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EFFECT OF FOLIAR SPRAYING OF GIBBERELLIC ACID AFTER HARVEST ON APRICOT "CANINO" FRUIT YIELD AND QUALITY

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ABSTRACT

Foliar spraying of gibberellic acid (GA_3) after harvest (picking) at different concentrations (10, 25, 50 and 100 ppm) and at two dates (July 1st and 15th) on apricot "Canino" trees , 5 years old grown in new reclaimed sandy soils. All treatments were performed for two successive seasons of 2005-2006 and 2006-2007.

Foliar spraying of GA_3 at 10, 25 and 50 ppm and at both dates of July 1st and 15th after picking increased significantly yield/tree (kg) for both seasons following applications as compared to the control (unsprayed). All the concentrations of GA_3 at the two dates of spraying after picking increased significantly shoot length and fruit weight as compared with the control in the two seasons of the study. Generally, the chemical characteristics of fruits from treated trees did not differ significantly as compared with the untreated control.

INTRODUCTION

Apricot planted area in Egypt was 4785 Feddan in 1980 and reached 20971 Feddans in 2005 (Ministry of Agriculture Statistics). Apricot "Canino" cultivar is newly introduced producing high yield in new reclaimed lands.

There are three important actions (mode of actions) for gibberellic acid (GA). The first that GA intensifies an organ ability to function as a nutrient sink. A second action is the ability of GA to increase the synthesis of IAA in plant tissues. The third action involves accelerating synthesis of hydrolytic enzymes as amylase and other hydrolytic enzymes in aleurone cell (Addicott and Addicott, 1982).

Flowering and fruiting in "Patterson" apricot trees as affected by post-harvest application of gibberellic acid were noticed by Southwick, et al. (1995 b) who used GA_3 at 10, 50 and 100 ppm as post-harvest foliar application in July or August (approximately 2 or 6 weeks, respectively, after fruit picking). GA_3 foliar spraying at 50 and 100 ppm applied in early July (before flower bud induction) reduced flower number per centimeter of limb circumference in the year following treatment and that eliminate the need for chemical or hand fruit thinning . Fruit set was not affected by GA_3 sprays at 10,50 and 100 ppm. They added that individual fruit weight (size) was increased by GA_3 sprays of 50 and 100 ppm in July as compared to hand thinned trees.

The saleable yield of peach fruit (season 1994) was increased by GA_3 sprays of 50 and 75 mg/1 applied on 9 July 1993 compared to controls (Southwick, *et al.* 1995 b) they added that there were no differences in peach fruit size (by weight or diameter) among the gibberellic acid treatments and hand thinning.

There was a strong trend for GA_3 June sprays at 25- 50 ppm to minimize the total flower bud density (buds/cm shoot) of unbranched shoots on mature 'Redhaven' and 'Cresthaven' trees (Taylor and Taylor. 1998).

Also, García-Pallas, *et al.* (2001) working on 'Crimson Gold' nectarine found that flowering was slightly delayed by the post harvest GA_3 treatments, but no differences in ripening were detected at harvest, this depending rather on fruit size. They added that the yield obtained by the application of 200 mg/l GA_3 corresponded to that obtained with a very good thinning level, as established by hand thinning. No secondary effects on vegetative growth followed either the application of GA_3 or the reductions in crop load by means of hand thinning.

