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EFFECT OF GIBBERELLIC ACID, SOME ANTITRANSPIRANTS AND POSTHARVEST TREATMENTS ON THE QUALITY OF CUT FATSIA LEAVES

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ABSTRACT: *The aim of this study was to investigate the responses of cut Fatsia japonica leaves to GA_3, citrosol and storage durations and to examine the physiological changes in the leaves in response to the treatments. Leaves were harvested at mature stage and were pulsed in distilled water or 100 ppm GA_3 for 20 hours. Leaves were sprayed with 100 ppm GA_3 or citrosol. After the treatments, a set of leaves was transferred to a postharvest evaluation room. Another set of leaves was stored at 5°c for 1 and 2 weeks before transferring to the postharvest room. In the postharvest room, leaves were held in vase solutions containing 2% sucrose and 200 ppm 8-hydroxyquinoline citrate. In general, gibberelin treatments increased leaves longevity and reduced the occurrence of leaf chlorosis. Spraying treatments with 100 ppm GA_3 followed by citrosol were more effective in increasing leaves longevity, water uptake, total sugars percentage and chlorophyll contents than the other treatments. Cold storage of leaves accelerated leaf chlorosis and reduced leaves longevity especially with 2 weeks storage. Spraying treatment of 100 ppm GA_3 followed by citrosol prevented leaf chlorosis and increased leaves longevity of cold-stored stems in a similar fashion that was observed in non cold-stored stems.*

Key words: *Fatsia leaves, gibberellic acid, antitranspirants, postharvest.*

INTRODUCTION

Cut foliage occupy an important position in the local and foreign markets because of the importance as a source of national income. There is a suitable environmental conditions and produce flower and foliage crops for local markets and for export. Cut foliage production has been increasing rapidly in recent years. Flower and foliage plants are one of the most colorful and attractive horticultural plants. Japanese aralia (*Fatsia japonica*) belongs to family Araliaceae. It has huge, up to 12 inch (30cm) wide leaves that are deeply lobed and slightly serrated. Leaf stems are quite long and hold the leaves up and out with the plant growing to height of about 2.4 m and about half as wide. The upright stems are covered with prominent leaf scars and mostly unbranched. This plant is mainly grown for its outstandingly attractive foliage. The Japanese aralia is not surprisingly a native of Japan but is now enjoyed all over the world in landscape and as a container plant indoors and cut foliage.

The physiology of the rapid development of foliar chlorosis is not known but depletion of carbohydrate during storage may be the cause (Miller, 1993).

A positive effect of gibberellins in preventing premature leaf yellowing has been found in lily flowers (Sindhu and Pathania, 2004).

The application of wax or wax emulsion (such as polyethylene) coatings to certain perishable products has been practiced for many years. Waxing reduces moisture loss and thus retards shriveling (Hardenburg *et al.*, 1990).

The aim of this study was to investigate the responses of cut *Fatsia japonica* leaves to GA_3, citrosol, storage periods and examine the physiological changes of the leaves.

MATERIALS AND METHODS

This research was carried out at Horticultural Research Institute, Giza during two successive seasons (2006 and 2007). Aralia stems (*Fatsia japonica*) were harvested at mature stage from a commercial farm. Precooling of stems was performed by placing them in ice cold water for two hours. Stems were recut in air before treatments. The following chemical treatments were applied:

1- Control (pulsing in distilled water for 20 hours).

2- Pulsing in 100 ppm GA_3 for 20 hours.

3- The whole stem was sprayed with 100 ppm GA_3 + 0.1% Tween20 (polyoxyethylene sorbitan monolaurate as a surfactant). After the treatment, surfaces of leaves were allowed to dry for 2 hours, then pulsed in water.

4- Foliage was sprayed with Citrosol (watery emulsion composed of polyethylene wax, rosin (18%w/v) and it was obtained from Partida de La Alameda, Valencia, Spain). Citrosol used for protecting and shining postharvest treatment. After that, surfaces of leaves were allowed to dry for 2 hours then pulsed in water.

After the treatments a set of leaves (0 week) from each treatment was transferred to a postharvest evaluation room (22±2°c, 24 hr flourescent light at 1000 lux and 40-50% RH). Another set of leaves were wrapped in tightly sealed polyethylene film (30 micron thickness) then packed in carton boxes (102 x 50x 30 cm) and translocated to storage room at 5°c and RH 80-90% for 1 week and 2 weeks before transferring to the postharvest room. In the postharvest room, stems were placed in glass jars containing 300 ml of vase solution containing 2% sucrose and 200 ppm 8-hydroxy quinoline citrate. In the case of cold-stored stems, they were recut before placing in vase solution.

