height (cm)						Internode length (cm)						Number of introdes					
	1st season			2nd season			1st season			2nd season			1st season			2nd season		
	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean
	Term.	Subterm		Term	Subterm		Term.	Subterm		Term.	Subterm		Term.	Subterm		Term	Subterm	
0	52.50a	52.50a	52.50a	50.83b	53.92a	52.38a	9.99a	10.17a	10.08a	10.65a	11.15a	10.90a	2.58h	2.84g	2.71e	2.59h	2.39h	2.49f
60	42.83c	32.17gh	37.50b	45.83d	32.68fg	39.26b	5.88b	4.81c	5.34b	6.39b	5.67c	6.03b	4.44f	4.36f	4.40d	4.58g	4.82fg	4.70e
90	39.17d	31.00hi	35.08c	38.10e	33.69f	35.90c	5.09c	3.92de	4.51c	5.40c	3.91d	4.65c	5.07e	5.26de	5.17c	5.68de	4.94f	5.31d
120	47.08b	29.67i	38.38b	47.33c	28.57h	37.95d	4.01d	3.43de	3.72d	3.82d	3.68d	3.75d	5.53bc	5.42cd	5.48b	5.94cd	5.43e	5.69c
150	35.70e	33.42fg	34.56c	31.67g	31.31g	31.49f	3.48de	3.26ef	3.37d	3.52d	3.63d	3.58d	5.58bc	5.53bc	5.56b	5.98bcd	6.06bc	6.02b
180	33.83f	33.00fg	33.42d	33.81f	31.67g	32.74e	2.56g	2.68fg	2.62e	3.67d	2.62e	2.93e	5.70ab	5.84a	5.77a	6.29ab	6.39a	6.34a
Mean	***41.85a***	***35.29b***		***41.26a***	***35.31b***		***5.17a***	***4.71a***		***5.53a***	***5.11a***		***4.82a***	***4.88a***		***5.17a***	***5.01a***	
L.S.D. 0.01 Cutting type	0.934			0.611			0.687			0.685			0.82			0.34		
Uni.rate	0.953			0.969			0.475			0.501			0.14			0.23		
Interaction	1.350			1.370			0.670			0.710			0.20			0.32		

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.

Table (2.c): Mean values for the number of shoots, the leaf area (cm^2) and the dry weight of shoots (g) of *Jacobinia carnea*, Nichols plants as affected by immersion of different unrooted cutting types in uniconazole solutions prior to rooting in the two seasons of 1996-97 and 1997-98[1)].

Uni-conazole rate (ppm)	Number of shoots								Leaf area (cm^2)								Dry weight of shoots (g)							
	1st season			2nd season					1st season				2nd season				1st season				2nd season			
	Cutting type		Mean	Cutting type		Mean			Cutting type		Mean		Cutting type		Mean		Cutting type		Mean		Cutting type		Mean	
	Term.	Subterm		Term.	Subterm				Term.	Subterm			Term.	Subterm			Term.	Subterm			Term.	Subterm		
0	3.61g	3.91g	3.76e	3.14i	4.02h	3.58f			1884.34a	1642.49b	1763.42a		1875.36a	1669.94b	1772.65a		11.19a	11.16a	11.18a		9.80b	11.32a	10.56a	
60	8.72de	6.28f	7.50d	8.11f	6.70g	7.41e			1384.84d	1395.77c	1390.30b		1334.51c	1318.14c	1326.33b		6.82b	6.11cd	6.45b		6.49c	6.26cd	6.38b	
90	9.09d	8.28e	8.68c	9.11e	8.74ef	8.93d			1347.90e	1132.41h	1240.16c		1326.67c	1184.18e	1255.42c		6.55bc	5.37e	5.96c		6.19d	5.59ef	5.89c	
120	11.33b	8.72de	10.03b	9.83cd	9.22de	9.53c			1329.02f	1102.91i	1215.97d		1319.79c	1111.37f	1215.58d		6.02d	5.01e	5.52d		5.71e	5.27g	5.49d	
150	12.60a	10.65c	11.32a	10.38c	11.12b	10.75b			1211.18g	1051.63j	1131.41e		1274.86d	1078.14g	1176.50e		5.47e	4.36f	4.92e		5.41fg	4.50h	4.95e	
180	12.39a	10.78bc	11.58a	11.98a	12.29a	11.95a			942.32j	978.13k	959.23f		919.75i	947.95h	933.85f		5.13e	3.26g	4.20f		5.14g	4.24h	4.69f	
Mean	9.52a	8.10b		8.70a	8.66a				1349.93a	1216.89b			1341.82a	1218.28b			6.87a	5.88b			6.46a	6.20a		
L.S.D. 0.05 Cutting type		1.15			0.33					13.06				20.52				0.66				0.30		
Uni.rate		0.47			0.49					7.16				10.20				0.36				0.20		
Interaction		0.66			0.70					10.13				14.43				0.52				0.28		

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.

At the rates of 90 and 120 ppm in the 2nd season, the terminal cuttings were significantly able to produce more internodes, compared with the subterminal ones. Also, the terminal cutting obtained plants significantly had higher number of the shoots in the 1st season at the rates from 60 to 180 ppm and at that of 60 ppm in the 2nd one, compared with the subterminal cutting obtained ones, while the opposite was noticed in the 2nd season at 150 ppm.

The general effect of the cutting types, regardless the uniconazole rates, showed that the terminal cuttings significantly overcame the subterminal ones for the shoot numbers in the 1st season (Table 2.c). The general effect of the uniconazole rates proved in both seasons that the rates from 60 to 180 ppm caused significant increments in the internode and shoot numbers, as compared with the control. There were apparent trends towards increasing the two traits by increasing the uniconazole rate (Table 2.c).