Recently, Lenahan , *et al.* (2006) stated that GA_3 shows potential as a novel crop load management tool in productive 'Bing' sweet cherry orchard systems. They noted that gibberellic acid Inhibits floral bud induction and improves 'Bing' sweet cherry fruit quality. GA_3 was effective than GA_{4+7}. Also, GA_3-treated `Redhaven' peach trees at 13 weeks after full bloom inhibited flowering and had larger mean fruit size and improved fruit size distribution the year after GA_3 application. GA_3 application timing significantly increased overall tree growth measured by the changes in trunk cross-sectional area (Coneva and Cline, 2006). In addition, the application of gibberellic acid at 50 – 75 ppm during flower bud induction significantly reduced flowering of 'Black Diamond' and 'Black Gold' Japanese plums, and increased final fruit weight. This partial inhibition of flowering significantly reduced the cost of manual thinning (González-Rossia *et al.*, 2006). More over, Peach and nectarine trees treated with two applications of 50 and 100 mg/L yielded fruit with 7% and 12% higher soluble solids, 15 and 20% higher firmness, and 7 and 14% greater weight, respectively. Concentrations of 0.5 or 1.0 g/ tree of gibberellic acid reduce flowering by about 50% in both peaches and nectarines, respectively, and it gives rise to a reduction of costs of hand thinning by 50%, approximately, without affecting the yield (González-Rossia, *et al.* 2007). They found that fruit color was advanced, total soluble solids concentration and fruit firmness were increased as a result of treatments, and the effect was higher in the basal part of the shoots and reduced from the base to the apical part.

The aim of the present investigation is to study the effect postharvest (after picking) foliar spraying of different concentrations and times of GA_3 on fruit set, yield and quality of apricot "Canino" cultivar during 2005-2006 and 2006-2007 seasons.

MATERIALS AND METHODS

The present work was conducted during the two successive seasons of 2005-2006 and 2006-2007 on "Canino' apricot cultivar trees of 6 years old grafted onto seedlings of apricot rootstock, grown in new reclaimed sandy soil in private orchard and drip irrigated by river Nile water. Chosen trees were nearly uniform, planted at 5 x 5 meters apart and subjected to similar orchard management and the produced fruits were not thinned . Eight foliar applications of GA_3 beside the control or untreated trees were used (27

trees for all treatments), three trees were chosen for each treatment, one tree for each replicated. The following concentrations and treatments were foliar sprayed after post-harvest (after picking) :

1) 10 ppm GA_3 on July 1st.
2) 25 ppm GA_3 on July 1st.
3) 50 ppm GA_3 on July 1st.
4) 100 ppm GA_3 on July 1st.
5) 10 ppm GA_3 on July 15th.
6) 25 ppm GA_3 on July 15th.
7) 50 ppm GA_3 on July 15th.
8) 100 ppm GA_3 on July 15th.
9) Control (sprayed with tap water).

Fruit set percentages were calculated. At fruit maturity, number of fruits/tree was calculated and Yield (Kg/tree) was determined by multiply number of fruits/tree x the average fruit weight. Samples of twenty fruits from each replicate were taken to determine the following characteristics:

Average fruit weight (gm).
Average fruit volume (ml).
Average fruit diameter (cm).
Average fruit length (cm).
Average of fruit firmness (lb/Inch^2) was estimated by Magnese-Tylor pressure tester.
Total soluble solids (TSS) of fruit juice were estimated by using hand refractometer.
Total acidity (%) was calculated as gm malic acid/100 g. fresh weight (A.O.C.A., 1995).

After picking (the season after spraying) average shoot length (cm) and number of leaves/shoot were calculated. Also, the leaf area of twenty mature leaves for each replicate was measured using a planimeter according to Nautigual *et al.* (1990).

Statistical analysis:

The collected data were subjected to the proper statistical analysis of complete randomized block design according to the method described by Snedecor and Chochran (1990) and L.S.D. test at 0.05 level was used for comparison between means of treatments.

RESULTS AND DISCUSSION

Fruit set:

Fruit set values as affected by GA_3 post-harvest foliar spraying at different concentrations and two dates are shown in Fig. (1). In the first season, three treatments of GA_3 at 25 ppm on July 1st, on July 15th and 50 ppm on July 15th increased significantly fruit set as compared to the control, but in the second season, only one treatment of GA_3 at 25 ppm on July 15th increased significantly fruit set as compared with the control. The differences between the other treatments were not significant as compared with the control. The highest values of fruit set (24.37 and 25.23%) were recorded by GA_3 at 25 ppm on July 15th treatment as compared with the

lowest values of the control (18.97 and 18.97%), in the first and second seasons, respectively.