Measurements

1- 1-Evaluations weight loss % at end all storage duration.
2- The longevity of cut leaves was defined as the number of days in vase life required for more 20% of the leaf area was yellow.
3- Water uptake was determined by weighing the jars with and without the leaves every two days.
4- The percentage of fresh weight during vase life.
5- Leaves color changes during the vase life was estimated by a Hunter colorimeter type (Dp-9000) for the estimation of "L", "a" and "b" values and to evaluate color values as hue angle as described by (McGuire, 1992).
6- Chlorophyll and carotenoids were determined in leaves colorimetrically according to Saric *et al.*, (1967).
7- Total sugars content in leaves were determined colorimetrically according to the methods described by Dubois *et al.*, (1956)

Layout of the experiment: was completely randomized design in factorial experiment containing 12 treatments (4 pulsing solutions x 3 storage durations). Each treatment was repeated three times. The jar contained 300 ml of preservative solution and three leaves, i.e. 9 leaves per treatment.
The obtained data were statistically analyzed according to Snedecor and Cochran (1982) and means were compared by New Less Significant Difference (L.S.D) test at the 5% level of probability in the two seasons.

RESULTS AND DISCUSSION

Effect of gibberellic acid and citrsol postharvest treatments and cold storage duration and their interaction on *Fatsia japonica* leaves.

1- The longevity of cut leaves (days):

Data in Table (1) show that the percentages of leaves treated with GA_3 and citrosol significantly increased the longevity of leaves than those of the control in both seasons. The leaves treated with 100 ppm GA_3 + 0.1% tween 20 remained for (19.82 and 21.28 days in the first and second seasons, respectively) followed by citrosol (17.59 and 18.95 days in the first and second seasons, respectively). These results are in agreement with Amin (2006) on some cut foliage, who found that GA_3 application at 50 ppm was the most effective in increasing the shelf life. Regarding the effect of storage periods, it could be noticed that storage for 0 week had the longest vase life (18.55 and 20.04 days in the first and second seasons, respectively) followed by one week storage treatment (17.72 and 18.04 days in the first and second seasons, respectively) compared to two weeks storage treatment (13.89 and 13.78 days in the first and second seasons, respectively) and the differences were significant. The interaction between (postharvest treatment x storage periods) as shown in Table (1) indicate that spraying treatment of 100 ppm GA_3 + 0.1% Tween 20 followed by citrosol led to the highest increase in the

longevity along storage periods with its maximum at 0 week(without storage) compared to the other treatments in both seasons. These results coincided with the findings of Ranwala and Miller (2002) on cut Hybrid Lilies found that gibberellin treatments increased flower longevity of cold stored stems in a similar fashion that was observed in non- cold stored stems. Wasker et al. (1999) on pomegranate indicated that best results were obtained with wax containing carbendazm which maintained shelf life of pomegranate for up to 48 days in the cool chamber and 30 days at room temp.

Table (1): Effect of gibberellic acid and citrosol postharvest treatment and cold storage duration at 5°c on longevity of *Fatsia japonica* leaves during the two seasons (2006 & 2007).

	First season					Second season				
St. per.	Treatments									
	1	2	3	4	Means	1	2	3	4	Means
0 week	14.0	19.2	19.3	21.7	18.55	13.4	20.3	22.7	23.8	20.04
2 weeks	13.0	18.5	18.6	20.8	17.72	11.0	19.5	20.0	21.7	18.04
3 weeks	9.6	14.2	14.8	17.0	13.89	8.8	13.8	14.2	18.3	13.78
Means	12.18	17.29	17.59	19.82		11.04	17.89	18.95	21.28	
L.S.D. Values at 5% level:-										
Factors	T.		St. Per.		Int.	T.		St. Per.		Int.
L.S.D Values	1.45		1.25		2.51	1.54		1.33		2.66

1= Control (distilled water)	2 = 100 ppm GA_3
3 = Citrosol	4 = 100 ppm GA_3 + 0.1% Tween 20
T. = Treatments	St. Per. = Storage period
Int. = Interactions	

2- Water uptake:

The data concerning the effect of postharvest treatments and storage periods and their interaction on water uptake are presented in Table (2). These data reveal that spray treatment of 100 ppm GA_3 + 0.1% Tween 20 was more effective on the water uptake than the other treatments and the differences were significant in both seasons. Generally all pretreatments significantly increased the water uptake compared to control in both

seasons. Regarding the effect of storage periods, it can be observed from Table (2) that 0 week and 1 week were the best storage periods for water uptake compared to 2 weeks storage and the differences were significant in both seasons. The interaction between postharvest treatments and storage periods as shown in Table (2) show that spray treatment of 100 ppm GA_3 + Tween 20 followed by citrosol was the best treatments for obtaining the highest water uptake in the different storage periods as compared to the other treatments in both seasons. The above mentioned results are in agreement with Amin (2006) on some cut foliage mentioned that 25 ppm GA_3 improved water uptake.

Table (2): Effect of gibberellic acid and citrosol postharvest treatment and cold storage duration at 5°c on water uptake of Fatsia japonica leaves during the two seasons (2006 & 2007).

	First season					Second season				
St. per.	Treatments									
	1	2	3	4	Means	1	2	3	4	Means
0 week	98.8	115.0	117.7	125.0	114.1	108.3	119.0	130.5	127.5	121.3
2 weeks	65.0	85.0	90.8	115.0	89.0	61.7	90.5	96.5	120.5	92.3
3 weeks	43.0	67.8	70.0	90.5	67.8	35.0	58.3	61.3	95.3	62.5
Means	68.9	89.3	92.8	110.2		68.3	89.3	96.1	114.4	

L.S.D. Values at 5% level:-

Factors	T.	St. Per.	Int.	T.	St. Per.	Int.
L.S.D Values	2.90	2.51	5.03	4.95	4.28	8.57

1= Control (distilled water)	2 = 100 ppm GA_3
3 = Citrosol	4 = 100 ppm GA_3 + 0.1% Tween 20
T. = Treatments	St. Per. = Storage period
Int. = Interactions	

3- The percentage of leaves fresh weight:

It can be indicated from Table (3) that all postharvest treatments significantly enhanced the percentage of fresh weight of leaves in vases than those in control in both seasons. However, spray treatment of 100 ppm GA3+ 0.1% Tween 20 gained more weight (4.56 and 4.17 % in the first and second seasons, respectively) than the other treatments and the differences were

significant in both seasons. Concerning the effect of storage periods, it can be observed from Table (3) that storage for 0 week and 1 week significantly enhanced the percentage of fresh weight of leaves placed in vases after storage compared to 2 weeks storage in both seasons. This decrease in the percentage of fresh weight of leaves may be due to water loss by increasing storage duration. So 1 week storage was preferential than 2 weeks storage. Regarding the interaction between postharvest treatments and storage periods, it can be noticed that all postharvest treatments with leaves storage for 0 week followed by 1 week increased the percentage of leaves fresh weight compared to 2 weeks storage. However, the most effective treatment in this regard was the spray treatment of 100 ppm GA3+ Tween 20 x storage for 0 week and 1 week compared to the other treatments in both seasons. These results are in harmony with the findings of Rekha et al., (2002) on gladiolus found that sucrose + GA3 increased fresh weight. El-Saka and Auda (1997) on Hippeastrum vittatum showed that four weeks storage were less efficiency than two weeks for fresh weight increase.

Table (3): Effect of gibberellic acid and citrosol postharvest treatment and cold storage duration at 5°c on fresh weight increase of *Fatsia japonica* leaves during the vase life during the two seasons (2006 & 2007).

	First season					Second season				
St. per.	Treatments									
	1	2	3	4	Means	1	2	3	4	Means
0 week	2.4	4.2	4.3	5.9	4.19	2.5	4.0	4.8	6.1	4.36
2 weeks	2.0	3.2	3.4	4.6	3.29	1.9	3.0	3.8	5.0	3.42
3 weeks	1.1	2.0	2.1	3.2	2.09	1.0	1.9	2.0	3.0	1.99
Means	1.82	3.11	3.28	4.56		1.81	2.98	3.52	4.71	

L.S.D. Values at 5% level:-

Factors	T.	St. Per.	Int.	T.	St. Per.	Int.
L.S.D Values	0.96	0.84	1.67	0.97	0.84	1.68

1= Control (distilled water)	2 = 100 ppm GA_3
3 = Citrosol	4 = 100 ppm GA_3 + 0.1% Tween 20
T. = Treatments	St. Per. = Storage period
Int. = Interactions	