The number of internodes was not affected in *Plargonium zonale* treated with paclobutrazole as a dipping (Adriansen, 1989 and Nasr, 1995). The increments in the internode numberrs in the present work may be due to that uniconazole promoted the early growth of new and short internodes, possibly through the induction of an inbalance between endogenous hormones (Wang *et al.*, 1992). The results of the shooting are similar to those obtained by Naser and Shalabi (1996) on *Zantedeschia aethiopica* soaked in paclobutrazol and are not similar to those reported by Abdel-Maksoud (1992b) on *Hibiscus mutabilis* treated with chlormequat and uniconazole. The increments in the shoot numbers may also due to that uniconazole pronoted the early growth of lateral shoots, possibly through reduced auxin level, which weaked the apical dominance in the plant (Wang *et al.*, 1992 and Abdel-Maksoud *et al.*, 1993).

During both seasons, the control treatments significantly had the highest means of the leaf area and the shoot dry weight and the both traits were decreased with the increase of the uniconazole rates for each cutting type (Table 2.c). At each uniconazole rate the means of the leaf area and the shoot dry weights of the terminal cutting derived plants were significantly higher than those of the subterminal cutting derived ones, except at the rate of 60 ppm in the 1st season and at 180 ppm in both seasons, where the opposite was observed for the leaf area, while for the shoot dry weights this exception was noticed at the control in the 2nd season (Table 2.c).

The general effect of the cutting types indicated that the leaf area in both seasons and the shoot dry weights in the 1st season were significantly higher in the terminal cutting derived plants, comparing with those in the subterminal cutting derived ones. The general effect of the uniconazole rates showed that the leaf area and the shoot dry weights were significantly decreased in both seasons with the increases of the rates from 60 to 180 ppm, comparing with the control (Table 2.c).

The results of the leaf area are similar to those reported by Abdel-Maskoud (1992b) on *Hibiscus mutabilis* grown from cuttings submerged in uniconazole; Suh *et al.* (1994) on *Tulipa* grown from bulbs dipped in triazols; Nasr (1995) on *Pelargonium zonale* and Nasr and Shalabi (1996) on *Zantedeschia aethiopica* both soaked in paclobutrazol. Abdel-Maksoud (1992b) stated that immersion of *Hibiscus mutabilis* cuttings in chlormequat

did not affect the leaf area. The significant reduction in the leaf area may be due to that uniconazole retarded cell division rate, possibly cell expansion or both in lamina tissue by inhibiting gibberellin biosynthesis. The results of the shoot dry weights are in harmony with those reported by Nasr (1995) and JongMyung *et al.* (1999) on *Pelargonium* and *Lilium* soaked in paclobutrazol and uniconazole; respectively. In the current studies the internode length, the plant height and the leaf area were decreased with increasing the uniconazole rates, which caused a reduction in the shoot dry weights as mentioned by Thetford *et al.* (1995a).

I. Flowering growth traits: Analysis of variance proved that the cutting type had highly significant and significant effect on the flowering date and the floret numbers; respectively, in the 1st season and significant effect on the inflorescence diameter and dry weight in the 2nd one. The uniconazole rate and the interaction between the two factors had highly significant effect on the flowering traits in both seasons, except the inflorescence dry weight, where the interaction effect on it was only significant in the 1st season (Table 3.a).

The results indicated that the flowering of the terminal cutting derived plants was significantly earlier than that of the subterminal cutting derived ones at all uniconazole rates from 0 to 180 ppm in the 1st season and at those of 60 and 90 ppm in the 2nd one. The control plants of both cutting types significantly flowered earlier than those of the other treatments in both seasons and with increasing uniconazole rates, the flowering was delayed (Table 3.b). The general effect of the cutting types showed significant enhancement in the flowering of the terminal cutting derived plants in the 1st season (Table 3.b). The general effect of the uniconazole rates revealed the same results obtained with the plants of both cutting types in both seasons (Table 3.b).

The flowering was delayed in *Hibiscus mutabilis* plants derived from cuttings treated with uniconazole rates from 150 to 250 ppm, but the rate of 50 ppm induced early flowering, while chlormequat did not affect the flowering time (Abdel-Maksoud, 1992b). Suh *et al.* (1994) on *Tulipa* and JungMyung *et al.* (1990) on *Lilium* reported that the flowering was delayed as a result of a bulb dip in triazol compounds. The late flowering in *J. carnea*, Nichols was probably due to that uniconazola inhibited gibberellic acid biosynthesis and this effect could delay the flower bud formation and development in the treated plants (Cramer and Bridgen, 1998). Also, the possible alteration of the hormonal balance of the plants by uniconazole can not be overlooked (Willkinson and Richards, 1987).

Considering the number of florets per inflorescence, the maximum mean was detected at the treatment of 120 ppm with the terminal cuttings and significantly differed from the other treatments in both seasons. The minimum mean was detected at the treatments of 60 and 180 ppm with the terminal cuttings in the 1st and 2nd seasons; respectively (Table 3.b). The mean values at the treatments of 90, 120 and 150 ppm with the terminal cuttings in both seasons and the control of the terminal cuttings in the 1st season were significantly higher than those at the same rates with the

subterminal ones, while the opposite was noticed at the rest treatments in both seasons (Table 3.b).