The present results by spraying G A_3 concentrations except the concentration of 25 ppm at July 15th in the two seasons of the study are in harmony with Southwick, *et al.* (1995) who used GA_3 at 10, 50 and 100 ppm as post-harvest spraying on "patterson" apricot trees and stated that fruit set was not affected by GA sprays.

Fruit number/tree:

Results in Fig. (2) clear out the effect of GA_3 post-harvest foliar spraying at different concentrations and two dates on fruit number/tree. Two treatments of GA_3 GA_3 at 25 ppm on July 1st and 15th increased significantly fruit number/tree as compared with the control in the two seasons of study. On the other hand the two treatments of spraying GA_3 at 100 ppm on July 1st in the two seasons or at 100 ppm in the first season only on July 15th decreased significantly the number of fruits/tree where they recorded 691, 728.3 and 800, respectively as compared with the control (950 and 1034 fruits/tree) in the first and second season, respectively. The highest number of fruits (1117 and 1517 fruits/tree) was obtained as a result of spraying GA_3 at 25 ppm on July 15th in the first season and second season, respectively as compared with the control (950 and 1034 fruits/tree). The other concentrations of GA_3 and dates treatments had no effect as regard fruit number. The concentration of GA_3 and dates play an important role in this respect.

The present results are corresponding with the previous work of Southwick, et al. (1995) on apricot and of González-Rossia, et al.(2006, on plum and 2007, on peach and nectarine).

Fruit yield:

Fruit yield/tree values as affected by GA_3 post-harvest foliar spraying at different concentrations and two dates are obvious in Fig. (3). The concentrations of GA_3 at 10, 25 and 50 ppm and at both dates of July 1st and 15th increased significantly yield/tree (kg.) as compared to the control (unsprayed). The high concentration of GA_3 at 100 ppm in both dates of July 1st and July 15th spraying did not gave the same trend in the two seasons of the study, where 100 ppm spraying on July 1st decreased yield in the first season and gave no effect on the second season, and 100 ppm spraying on July 15 gave no significant effect on the 1st season and increased the yield in 2nd season as compared with the control. The highest yield/tree values (37.47 and 43.83 Kg/tree) were obtained by GA_3 at 25 ppm on July 15th on the first season and GA_3 at 25 on July 1st in the second season, respectively as compared with the control (29.27 and 28.60 Kg/tree).

The present results are in harmony with the previous work of Southwick, et al. (1995 b) on apricot and peach and of González-Rossia, *et al.*(2006, on plum and 2007, on peach and nectarine).

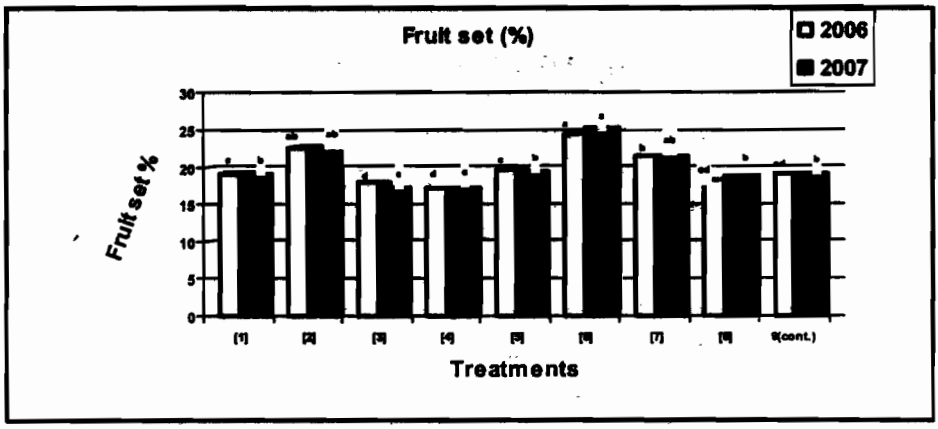

Fig. (1): Effect of post-harvest foliar spraying of gibberellic acid on apricot "Canino" fruit set during 2005-2006 and 2006-2007 seasons. Means within the similar color columns having the same letters are not statistically significant.