4- Leaves color:

According to data recorded in Table (4) it is obvious that color changed directly during vase life from dark green (hue angle is more than 120) to light green (hue angle is less than 120). Moreover, it is clear that all postharvest applications significantly reduced leaves color changing during vase life compared to control which means that leaves were still more fresh. Furthermore data indicate that pulsing treatment with 100 ppm GA_3 or spray treatment with 100 ppm GA_3 + 0.1% Tween 20 significantly reduced leaves color deterioration during vase life compared to other treatments in both seasons. Moreover, these treatments reduced leaves color deterioration during storage in both seasons. Data also state that 2 weeks storage at 5°C significantly accelerated leaves color changing during vase life in the two seasons. The best leaves color (122.2 and 123.0) in the first and second seasons, respectively was achieved by treated leaves with100 ppm GA_3 +0.1% Tween 20 without storage (0 week), while the poorest leaves color (113.2 and 113.6 in the first and second seasons, respectively) was achieved by storage leaves for two weeks without prestorage treatment (control).

Table (4): Effect of gibberellic acid and citrosol postharvest treatment and cold storage duration at 5°c on colour (represented as hue angle) of Fatsia japonica leaves during the vase life during the two seasons (2006 & 2007).

	First season					Second season				
St. per.	Treatments									
	1	2	3	4	Means	1	2	3	4	Means
0 week	117.7	121.3	119.7	122.2	120.2	118.4	121.8	120.5	123.0	120.9
2 weeks	116.0	120.0	117.2	122.1	118.8	116.3	119.5	118.0	122.5	119.1
3 weeks	113.2	119.3	115.5	120.6	117.2	113.6	118.4	115.8	120.7	117.1
Means	115.6	120.2	117.5	121.6		116.1	119.9	118.1	122.1	

L.S.D. Values at 5% level:-

Factors	T.	St. Per.	Int.	T.	St. Per.	Int.
L.S.D Values	1.86	1.61	3.21	2.05	1.78	3.56

1= Control (distilled water)	2 = 100 ppm GA_3
3 = Citrosol	4 = 100 ppm GA_3 + 0.1% Tween 20
T. = Treatments	St. Per. = Storage period
Int. = Interactions	

5-Leaves weight loss percentage during dry cold storage at 5°C:

The data in Fig. (1) indicate that the leaves pretreated with postharvest treatments showed the lowest percentage of loss in fresh weight of leaves compared to control. However, the most effective treatment in this respect was the spray treatment of 100 ppm GA_3 + 0.1% Tween 20 in both seasons. Regarding the effect of storage periods, it can be concluded from Fig. (1) that increasing cold storage periods from 1 to 2 weeks increased the percentage of loss in fresh weight of leaves in both seasons. The results of interaction (postharvest treatments x storage periods) show that the least percentage of weight loss was achieved with the spray treatment of 100 ppm GA_3 + 0.1% Tween 20 along cold storage periods with its maximum at 1 week in both seasons. These results are in agreement with Khenizy (2000) on *Dianthus caryophyllus* who found that weigh loss percentage increased with extending storage period up to 40 days.