The general effect of the cutting types revealed that the number of florets per inflorescence in the terminal cutting derived plants was significantly higher than that of the subterminal cutting derived ones in the 1st season. The results of the general effects of the uniconazole rates in both seasons were nearly similar to those of the terminal cuttings in the 1st season (Table 3.b). The increments of the floret numbers either at the uniconazole rates of 90, 120 and 150 ppm with the terminal cuttings or as the general effect of uniconazole are supported by Abdel-Maksoud (1992b) and Nasr (1995), where sometimes the growth retardants at specific rates may act as stimulant factors for some traits. The decreasing of the floret numbers in the present study is in line with the results obtained by Suh *et al.* (1994). In general the results of increasing or decreasing of the florets could be attributed to a diversion of assimilate redistribution as a result of the different uniconazole rates effects

Regarding the inflorescence dimensions, the highest and lowest means of the inflorescence length were recorded in both seasons at the treatments of 120 and 0 ppm with the subterminal cuttings; respectively (Table 3.b). The highest mean of the inflorescence diameter was found at the treatment of 180 ppm with the terminal cuttings in the 1st season and at that of 0 ppm with the subterminal ones in the 2nd one (both treatments had short inflorescences), while the smallest diameter was detected at the treatment of 120 ppm with the terminal cuttings (with intermediate length) and at 60 ppm with the subterminal ones (with tall inflorescence) in the 1st and 2nd seasons; respectively (Table 3.c). For the treatments involved the terminal cuttings, and compared with the control, the chemical rates of 60 and 90 ppm in both seasons and that of 150 ppm in the 2nd one significantly increased the inflorescence length, but the rate of 180 ppm significantly reduced it in both seasons (Table 3.b), while the diameter was significantly increased at the rates of 90, 150 and 180 ppm in the 1st season and at those from 60 to 180 ppm in the 2nd one (Table 3.b). In the case of the subterminal cuttings, the chemical rates from 60 to 180 ppm significantly increased the inflorescence length and decreased the diameter compared with the control in both seasons (Table 3b and c).

The untreated terminal cutting derived plants had longer inflorescences with smaller diameters than those of the untreated subterminal cutting derived ones in both seasons. There were significant differences between the inflorescence lengths of the two cutting types derived plants at the rates of 90 and 120 ppm in both seasons and at 180 ppm in the 1st one (Table 3.b). The inflorescence diameter in the terminal cutting derived plants was significantly wider than that in the subterminal cutting derived ones at the uniconazole rates of 90,150 and 180 ppm in the 1st season and at those from 60 to 180 ppm in the 2nd one, and the same trend was observed for the general effect of the cutting types on the inflorescence diameter in the 2nd season (Table 3.c).

Table (3.a): Analysis of variance for the flowering growth characters of *Jacobinia carnea*, Nichols plants as affected by immersion of different unrooted cutting types in uniconazole solutions prior to rooting in the two seasons of 1996-97 and 1997-98.

Source of variation	d.f.	Mean squares											
		Flowering date		No. of florets		Inflorescence length (cm)		Inflorescence diameter (cm)		Fading date		Inflorescence dry weight (g)	
		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	1.81	2.44	6.63	4.60	0.15	0.39	0.29	0.41	0.06	0.15	0.001	0.001
Cutting type (A)	(a-1)=1	695.55**	129.01^{NS}	181.26**	8.18^{NS}	0.12^{NS}	0.17^{NS}	0.45^{NS}	0.51*	0.05^{NS}	0.13^{NS}	0.007^{NS}	0.025*
Error "a"	(r-1) (a-1) =2	1.96	20.73	3.67	0.63	0.29	0.57	0.24	0.01	1.73	0.86	0.003	0.0004
Uniconazole rate (B)	(b-1) = 5	3182.22**	3035.72**	41.95**	67.98**	3.57**	3.45**	0.36**	0.57**	6.07**	9.67**	0.064**	0.036**
AB	(a-1) (b-1) =5	45.67**	43.24**	37.57**	76.84**	2.47**	1.68**	0.92**	1.24**	0.93**	1.68**	0.007*	0.003**
Error "b"	(r-1) (ab-a) =20	3.24	1.92	1.29	0.70	0.15	0.12	0.06	0.03	0.10	0.13	0.002	0.0003
Total	(abr-1) = 35												

N.S. = Non- significant effect

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

Table (3.b): Mean values for the days to flowering (flowering date), the number of florets per inflorescence and the inflorescence length (cm) of *Jacobinia carnea*, Nichols plants as affected by immersion of different unrooted cutting types in uniconazole solutions prior to rooting in the two seasons of 1996-97 and 1997-98[1)].

Uniconazole rate (ppm)	Days to-flowering						Number of florets						Inflorescence length (cm)					
	1st season			2nd season			1st season			2nd season			1st season			2nd season		
	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean	Cutting type		Mean
	Term.	Subterm		Term.	Subterm		Term.	Subterm		Term	Subterm		Term.	Subterm		Term.	Subterm	
0	73.11j	76.44i	74.78f	79.22h	80.33h	79.78f	33.67c	29.67de	31.67c	24.56e	28.55d	26.55c	10.72d	9.63e	10.18c	10.86def	9.70h	10.28c
60	111.67h	126.45e	119.06e	117.24g	126.89e	122.09e	27.84e	29.82d	28.83d	23.45e	27.61d	25.53d	11.83bc	11.89bc	11.86ab	12.10ab	12.07ab	12.09a
90	116.22g	132.11cd	124.17d	120.22f	131.64d	125.93d	37.81b	29.91d	33.87b	33.04b	27.56d	30.30b	12.32ab	10.78d	11.55b	12.01b	10.68defg	11.35b
120	126.00f	135.00bc	130.50c	133.22cd	135.22c	134.22c	41.22a	30.03d	35.63a	39.22a	27.39d	33.31a	11.30cd	12.92a	12.11a	11.16cdef	12.64a	11.90a
150	130.56d	137.09ab	133.82b	137.86b	138.00b	137.93b	35.39c	29.20de	32.30c	31.33c	27.94d	29.64b	11.44cd	11.66bc	11.55b	11.59bc	11.26cd	11.42b
180	135.34b	136.56a	136.95a	141.22a	139.67ab	140.45a	28.95de	29.33de	29.14d	21.00f	27.83d	24.42e	9.79e	11.23cd	10.51c	10.10gh	10.63efg	10.37c
Mean	***115.48b***	***124.27a***		***121.51a***	***125.29a***		***34.15a***	***29.66b***		***28.77a***	***27.81a***		***11.24a***	***11.35a***		***11.30a***	***11.16a***	
L.S.D $_{0.01}$ Cutting type	2.01			6.63			2.75			1.14			0.78			1.09		
Uni.rate	2.71			1.67			1.37			1.01			0.46			0.41		
Interaction	3.07			2.36			1.93			1.42			0.66			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.

