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EFFECT OF SITOFEX AND GA_3 SPRAY AND TIME OF APPLICATION ON FRUIT SET, YIELD AND FRUIT QUALITY OF "Mackawa Jiro" KAKI CULTIVAR

BY

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ABSTRACT

This study was carried out to investigate the effect of Sitofex sprayed at different concentrations (5, 10 or 20 ppm) and GA_3 sprayed at 10 ppm alone or combined with them at two application dates: the 1st date (at full bloom) and the 2nd date (at fruit set) on fruit set, yield and fruit quality of "Mackawa Jiro" kaki cultivar.

Insignificant differences were detected between two tested dates. Combined with GA_3 (10ppm) + Sitofex (5ppm) treatment was the best effective. It is recommended to ensure the highest fruit set, the lowest fruit drop and achieving the highest yield as well as physical properties of fruits i.e. weight, size, length, diameter and firmness in addition to state delaying of the date of the maturation (the lowest TSS% and the highest acidity% of the juice). This will be of great importance for postponing its' harvest date, increasing its shelf-life period and storage ability.

INTRODUCTION

The oriented persimmon (Diospyros Kaki L, Fam. Ebenaceae) is one of the deciduous fruits native to china, where it has been cultivated for centuries and more than two thousands different cultivars exist. It spread to Korea and Japan many years ago where additional cultivars were developed.

Persimmon tree has been introduced to Egypt in 1911 by Ministry of Agriculture (Bagdady and Mineasy, 1964). Recent cultivation of oriented persimmon are extended in Egypt.

Good yield and high fruit quality are two important targets of fruit grower's additives. There are several approaches to increase productivity and fruit quality of fruit trees, it is well known that, plant growth regulators has been used successfully as an applicable mean for enhancing flowering, fruiting and improving fruit quality of persimmon tree.

It is documented that fruit size depends on different factors:

1- The number of cells presented at fruit set
2- Rate of cell division that occur subsequently
3- The extent which these cells expand.

Cell division in the early stage of fruit development has a larger influence on final fruit size (Westwood, 1993). Early fruit cell division normally influenced by natural growth hormones especially cytokinin (Looney, 1993). The new plant growth regulator CPPU* in many studies has indicated that, it is one of the major factors affecting fruit growth and fruit size; i.e. on grapes (Nickell, 1986); apple (Green, 1989); Kiwi fruit (Baisl *et al.*, 1991 and Lows and Woolley, 1992); pear (Guirguis *et al.*., 2003) persimmon (Jtal *et al.*, 1995 and Sugiyama *et al.*, 1995).

As regard to GA action (plant growth regulator), there are three important apparent actions: The first action that, GA intensifies an organ ability to function as a nutrient sink. A second one is GA ability to increase the synthesis of IAA in plant tissues. The third action involves accelerated synthesis of

* CPPU (Sitofex) (synthetic cytokinin) N-(2-chloro-4-pyridinyl)-N urea phenyl) is a product of ALZ Chem. Germany. Trans Fridge intr., Comp., Is the only agent in ARE.

hydrolytic enzymes such as amylase in aleurone cells (Addicott and Addicott, 1982). The main active component in persimmon flower calyx seems to be identical with GA_3 (Yamamura and Naito, 1973). It was found that a large increase in extractable auxin followed GA treatment in "Coville" and "Jersey" Highbush blueberry (Mainland and Eck, 1971). It is clear that auxins stimulate fruit growth and maturation (Hegazi, 1980, on apple).

The promotion effect of GA applications on fruit set, fruiting and fruit quality or improving fruit size were supported by many investigators (Halail, 1986) on pear trees and on persimmon (Alumenf *et al.*, 1986; Early 1986; Yamanara *et al.*, 1989; Kintajima *et al.*, 1992 and El-Sheikh *et al.*, 1999).

In Egypt, the high drop of kaki fruits before maturity is the major problem for persimmon production, so the final yield is very low. Our aim of this investigation is to increase the yield and improve the fruit quality through reporting the effect of spraying CPPU and GA_3 alone and the combination between the two plant growth regulators on the yield and the effect of different treatments on the physical and chemical characteristics of kaki fruits.

MATERIAL AND METHODS

This investigation was conducted through the two seasons; 2006 and 2007 on eight years old persimmon cultivar (Mackawa Jiro) budded on Diospyros virginiana rootstock at Goppi farm, Giza governorate. Trees were spaced 3.5 X 3.5 m apart, to study the effect of CPPU, GA_3 and combination between CPPU + GA_3 on fruit set, dropping and persimmon fruit quality. The 15 selected trees under study were similar in vigour, planted and subjected to the some cultural practices. Thus, two branches (same in diameter) on each tree were tagged and sprayed with one of the three concentrations of CPPU and 10 GA_3 at full bloom and 14 days after full bloom on other trees. While the control sprayed with tap water. The treatments were arranged completely randomized block design with three replicates of one tree for each. Thus, the experiment involved the following treatments:-

I- The first season (2006)

At full bloom 5, 10, 20 ppm CPPU; GA_3 10 ppm and combination between CPPU + GA_3 were sprayed the same treatment were repeated on other labeled branches at 14 days after full bloom while the labeled branches of the control were sprayed with tap water.