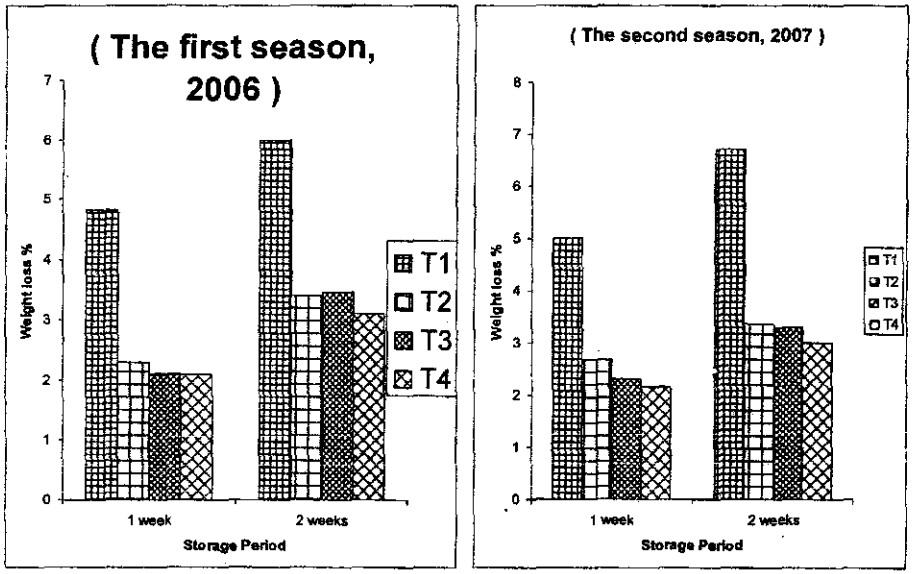
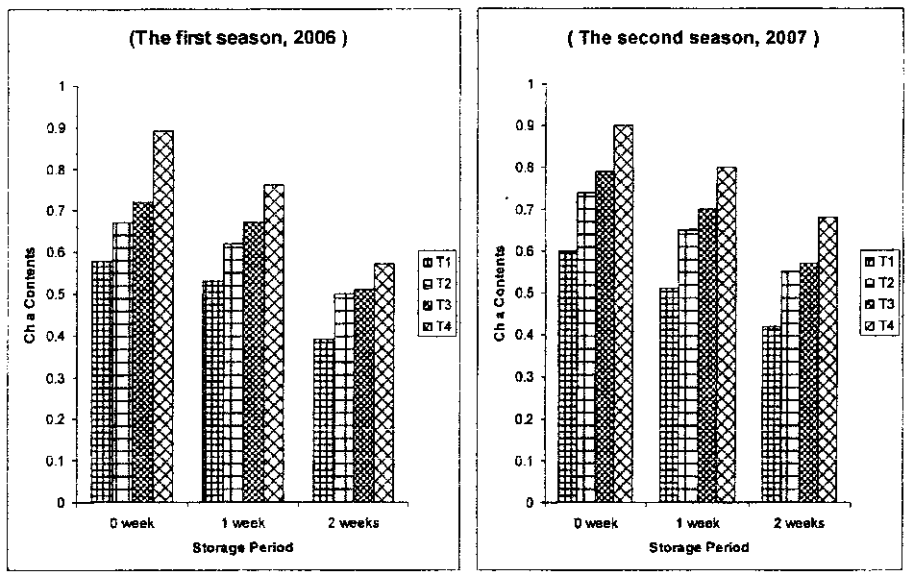


Figure (1): Effect of gibberllic acid and citrosol postharvest treatment and cold storage duration at 5°c on weight loss percentage of cut Fatsia japonica leaves during the two seasons (2006 and 2007).

6- Chlorophyll and caroteniods content in leaves:

Data presented in Fig (2,3 and 4) indicate that spray treatment of 100 ppm GA_3 + 0.1% Tween 20 gave the highest level of chlorophyll a and b as compared to the other treatments in both seasons. On the other hand,

control treatment gave the highest level of caroteniods compared to other treatments in both seasons. Regarding the effect of storage periods, it can be concluded from Fig (2,3 and 4) that the leaves were stored for different periods (0,1 and 2 weeks) recorded a continuous decrease in chlorophyll a and b and an increase in caroteniods content with the prolonging of storage periods. The interaction between postharvest treatments and storage periods, it can be recorded that chlorophyll a and b was decreased and caroteniods increased with extended storage periods up to 2 weeks in all postharvest treatments in both seasons. Spray treatment of 100 ppm GA_3 + 0.1% Tween 20 and stored for 0 or 1 week improved chlorophyll contents as compared to other treatments in the two seasons. These results are in agreement with Byum et al., (2004) on cut *Lilium longiflorum* pointed out that combination of GA_3 and BA at 25 mg/liter was very effective for the inhibition of leaf yellowing, the chlorophyll content was maintained for along time compared with the control.



T1 = Control (distilled water)	T2 = 100 ppm GA_3
T3 = Citrosol	T4 = 100 ppm GA_3 + 0.1% Tween 20

Figure (2): Effect of gibberllic acid and citrosol postharvest treatment and cold storage duration at 5°c on Clorophylle a contents of cut *Fatsia japonica* leaves during the two seasons (2006 and 2007).