Table (3.c): Mean values for the inflorescence diameter (cm), days to fading (fading date) and the dry weight of *the inflorescence* (g) *of Jacobinia carnea*, Nichols plants as affected by immersion of different unrooted cutting types in uniconazole solutions prior to rooting in the two seasons of 1996-97 and 1997-98[1)].

Uniconazole rate (ppm)	Inflorescence diameter (cm)								Days to fading								Dry weight of inflorescence (g)							
	1st season			2nd season					1st season			2nd season					1st season			2nd season			
	Cutting type		Mean	Cutting type		Mean	Mean		Cutting type		Mean	Cutting type		Mean	Mean		Cutting type		Mean	Cutting type		Mean	Mean
	Term	Subterm		Term	Subterm				Term	Subterm		Term	Subterm				Term	Subterm		Term	Subterm		
0	7.42def	8.36a	7.89ab	7.46ef	8.66a	8.06a	7.98a		13.00g	13.66f	13.33e	13.94h	14.28gh	14.11e	14.03d		0.74a	0.75a	0.75a	0.64a	0.62a	0.63a	0.69a	
60	7.71cde	7.28ef	7.49c	8.15cd	7.16g	7.66b	7.58b		14.50de	14.44e	14.47d	14.78efg	14.72fg	14.75d	14.61c		0.55bc	0.55bc	0.55bc	0.52bc	0.51cd	0.52b	0.53b	
90	7.86bc	7.49def	7.68bc	8.24cd	7.24fg	7.74b	7.71b		14.56de	15.01cd	14.78cd	15.60c	15.17def	15.39c	15.28b		0.52bcde	0.52bcde	0.52bc	0.55b	0.48d	0.52b	0.52b	
120	7.24f	7.62cdef	7.43c	8.18cd	7.68e	7.43c	7.55b		15.56b	15.56b	15.56b	16.28c	15.39de	15.83b	15.61b		0.56b	0.41f	0.48bcd	0.51cd	0.39e	0.45c	0.47b	
150	8.29ab	7.76cd	8.03a	8.35bc	8.05d	8.20a	8.12a		16.99a	15.61b	16.30a	18.51a	17.17b	17.84a	17.51a		0.54bcd	0.47def	0.51cd	0.49cd	0.41e	0.45c	0.48b	
180	8.58a	7.26f	7.91ab	8.55ab	7.71e	8.13a	8.02a		14.57de	15.33bc	14.95c	14.83efg	16.60c	15.87bc	15.73a		0.45ef	0.78cdef	0.47d	0.42e	0.40e	0.41d	0.43c	
Mean	*7.85a*	*7.63a*		*7.99a*	*7.75b*				*14.86a*	*14.94a*			*15.86a*	*15.54a*			*0.58a*	*0.53a*		*0.52a*	*0.47b*			
L.S.D. at 0.01 level of probability																								
Cutting type			0.70			0.11				1.89				1.33					0.08			0.03		
Uniz.ale			0.30			0.19				0.37				0.44					0.05			0.02		
Interaction			0.43			0.27				0.53				0.62					0.07			0.03		

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 general effect of the uniconazole rates revealed that the rates from 60 to 150 ppm significantly increased the inflorescence length in both seasons (Table 3.b), while those of 60 and 120 ppm in both seasons besides 90 ppm in the 2nd one significantly reduced the inflorescence diameter, compared with the control (Table 3.c).

The changes in the inflorescence dimensions of *J. carnea*, Nicholas treated with uniconazole are similar to those reported by Abdel-Maksoud (1992b) on *Hibiscus mutabitis*; Nasr (1995) on *Pelargonium zonale* and Nasr and Shalabi (1996) on *Zontedeschia aethiopica*. From the present results, it was clear that uniconazole application as cutting immersion resulted in an increase or a decrease in the inflorescence dimensions. This probably is due to the nature of the treatments which stimulate photosynthesis process at specific rates (Thetford *et al.*, 1995a), consequently the inflorescence length or diameter would be increased. Also uniconazole application as terminal cuttings immersion may resulted in diversion of assimilates into floret formation and development, consequently the inflorescence length decreased and the diameter increased and the diversion of assimilate redistribution would seem a likely explanation for the overall effects of uniconazole on the flowering response. Also, the possible alteratiion of the hormonal balance of the plants cannot overlooked (Wilkenson and Richards, 1987). Triazol compounds at specific rates with certain application methods can cause no or different effects on the same trait from inhibition to stimulation (Thetford *et al.*, 1995b).

For the inflorescence longevity on the plant, the results of both seasons showed in both cutting types that all utilized uniconazole rates significantly increased the inflorescence life, compared with the control, except the rate of 60 ppm with the subterminal cuttings in the 2nd season. The treatment of 150 ppm with the terminal cuttings had the longest inflorescence longevity (Table 3.c). At the terminal cutting treatments, the increases in the inflorescence longevity ranged from 1.50 to 3.99 days in the 1st season and from 0.84 to 4.57 days in the 2nd one, while at those of the subterminal ones, ranged from 0.78 to 1.95 days and from 0.44 to 2.89 days in the 1st and 2nd seasons; respectively. The treatments of the terminal cuttings treated with 150 ppm in both seasons and treated with 90 and 120 ppm in the 2nd season were significantly able to increase the inflorescence life as compared with the same treatments of the subterminal cuttings and the opposite situation was noticed at the control in the 1st season and at the rate of 180 ppm in both seasons (Table 3.c). The general effect of the unoconazole rates showed the same trend observed in each cutting type during both seasons (Table 3.c). These results are similar to those reported by Abdel-Maksoud (1992 b); Suh *et al.* (1994) and Nasr and Shalabi (1996).