1) 10 ppm GA_3 on July 1st.
2) 25 ppm GA_3 on July 1st.
3) 50 ppm GA_3 on July 1st.
4) 100 ppm GA_3 on July 1st.
5) 10 ppm GA_3 on July 15th.
6) 25 ppm GA_3 on July 15th.
7) 50 ppm GA_3 on July 15th.
8) 100 ppm GA_3 on July 15th.
9) Control (unsprayed).

Fruit physical characteristics:

Results in Table (1) illustrate the effect of GA_3 post-harvest foliar spraying at different concentrations and two dates on number of apricot fruits/Kg, fruit weight (g), fruit volume (ml),fruit dimensions (cm) and fruit firmness (lb/Inch^2). All the treatments of GA_3 reduced the fruit number/Kg as compared with the control. However, the statistical significant reductions in fruit number/Kg were obtained by 100 ppm GA_3 on July 1st, 10 ppm GA_3 on July 15th, 25 ppm GA_3 on July 15th, 50 ppm GA_3 on July 15th and 100 ppm on July 15th in the first season and all concentrations in the second season except the low concentration of 10 ppm GA_3 on 1st and 15th July seasons of the study as compared with the Control (unsprayed). The spraying of 50 ppm GA_3 on July 1st obtained significant reduction in the second season only. Reduction of fruit number/Kg means good quality of fruits. All the treatments of GA_3 at all concentrations and on the two dates of spraying increased significantly fruit weight as compared with the control in the two seasons of the study. The highest significant fruit weights (36.67 and 30.20 g) were obtained by spraying of GA_3 at 100 ppm on July 15th and 1st July in the 1st and 2nd season, respectively as compared with the control (31.87 and 24.30 g). The fruit volume values as affected by different GA_3 concentrations on the two dates take the same trend as fruit weight. As regard fruit dimensions (diameter and length), the treatments of spraying GA_3 at 100 ppm on July 1st July 1st and 15th increased significantly fruit diameter and length in the two seasons of the study as compared with the control.

Table (1): Effect of post-harvest foliar spraying of gibberellic acid on apricot "Canino" fruit physical characteristics during 2005-2006 and 2006-2007 seasons.

Treatments	No. of fruits/Kg		Fruit weight (g.)		Fruit volume (ml)		Fruit diameter (cm)		Fruit length (cm)		Fruit firmness ($lb/Inch^2$)	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
10 ppm GA_3 on July 1st.	31.43 a	39.80 ab	32.60 b	26.27 b	33.33 ab	28.33 b	3.67 b	3.68 b	3.71 ab	3.6 8 ab	7.74 a	7.72 b
25 ppm GA_3 on July 1st.	30.54 ab	34.73 b	32.80 b	28.83b	34.17 ab	30.33 b	3.72 b	3.73 b	3.78 ab	3.79 b	7.91 a	7.94 ab
50 ppm GA_3 on July 1st.	30.36 ab	33.27 c	32.97 b	30.10 a	35.00 ab	33.00 a	3.83 a	3.81 b	3.87 a	3.88 ab	7.27 a	7.28 b
100 ppm GA_3 on July 1st.	30.27 b	32.57 c	33.13 b	30.20 a	35.00 ab	33.33 a	3.85 a	3.87 a	3.87 a	3.91 a	7.32 a	7.34 b
10 ppm GA_3 on July 15th	29.98 bc	38.57 ab	33.67 b	26.00 b	32.67 b	27.67 b	3.64 b	3.63 b	3.63 b	3.68 b	7.78 a	8.08 a
25 ppm GA_3 on July 15th	29.88 bc	36.00 b	33.73 b	27.80 b	33.33 ab	27.67 b	3.72 b	3.70 b	3.65 b	3.68 b	7.93 a	8.93 a
50 ppm GA_3 on July 15th	29.27 bc	34.97 c	34.53 b	29.20 ab	35.67 ab	30.00 ab	3.77 b	3.73 b	3.70 ab	3.74 ab	7.87 a	8.21 a
100 ppm GA_3 on July 15t	27.38 c	33.83 c	36.67 a	29.67 a	37.67 a	31.67 a	3.87 a	3.88 a	3.87 a	3.93 a	7.19 a	7.18 b
Control (unsprayed)	31.43 a	41.27 a	31.87 c	24.30 c	32.00 c	26.00 c	3.56 b	3.56 b	3.57 b	3.58 b	7.34 a	7.30 b

Means separation within column having the same letter are not statistically significant.