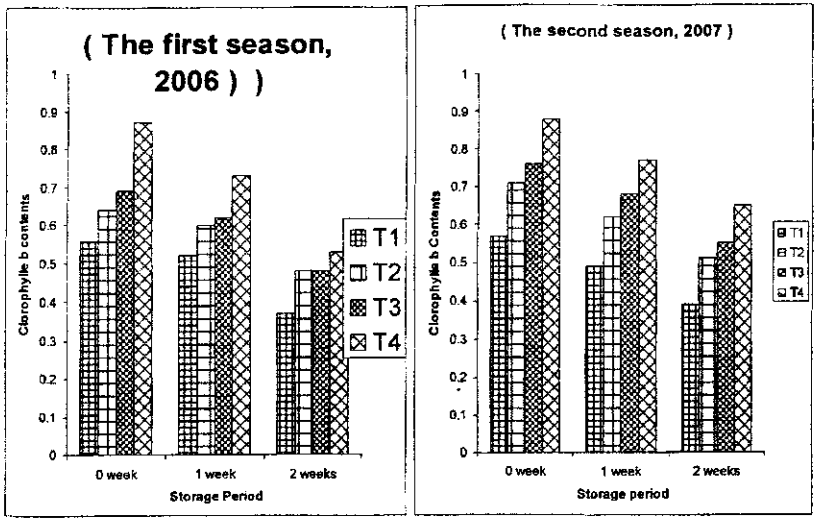
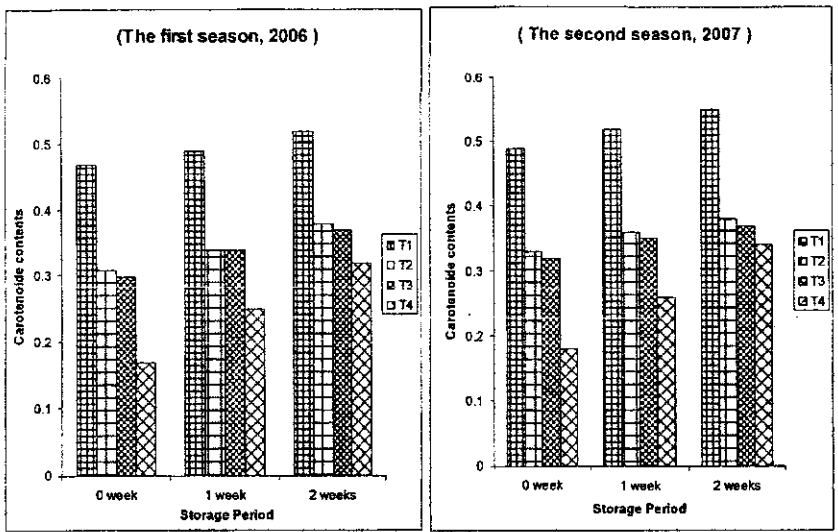


Figure (3): Effect of gibberllic acid and citrosol postharvest treatment and cold storage duration at 5°c on Clorophylle b contents of cut Fatsia japonica leaves during the two seasons (2006 and 2007).

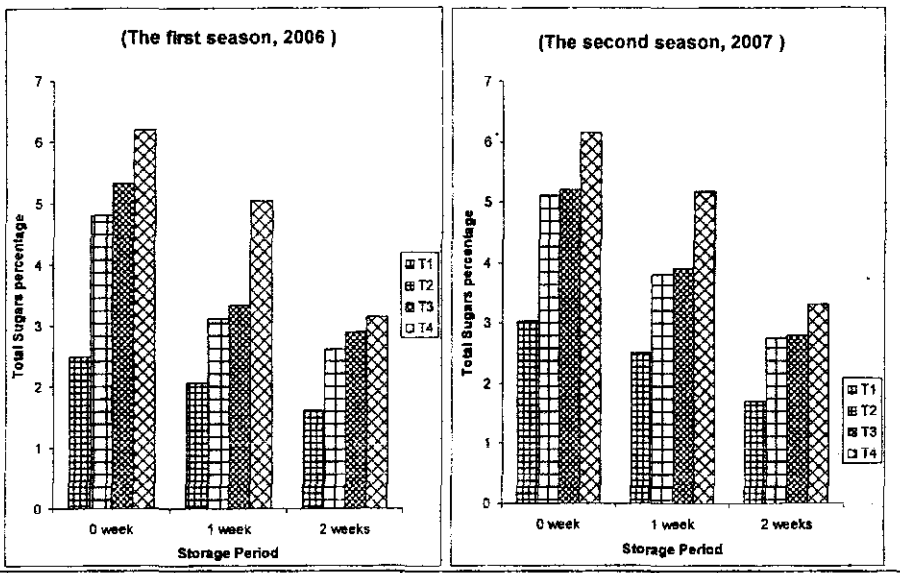


T1 = Control (distilled water)	T2 = 100 ppm GA_3
T3 = Citrosol	T4 = 100 ppm GA_3 + 0.1% Tween 20

Figure (4): Effect of gibberllic acid and citrosol postharvest treatment and cold storage duration at 5°c on Carotenoids contents of cut Fatsia japonica leaves during the two seasons (2006 and 2007).