This prolongation of the inflorescence life is probably due to that uniconazole is cabable to retard the senescence of the plant tissues by maintaining a high level of chlorophyll (as shown hereafter) and slowing down its degradation rate. Also, plants treated with growth retardants display increased resistance to the environmental stress and their transpiration is reduced which is correlated with the reduced leaf area (Proebesting and Mills, 1985 and Vaigro-Wolff and Warmund, 1987).

All uniconazole rates from 60 to 180 ppm caused a significant reduction in the inflorescence dry weight, compared with the control for both cutting types plants and the lowest mean was recorded at the treatment of 120 ppm with the subterminal cuttings in both seasons. The inflorescence dry weight at the rate of 120 ppm with the terminal cuttings in the 1st season and at 90, 120 and 150 ppm also with the same cuttings in the 2nd one was significantly higher than that at the same rates with the subterminal cuttings. The general effect of the cutting types showed in the 2nd season that the infloresence dry weight of the terminal cutting derived plants was significantly higher than that of the subterminal cutting derived ones (Table 3.c). These results were expected because the number of florets and the inflorescence diameter at the treatments of the terminal cuttings mentioned before were higher than those at the corresponding treatments of the subterminal ones. Also, the inflorescence diameter was increased as a result of the general effect of the terminal cuttings, thus the inflorescence dry weight was increased. The lowering in the inflorescence dry weight of the subterminal cutting treatments could be attributed to the reduction in their inflorescence diameter.

The general effect of the uniconazole rates on the inflorescence dry weight revealed similar results to those observed with the both cutting types plants in both seasons and the maximum decrease was observed at the rate of 180 ppm (Table 3.c) which was related to the decreases in the inflorescence length, diameter or number of florets according to the effect of the rate. Nasr and Shalabi (1996) on *Zantedeschia aethiopica* and JongMyung *et al.* (1999) on *Lilium* reported that prepropagation dipping in triazol compounds resulted in reduction in the inflorescence dry weight. The flower dry weight of *Hibiscus mutabilis* did not response to the cutting immersions in chlormequat or uniconazole (Abdel-Maksoud, 1992b).

At the treatments of the terminal cuttings, the number of florets was increased at the rates from 90 to 150 ppm and the inflorescence dimensions were increased at the rates from 60 to 150 ppm, compared with the control, but the inflorescence dry weight was decreased, compared with the control. This reduction may be due to the alterations in the inflorescence carbohydrate metabolism caused by the treatments and/or to other physiological roles in the plants.

IV. Chemical analysis:

1. Leaf chlorophyll contents ("a" and "b"): Analysis of variance proved that the cutting type had significant effect on chlorophyll "a", while the uniconazole rate had highly significant effect on both chlorophyll kinds. The interaction between the two factors exhibited significant effect on chlorophyll "b" (Table 4.a).

There were significant increments in the two chlorophyll kinds in the treated plants generated from both cutting types, as compared with the untreated plants. The highest means of chlorophyll "a" and "b" were noticed at the treatments of 120 and 180 ppm with the subterminal cuttings; respectively. The subeterminal cutting derived plants at the rates of 120 and 180 ppm significantly contained higher amounts of chlorophyll "a" than those respectively. The subeterminal cutting derived plants at the rates of 120 and

180 ppm significantly contained higher amounts of chlorophyll "a" than those derived from the terminal ones and the same observation was recorded for chlorophyll "b" at the rate of 180 ppm (Table 4.b).

The general effect of the cutting types showed that the leaf chlorophyll "a" content in the subterminal cutting derived plants was significantly higher than that in the terminal cutting derived ones. The general effect of the uniconazole rates exhibited similar results to those obtained with the plants of both cutting types and the highest amounts of chlorophyll "a" and "b" were noticed at the rate of 150 ppm (Table 4.b).

These increments in chlorophyll pigments are similar to those reported by Nasr (1995) and Yoon and Lang (1998) and were probably due to the effect of uniconazole causing reduction in the cell size and elongation. Consequently, the amounts of chlorophyll in the leaves were concentrated in a limited size as stated by Abdel-Maksoud (1992b) and Abdel-Maksoud *et al.* (1992 and 93).

2. Sugar contents: Analysis of variance indicated that the effect of the cutting type was significant on the reducing sugar content of the leaves and on the non-reducing and total soluble sugars contents of the leaves and roots. The effect of the uniconazole rate and the interaction between the two factors was highly significant on the sugar types contents of the leaves and roots (Table 4.a).

For the leaf reducing sugar, the highest and lowest means were noticed at the rate of 150 ppm with the terminal cutting and at that of 60 ppm with the subterminal ones; respectively. The rates of 60, 120 and 180 ppm with the terminal cuttings significantly decreased the leaf reducing sugar, while those from 90 to 180 ppm with the subterminal ones significantly increased it, compared with the controls. The rates of 90, 120 and 180 ppm with the subtermial cuttings were significantly able to increase the leaf reducing sugar compared with the same rates in the terminal cuttings (Table 4.c.). The general effect of the cutting types indicated that the subterminal cutting significantly increased the leaf reducing sugar compared with the terminal ones, similar to the results of chlorophyll "a". The general effect of the uniconazole rates showed that the rate of 60 ppm significantly decreased the leaf reducing sugar, while both rates of 150 and 180 ppm significantly increased it (Table 4.c).