As regard to fruit firmness (lb/Inch^2), all treatments did not differ significantly than the control in the first season, however, in the second season the concentrations of GA_3 at 10, 25 and 50 ppm on July 1st only increased significantly fruit firmness as compared with the control and the remained treatments recorded insignificant differences.

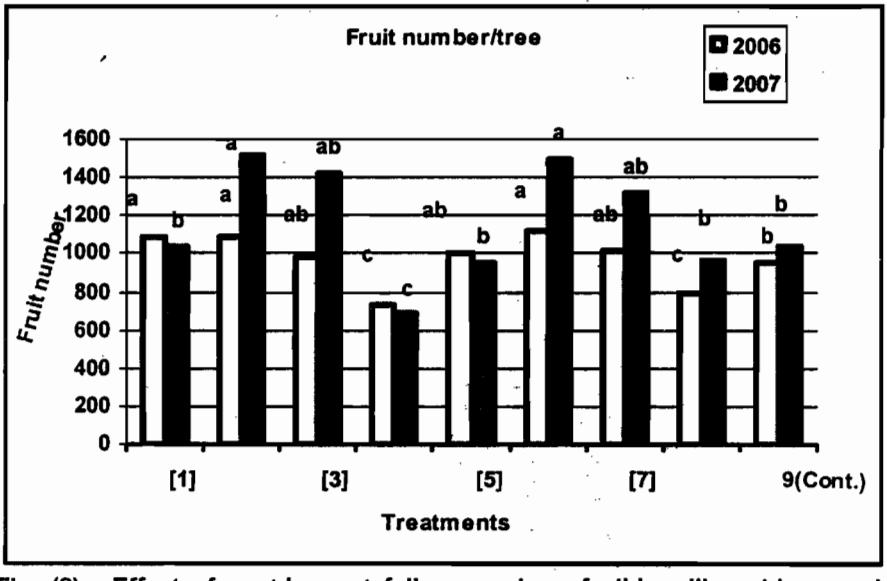

Fig. (2): Effect of post-harvest foliar spraying of gibberellic acid on apricot "Canino" fruit number/tree during 2005-2006 and 2006-2007 seasons. Means within the similar color curves having the same letters are not statistically significant.

1) 10 ppm GA_3 on July 1st.
2) 25 ppm GA_3 on July 1st.
3) 50 ppm GA_3 on July 1st.
4) 100 ppm GA_3 on July 1st.
5) 10 ppm GA_3 on July 15th.
6) 25 ppm GA_3 on July 15th.
7) 50 ppm GA_3 on July 15th.
8) 100 ppm GA_3 on July 15th.
9) Control (unsprayed).

The present results are in line with the previous results of Southwick, *et al.* (1995) on apricot who found that individual fruit weight or size was increased by GA_3 sprays of 50 and 100 ppm in July as compared to hand thinned trees. Also, González-Rossia, *et al.* (2007) on peach and nectarine agree with the present results .

Fruit chemical characteristics:

The effects of GA_3 post-harvest foliar spraying at different concentrations and two dates on TSS (%), acidity (%) and TSS/acid ratio are shown in Table 2. TSS (%) values resulted from all the treatments of GA_3 at all concentrations (10, 25, 50 and 100 ppm) and on the two dates (July 1st

and July 15th) of spraying except the treatment of GA_3 at 10 ppm on July 15th in the second season did not differ significantly than the control in the two seasons of the study. As regard to total acidity (%), all the treatments of GA_3 at all concentrations (10, 25, 50 and 100 ppm) and on the two dates (July 1st and July 15th) recorded insignificant differences as compared with the control in the two seasons of the study. TSS/acid ratio values were different from season to season, all the treatments except the treatments of GA_3 at 25 ppm on 15th July in the first seasons and on July 1st in the second season did not differ significantly than the control in the two seasons of the study.