7- Total sugars percentage in leaves:

Data in Fig (5) state that control gave the least value in total sugars percentage in leaves compared to the other treatments in the two seasons. The spray treatment of 100 ppm GA_3+ 0.1% Tween 20 recorded the highest value in total sugars percentage as compared to other treatments in both seasons. As for the storage periods, it is clear that the storage periods for 0 week had the highest value in the percentage of total sugars followed by storage for 1 week compared to the storage for 2 weeks in the two seasons. The interaction effects (postharvest treatments x storage periods) show that the spray treatment of 100 ppm GA_3 + 0.1% Tween 20 then stored for 0 week or 1 week were the best treatments for obtaining the highest percentage of total sugar in leaves compared to the other treatments in two seasons. The above mentioned results coincided with Khenizy (2004) on *Gladiolus sp* cv. Manhattan found that spikes placed in preservatives solution consisting of GA_3 improved total sugars percentage.



T1 = Control (distilled water)	T2 = 100 ppm GA_3
T3 = Citrosol	T4 = 100 ppm GA_3 + 0.1% Tween 20

Figure (5): Effect of gibberllic acid and citrosol postharvest treatment and cold storage duration at 5°c on Total Sugars percentage of cut Fatsia japonica leaves during the two seasons (2006 and 2007).

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تأثير المعاملة بالجبرالين وبعض مثبطات النتح و معاملات ما بعد الحصاد على جودة أوراق الفاتسيا المقطوفة

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الملخص العربي

أجرى هذا البحث فى معمل بحوث تداول الزينة بمعهد بحوث البساتين خلال موسمى ٢٠٠٦-٢٠٠٧ وذلك بهدف دراسة استجابة أوراق الفاتسيا المقطوفة للجبرالين والسيتروزول وفترات التخزين ولمعرفة التغييرات الفسيولوجية الحادثة للأوراق كاستجابة لهذه المعاملات. تم قطف الأوراق فى مرحلة النضج ثم غمست قواعد الأوراق لمدة ٢٠ ساعة فى كل من الماء المقطر أو الجبرالين بتركيز ١٠٠ جزء فى المليون ، مجموعة أخرى من الأوراق تم رشها بالجبرالين بتركيز ١٠٠ جزء فى المليون أو السيتروزول. بعد المعاملات مجموعة من الأوراق تم وضعها فى معمل التداول (بدون تخزين) والمجموعة الأخرى تم تخزينها على درجة ٥م° لمدة أسبوع ، أسبوعين وذلك قبل نقلها الى معمل التداول. فى معمل التداول تم وضع الأوراق فى محلول الفازة والذى يتكون من ٢% سكروز ، ٢٠٠ جزء فى المليون ٨- هيدروكسى كينولين سترات. وأهم النتائج التى تم الحصول عليها كانت كالتالى:

تاثير معاملات ما بعد الحصاد :

بصفة عامة معاملات الجبرالين أطالت فترة حياة الأوراق وقللت إصفرار الأوراق.

معاملة الرش بالجبرالين بتركيز ١٠٠ جزء فى المليون يليها معاملة الرش بالسيتروزول كانت أكثر فعالية فى إطالة فترة حياة الأوراق ، وزيادة امتصاص المحلول وقللت استنزاف السكريات والصبغات فى الأوراق بالمقارنة بالمعاملات الأخرى.

تاثير معاملات التخزين:

التخزين البارد للأوراق أسرع من اصفرار الأوراق وقلل فترة حياتها (خاصة مع التخزين لمدة أسبوعين).

تأثير التفاعل بين معاملات ما بعد الحصاد وفترة التخزين:

معاملة الرش بالجبرالين بتركيز ١٠٠ جزء فى المليون يليها معاملة الرش بالسيتروزول قللت اصفرار الأوراق وزودت فترة حياتها وذلك بالنسبة للأوراق المخزنة تخزين بارد وذلك بطريقة مشابهة للأوراق التى لم يتم تخزينها تخزين بارد.