The decreases in the leaf reducing sugar mentioned before were similar to those reported by Nasr (1995) on *Pelargonium zonale* treated with paclobutrazol, while the increases were similar to those reported by Curry (1988) on apple treated with paclobutrazol or RSWO411 and El-Sabrout (1996) on *Citrus sinensis* treated with chlormequat.

The decreases in the leaf reducing sugar mentioned before were similar to those reported by Nasr (1995) on *Pelargonium zonale* treated with paclobutrazol, while the increases were similar to those reported by Curry (1988) on apple treated with paclobutrazol or RSWO411 and El-Sabrout (1996) on *Citrus sinensis* treated with chlormequat.

Regarding the reducing sugar of the roots, the highest and lowest means were recorded at the rates of 90 and 60 ppm with the subterminal cuttings; respectively.

Table (4.a): Analysis of variance for the leaf chlorophyll contents "a" and "b" (mg/g. f.w.) the reducing, the non-reducing and the total soluble sugars and the starch contents in the leaves and roots (mg/100g d.w.) of *Jacobinia carnea*, Nichols plants as affected by immersion of different unrooted cutting types in uniconazole solutions prior to rooting in the 2nd season of 1997-98.

Source of variation	d.f.	Mean squares									
		Chlorophyll (mg/g f.w.)		Reducing sugar (mg/100 g d.w.)		Non-reducing sugar (mg/100 g d.w.)		Total soluble sugars (mg/100g d.w.)		Starch (mg/100g d.w.)	
		"a"	"b"	leaves	Roots	Leaves	Roots	Leaves	Roots	Leaves	Roots
Rep.	(r-1) =2	27.70	6.69	$5x10^{-5}$	$22x10^{-7}$	0.006	0.03	0.006	0.03	0.36	0.04
Cutting type (A)	(a-1)=1	566.12*	$8.20^{N.S}$	$393x10^{-4*}$	$147x10^{-7N.S}$	0.286*	0.80*	0.307*	0.80*	$20.09^{N.S}$	$2.44^{N.S}$
Error "a"	(r-1) (a-1) =2	18.01	8.04	$1x10^{-5}$	$14x10^{-7}$	0.006	0.01	0.006	0.01	2.24	0.68
Uniconazole rate (B)	(b-1) = 5	2006.03**	393.78**	$91x10^{-4**}$	$129x10^{-7**}$	1.636**	0.68**	1.616**	0.68**	3.41**	29.40**
AB	(a-1) (b-1) =5	$101.40^{N.S}$	45.89*	$246x10^{-4**}$	$217x10^{-7**}$	0.132**	0.18**	0.132**	0.17**	1.52**	2.91**
Error "b"	(r-1) (ab-a) =20	45.60	15.28	$7x10^{-6}$	$4x10^{-7}$	0.004	0.02	0.004	0.02	0.20	0.19
Total	(abr-1) = 35										

N.S. = Non- significant effect

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

Table (4.b): Mean values for the leaf chlorophyll contents "a" and "b" (mg/g f.w) of *Jacobinia carnea*, Nichols plants as affected by immersion of different unrooted cutting types in uniconazole solutions prior to rooting in the 2nd season of 1997-98 [1].

Uniconazole Rate (ppm)	Chlorophyll "a" (mg/g f.w.)			Chlorophyll "b" (mg/g f.w.)		
	Cutting type		Mean	Cutting type		Mean
	Term.	Subterm.		Term.	Subterm.	
0	32.91e	38.02 e	35.47 d	25.13 f	22.92 f	24.02 d
60	58.65 cd	56.73 d	57 69 c	36.75 de	36.64 e	36.70 c
90	61.17bcd	70.71 b	65 94 b	42.43 bcde	44.16 abc	43.30 ab
120	70.70 b	89.09 a	79.90 a	39.83 cde	40.48cde	40.16 bc
150	84.46 a	84.92 a	84.69 a	48.69 ab	43.34 abcd	46.02 a
180	69.49 bc	85.49 a	77 49 a	38.93 cde	49.95 a	44.44 ab
Mean	62.90 b	70.83 a		38.63 a	39.58 a	
L.S.D.						
Cutting type	6.09			4.07		
Uni.rate	8.13			4 71		
Interaction	11 50			6.66		

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 rates of 90, 120 and 180 ppm with the terminal cuttings significantly decreased the root reducing sugar, compared with the control. The rates from 90 to 180 ppm with the subterminal cuttings had significantly higher amounts of the reducing sugar compared with its control and the same rates with the terminal ones, while at the rate of 60 ppm the opposite was observed (Table 4.c). The general effect of the uniconazole rates showed that the rate of 60 ppm significantly decreased the root reducing sugar, while those of 90 and 150 ppm significantly increased it, compared with the control (Table 4.c).

The current results showed that the reducing sugar contents were increased at some intermediate and high uniconazole rates with both cutting types. These increments were associated with the high levels of chlorophyll pigments, prolongation of the inflorescence life, increased inflorescence dimensions and number of florets, early flowering, increased shoot and internode numbers and decreased plant height and dry weight. Therefore, the increments in reducing sugars may be transient and also may indicate suppression of some growth traits but not of photosynthetic activity (Han *et al.*, 1998). The decreases of the reducing sugar at most treatments in uniconazole treated plants could be explained basing on that much of available sugar may has been utilized for some growth traits.

The highest and lowest means of the non-reducing and total soluble sugars of the leaves were recorded at the treatments of the control and the rate of 120 ppm of the terminal cuttings; respectively, and the rates from 60 to 180 ppm with the two cutting types significantly decreased their levels, compared with the controls. The rates of 60, 90 and 120 ppm with the subterminal cuttings significantly resulted in higher amounts of these leaf sugars, compared with the corresponding rates with the terminal ones (Table 4.c).