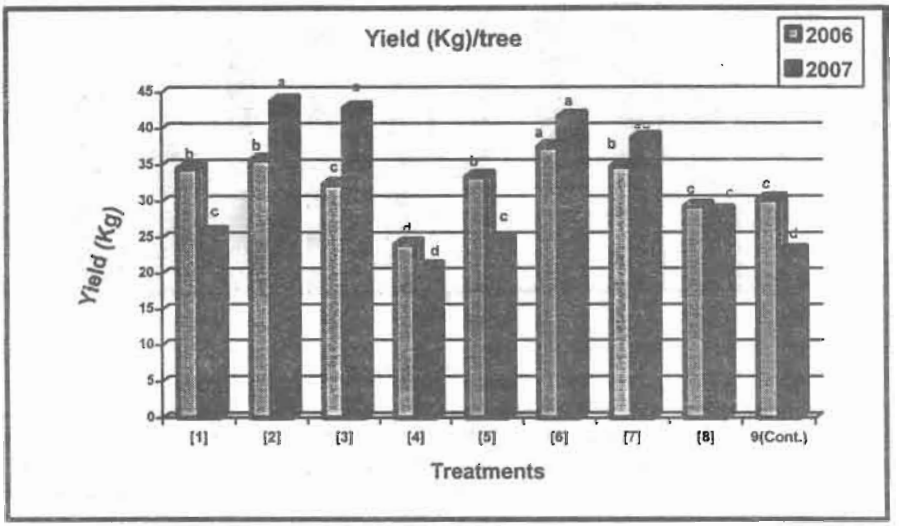

Fig. (3): Effect of post-harvest foliar spraying of gibberellic acid on apricot "Canino" yield (Kg)/tree during 2005-2006 and 2006-2007 seasons. Means within the similar color columns having the same letters are not statistically significant.

1) 10 ppm GA_3 on July 1st.
2) 25 ppm GA_3 on July 1st.
3) 50 ppm GA_3 on July 1st.
4) 100 ppm GA_3 on July 1st.
5) 10 ppm GA_3 on July 15th.
6) 25 ppm GA_3 on July 15th.
7) 50 ppm GA_3 on July 15th.
8) 100 ppm GA_3 on July 15th.
9) Control (unsprayed).

Vegetative growth :

Results in Table (3) show the effect of GA_3 post-harvest foliar spraying at different concentrations and two dates on vegetative growth (shoot length, number of leaves/shoot and leaf area) during 2005-2006 and 2006-2007 seasons. All treatments of of GA_3 at all concentrations (10, 25, 50 and 100 ppm) and on the two dates (July 1st and 15th) increased significantly shoot length (cm) as compared with the control. The highest values of shoot length (44 and 43 cm) were recorded by the treatment of GA_3 at 100 ppm on

July 15th in the first and second season, respectively as compared with the control (31.33 and 32.00 cm). As regard to number of leaves/shoot, all the treatments in the first season increased significantly leaf number/shoot as compared with the control, however, in the second season two treatments of GA_3 at 50 ppm on July 1st and 15th increased significantly leaf/number shoot as compared to the control. Concerning leaf area (cm^2) no significant differences were recorded between all treatments and the control in the two seasons of the study.

Table (2): Effect of post-harvest foliar spraying of gibberellic acid on apricot "Canino" fruit some chemical characteristics during 2005-2006 and 2006-2007 seasons.

Means separation within column having the same letter are not statistically significant.