Table (4.c): Mean values for the reducing, non-reducing and total soluble sugars contents in the leaves and roots (mg/100 g d.w) of *Jacobinia carnea*, Nichols plants as affected by immersion of different unrooted cutting types in uniconazole solutions prior to rooting in the 2nd season of 1997-98[1].

Uniconazole 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		
	Cutting type		Mean		Cutting type		Mean	Cutting type		Mean		Cutting type		Mean	Cutting type		Mean		Cutting type		Mean
	Term.	Subterm			Term.	Subterm		Term.	Subterm			Term.	Subterm		Term.	Subterm			Term.	Subterm	
0	0.042d	0.040de	0.041cd		0.011b	0.009cd	0.010b	2.93a	2.84a	2.88a		2.18ab	2.03bc	2.11a	2.97a	2.88a	2.92a		2.19b	2.04b	2.12a
60	0.022fg	0.019g	0.021e		0.010bc	0.006f	0.008c	1.84c	2.33b	2.09b		1.03f	1.26e	1.14d	1.87c	2.35b	2.11b		1.04e	1.26de	1.15d
90	0.040de	0.046c	0.043cb		0.009cd	0.014a	0.012a	1.39e	1.52d	1.45e		2.13b	1.77d	1.95b	1.43e	1.57d	1.50d		2.13b	1.79c	1.96b
120	0.037e	0.051bc	0.044b		0.008de	0.011b	0.010b	1.22f	1.83c	1.53d		2.26a	1.45e	1.86b	1.26f	1.88c	1.57d		2.27b	1.46d	1.87b
150	0.063a	0.059a	0.061a		0.011b	0.013a	0.012a	1.81c	1.76c	1.78c		2.03bc	1.75d	1.89b	1.87c	1.82c	1.85c		2.04b	1.76c	1.90b
180	0.025f	0.054b	0.040d		0.007ef	0.013a	0.010b	1.79c	1.78c	1.78c		1.89cd	1.46e	1.67c	1.81c	1.83c	1.82c		2.90a	1.47d	1.68c
Mean	***0.038b***	***0.045a***			***0.010a***	***0.011a***		***1.83b***	***2.01a***			***1.92a***	***1.61b***		***1.87b***	***2.05a***			***1.93a***	***1.83b***	
L.S.D $_{0.01}$ Cutting type		0.004				0.0020			0.11				0.13			0.11				0.15	
Uni rate		0.003				0.0007			0.08				0.15			0.08				0.15	
Interaction		0.003				0.0010			0.11				0.21			0.11				0.21	

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 general effect of the cutting types indicated that the plants derived from the subterminal cuttings significantly had higher amounts of the non-reducing and total soluble sugars in their leaves, compared with those derived from the terminal ones. The general effect of the uniconazole rates showed the same results of each cutting type plants (Table 4.c).

The reduction of the non-reducing sugar in the current study is not similar to the results reported by Curry (1988) on apple treated with paclobutrazol or RSWO411 and El-Sabrout (1996) on *Citrus sinensis* treated with chlormequat, where the non-reducing sugars were increased in the leaves. The reduction of the leaf total soluble sugars in the current work is similar to that reported by Abdel-Nasser and El-Shazly (1994) on *Citrus reticulata* treated with chlormequat (2400 mg/l) and Nasr (1995) on *Pelargonium zonale* treated with paclobutrazol. Contrarily, the leaf total sugars were increased in *Citrus reticulata* treated with chlormequat rates of 800 and 1600mg/l (Abdel-Nasser and El-Shazly, 1994) and *Citrus sinensis* treated with chlormequat rates from 500 to 1500 mg/l (El-Sabrout, 1996).

The highest means of the non-reducing and total soluble sugars contents in the roots were recorded at the rates of 120 and 180 ppm with the terminal cuttings; respectively, while the lowest ones were recorded at the rate of 60 ppm combined with the terminal cuttings. In the case of the terminal cuttings, the rate of 60 ppm significantly reduced the mentioned sugars in the roots compared with the control, but that of 180 ppm significantly decreased the nun-reducing sugars and increased the total soluble sugars in the roots. For the subterminal cuttings treatments, the two sugar types in the roots were significantly decreased at the rates from 60 to 180 ppm, compared with the control. At the rates from 90 to 180 ppm with the terminal cuttings, the amounts of the two sugar types in the roots were significantly higher than those at the same rates with the subterminal ones, but the opposite was true at the rate of 60 ppm for the non-reducing sugars (Table 4.c).

The general effect of the cutting types revealed that the non-reducing and total soluble sugars in the roots of the terminal cutting derived plants were significantly more than those of the subterminal cutting derived ones. The general effect of the uniconazole rates exhibited the same results recorded with the subterminal cutting treatments (Table 4.c).

The decreases of non-reducing and total sugars mentioned before could be explained basing on much of available sugars may have been used for some growth traits. The treated plants seemed to have a greater number of shoots and florets with longer and sometimes wider inflorescences and extended inflorescence longevity compared to the untreated plants. Therefore, the reduction in the sugar types contents of these plants may be attributed to continuous use of photosynthates for supporting the growth traits mentioned before (El-Mahrouk *et al.*, 1992; El-Sabrout, 1996 and Han *et al.*, 1998).

3. Starch contents: Analysis of variance showed that the uniconazole rates and the interaction were highly significant effective on the starch contents of the leaves or the roots (Table 4.a). The maximum means of the starch content in the leaves and the roots were detected at the treatment of

the terminal cuttings treated with the rate of 90 ppm, while the minimum ones were detected at the those of 0 and 180 ppm with the subterminal cuttings for the leaf and root starch; respectively. Comparing with control, the leaf starch contents were significantly increased at the rates from 60 to 180 ppm in both cutting types except at that of 120 ppm with the subterminal cuttings. The leaf starch contents at the rates from 0 to 120 ppm with the terminal cuttings were significantly higher than those at the same rates with the subterminal ones (Table 4.d). Comparing with the control, the starch contents of the roots were significantly increased at the rate of 90 ppm with both cutting types and significantly decreased at the other rates with the terminal cuttings and at those of 60, 150 and 180 ppm with the subterminal ones. The starch contents of the roots at the rates of 120 and 150ppm with the subterminal cuttings were significantly higher than those at the same rates with the terminal ones and the opposite was observed at the rate of 180 ppm (Table 4.d). The general effect of the uniconazole rates on the starch contents in the leaves and roots exhibited similar results to those obtained with the terminal cutting treatments (Table 4.d). The increments of the leaf starch in the current work are similar to those reported by Steffens *et al* (1985) on apple trees treated with paclobutrazol and are not similar to the result reported by El-Sabrout (1996), where the leaf starch of *Citrus sinensis* was decreased as a result of chlormequat application. Generally, the decreases of the root starch are not in accordance to the results mentioned by El-Gamal (1994), where paclobutrazol did not affect the root starch content of sweet potato.

Table (4.d): Mean values for the starch content in the leaves and roots (mg/100g d.w.) of *Jacobinia carnea*, Nichols plants as affected by immersion of different unrooted cutting types in uniconazole solutions prior to rooting in the 2nd season of 1997-9898 [1].

Uniconazole rate (ppm)	Leaves			Roots		
	Cutting type		Mean	Cutting type		Mean
	Term.	Subterm.		Term.	Subterm.	
0	6.37 de	5.19 f	5.78 c	6.97 b	7.08 b	7.03 b
60	8.80 a	6.54 cde	7.67 ab	6.10 c	5.69 cd	5.90 c
90	8.85 a	7.01 cd	7.93 a	9.00 a	9.49 a	9.47 a
120	8.83 a	5.78 ef	7.20 b	4.70 e	7.14 b	5.92 c
150	7.81 b	7.13 bcd	7.47 ab	3.73 f	5.23 de	4.48 d
180	7.29 bc	7.12 bcd	7 20 b	3.70 f	2.26 g	2.99 e
Mean	7.96 a	6.49 a		6.22 a	5.70 a	
L.S.D.						
Cutting type		2.15			1.18	
Uni rate		0.54			0.52	
Interaction		0.76			0.74	

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.

It was evident from the results that the starch was higher than the total sugar types of the leaves or roots of *J.carnea*, Nichols plants. This results agrees with that reported by El-Sabrout (1996) and is due to that the starch is the major storage carbohydrate in plants and resembles the major component of the leaf or root dry matter. The uniconazole rates from 60 to 180ppm significantly increased the accumulation of the starch in the leaves, but significantly decreased the plant height, the leaf area and the dry weight.

This may indicate the suppression of the growth but not of photosynthetic activity. The photosynthesis process still occurs at its high rate which leads to the accumulation of manufactured starch (Abdel-Nasser and El-Shazly, 1994 and Han *et al.*, 1998). The reduction of the starch content in the roots of the most uniconazole treated plants compared to the untreated ones in the current research could be due to the reduction of the root growth caused by uniconazole or due to that much starch was directed toward the top system where the continuous use of photosynthates for supporting the growth and production of the different organs of the top system during the period of high stress.

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استجابة نباتات الجاكوبينيا لليونيكونازول:
١- تأثير أنواع العقل وتركيزات اليونيكونازول والتفاعل بينهما

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نقعت العقل الطرفية والوسطية لنبات الجاكوبينيا "صنف محلي" لمدة ساعتين في محاليل اليونيكونازول بتركيزات صفر، ٦٠، ٩٠، ١٢٠، ١٥٠، ١٨٠ جزء فى المليون فى موسمين متتاليين فى تجربة قطع منشقة خصصت القطع الكبيرة لنوع العقل والقطع الصغيرة لتركيزات اليونيكونازول وأوضحت نتائج التأثير العام للعاملين المدروسين ما يلي:

١- كانت النباتات النامية من العقل الطرفية متفوقة معنويا على تلك النامية من العقل الوسطية في كل من أعداد الجذور وأطوالها - إرتفاع النبات- المساحة الورقية خلال الموسمين وفي التفريع - الوزن الجاف للفروع- التزهير المبكر - أعداد الزهيرات في النورة في الموسم الأول وفي قطر النورة ووزنها الجاف فى الموسم الثاني.

٢- أظهرت نتائج الموسمين أن تركيزات اليونيكونازول من ٦٠ إلي ١٨٠ جزء فى المليون أدت إلي إنخفاض معنوي فى كل من نسبة التجذير - أعداد الجذور وأطوالها- إرتفاع النبات- طول السلامية- المساحة الورقية- الوزن الجاف لكل من الفروع والنورات كما تسببت فى تأخير التزهير معنويا، أما الجرعات من ٦٠ إلي ٩٠ جزء فى المليون فقد نتج عنها نقص معنوي لقطر النورة، وقد حدثت زيادة معنوية لكل من عدد السلاميات- عدد الفروع- عمر النورة على النبات وذلك عند التركيزات من ٦٠ إلي ١٨٠ جزء فى المليون، بينما أدت الجرعات من ٦٠ إلي ١٥٠ جزء فى المليون إلى زيادة طول النورة معنويا. وحدثت زيادة معنوية لأعداد الزهيرات فى النورة عند التركيزات من ٩٠ إلي ١٥٠ جزء فى المليون مقارنة بالكنترول.

٣- كان تركيز الكلوروفيل "أ" وكل من السكريات المختزلة وغير المختزلة والكلية الذائبة أعلي معنويا فى أوراق النباتات النامية من العقل الوسطية مقارنة بأوراق النباتات النامية من العقل الطرفية وإحتوت جذور الأخيرة على كميات من السكريات غير المختزلة والكلية الذائبة أعلى معنويا عن مثيلاتها فى جذور الأولى.