Treatments	TSS (%)		Acidity		TSS/acid ratio	
	2006	2007	2006	2007	2006	2007
10 ppm GA_3 on July 1st.	12.33 a	11.33 ab	1.30 a	1.38 a	9.51 a	8.20 ab
25 ppm GA_3 on July 1st.	13.40 a	10.50 b	1.39 a	1.36 a	9.66 a	6.72 b
50 ppm GA_3 on July 1st.	12.00 a	11.17 ab	1.25 a	1.21 a	9.58 a	9.26 a
100 ppm GA_3 on July 1st.	12.17 a	11.00 b	1.19 a	1.16 a	10.20 a	9.47 a
10 ppm GA_3 on July 15th	12.77 a	12.17 a	1.25 a	1.39 a	10.19 a	8.77 a
25 ppm GA_3 on July 15th	12.33 a	10.83 b	1.38 a	1.43 a	8.93 b	7.60 ab
50 ppm GA_3 on July 15th	12.50 a	11.00 b	1.34 a	1.29 a	9.33 a	8.51 a
100 ppm GA_3 on July 15'	12.33 a	10.67 b	1.17 a	1.12 a	10.51 a	9.55 a
Control (unsprayed)	12.60 a	10.68 b	1.12 a	1.21 a	11.25 a	8.85 a

Table (3): Effect of post-harvest foliar spraying of gibberellic acid on apricot "Canino"shoot length, No. of leaves/shoot and leaf area during 2005-2006 and 2006-2007 seasons.

Means separation within column having the same letter are not statistically significant.

Treatments	Shoot length (cm)		No. Of leaves/shoot		Leaf area (cm^2)	
	2006	2007	2006	2007	2006	2007
10 ppm GA_3 on July 1st.	36.33 a	37.00 a	30.00 a	30.67 ab	39.20 a	39.00 a
25 ppm GA_3 on July 1st.	37.33 a	40.33 a	31.33 a	30.33 ab	39.33 a	39.67 a
50 ppm GA_3 on July 1st.	40.00 a	41.67 a	33.00 a	34.00 a	40.00 a	40.33 a
100 ppm GA_3 on July 1st.	41.67 a	43.67 a	31.67 a	32.00 ab	40.33 a	40.67 a
10 ppm GA_3 on July 15th	37.33 a	37.67 a	30.33 a	31.00 ab	39.20 a	38.83 a
25 ppm GA_3 on July 15th	38.33 a	40.00 a	30.67 a	32.00 ab	39.40 a	39.33 a
50 ppm GA_3 on July 15th	40.33 a	41.00 a	32.67 a	33.00 a	40.33 a	40.00 a
100 ppm GA_3 on July 15'	44.00 a	43.00 a	32.33 a	31.67 ab	40.67 a	40.33 a
Control (unsprayed)	31.33 b	32.00 b	28.33 b	28.00 b	39.00 a	38.67 a

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تأثير الرش الورقى بالجبرلين بعد الجمع على محصول وجودة ثمار المشمش صنف "كاتينو"

شعبان حسين و فاطمة إبراهيم إبراهيم أبوجره وعبد الفتاح سليمان والى

معهد بحوث البساتين – مركز البحوث الزراعية – جيزة

تم رش حمض الجبريليك على المجموع الخضرى بعد الجمع بتركيزات مختلفة (١٠و ٢٥و ٥٠ و١٠٠ جزء/مليون) وفى ميعادين (١ و ١٥ يوليو) على أشجار مشمش صنف "كاتينو" عمر ٥ سنوات منزرعة فى أراضى رملية مستصلحة، وذلك خلال موسمى ٢٠٠٥-٢٠٠٦ و ٢٠٠٦- ٢٠٠٧.

أدت معاملات ما بعد الجمع بحمض الجبريلك بتركيز ١٠و ٢٥ و ٥٠ جزء/مليون فى ١ و١٥ يوليو إلى زيادة معنوية إحصائياً فى محصول الشجرة (كجم) فى موسم النمو التالى عند مقارنتها بالأشجار غير المرشوشة (الكنترول) . أدت كل معاملات حمض الجبريليك فى ١ و١٥ يوليو إلى زيادة معنوية فى طول الفرع ووزن الثمرة وحجمها عند مقارنتها بمعاملة المقارنة (الكنترول). وعموماً, لم تختلف الصفات الكيميائية للثمار الناتجة عن المعاملات معنويا عند المقارنة بالثمار الناتجة من أشجار غير مرشوشة (الكنترول).