II- The second season (2007)

Repeated the same treatments by the same procedures on other trees to study the following parameters:-

Fruit set:

Percentages of initial fruit set (i.e. 15 days after every treatment after full bloom), and fruiting at harvesting time) were calculated as number of fruits per 100 flowers for all treatments and the control according to (Westwood, 1993).

Fruit drop:

Percentage of fruit drop was calculated by the following equation at full bloom treatments.

$$\%\text{Fruitdrop} = \frac{\text{Noof fruitletatfruitset} - \text{Noof harvestefruits}}{\text{Noof fruitletatfruitset}} \times 100$$

While those of 14 days after full bloom applications, the fruit drop percentage was calculated against number of fruitlets of application (El-Azzouni *et al.*, 1975).

Fruit characteristics:

Samples of 10 fruits for each replicate at harvest time were taken when fruits of the control attained maturity according to standard recorded by (El-Azzouni *et al.*, 1975) to study fruit weight, size, fruit length, fruit diameter, fruit shape index and fruit firmness using Pentrometer (Pressure tester). Percentage of total soluble solids (TSS) and percentage of total acidity as a malic acid were recorded according to (A.O.A.C., 1985).

The obtained data were subjected to analysis of variance and the means were compared using the new LSD values at 0.05 (Senedecor and Cochran, 1980).

RESULTS

1. Fruit set%:

Effect of date of spray on final fruit set% were statistically insignificant (Table, 1). As for the effect of the treatments, all the applied treatments significantly increased final fruit set% compared with the control which recorded the lowest percentage. Spraying GA_3 (10ppm) + Sitofex (5ppm) and GA_3 (10ppm) + Sitofex (10ppm) treatments recorded the highest percentages (Figure, 1). The interaction between date of spray and treatments was significant. Data revealed that the highest percentage was obtained as a result of GA_3 (10ppm) + Sitofex (5ppm) spraying either at full bloom or at fruit set for both seasons (Figure, 4).

2. Fruit drop%:

Final fruit drop% was not significantly affected by date of spray (Table, 1). With respect to the effect of the treatments, all the applied treatments goes in adverse line to final fruit set% which was appreciably decreased compared with the control which recorded the highest percentage. Spraying GA_3 (10ppm) + Sitofex (5ppm) and GA_3 (10ppm) + Sitofex (10ppm) treatments recorded the lowest percentages of fruit drop (Figure, 2). The interaction between date of spray and treatments was significant. Data recorded that the lowest percentage of fruit drop was obtained as a result of GA_3 (10ppm) + Sitofex (5ppm) spraying either at full bloom or at fruit set for both seasons (Figure, 5).

3. Yield / Tree (kg):

Effect of date of spray on the yield was statistically insignificant (Table, 1). Yield was significantly increased by treatments application. Spraying GA_3 (10ppm) + Sitofex (5ppm) resulted in the highest values (26.81 and 34.07 Kg/tree) for both seasons respectively, no significant differences could be shown between the two treatments GA_3 (10ppm) + Sitofex (5ppm) and GA_3 (10ppm) + Sitofex (10ppm) treatments (Figure, 3). The interaction between date of spray and treatments was significant. Data revealed that, the highest yield was obtained as a result of GA_3 (10ppm) + Sitofex (5ppm) and GA_3 (10ppm) + Sitofex (10ppm) treatments either at full bloom or at fruit set for both seasons (Figure, 6).

4. Fruit physical characteristics:

Effects of date of spray on fruit physical characteristics i.e. weight, size, length, diameter and firmness were statistically insignificant. Positive effects attributed to treatments applications were evident on all fruit physical characteristics (Table, 2). Application treatments were superior to control. GA_3 (10ppm) + Sitofex (5ppm) treatment induced the highest effects but they were insignificantly different from GA_3 (10ppm) + Sitofex (10ppm) treatment for all studied characters (Figure, 7, 8, 9, 10 & 11). The interaction between date of spray and treatments was significant. In general, the application of GA_3 (10ppm) + Sitofex (5ppm) spraying either at full bloom or at fruit set for both seasons (Figure, 14, 15, 16, 17 & 18), induced the best physical characteristics.

5. Fruit chemical characteristics:

Fruit chemical characteristics i.e. TSS% and acidity% were tabulated in (Table, 2). Insignificant differences were detected between the two tested dates, with respect to spraying, all treatments application resulted in the least significant TSS%, and the highest acidity% compared with control. Spraying GA_3 (10ppm) + Sitofex (5ppm) resulted in the lowest percentage of TSS and the highest percentage of acidity for both seasons, no significant differences could be shown between the two treatments GA_3 (10ppm) + Sitofex (5ppm) and GA_3 (10ppm) + Sitofex (10ppm) treatments (Figure, 12 & 13). The interaction between date of spray and treatments was significant. Data revealed that the lowest percentage of TSS and the highest percentage of acidity was obtained as a result of GA_3 (10ppm) + Sitofex (5ppm) and GA_3 (10ppm) + Sitofex (10ppm) treatments either at full bloom or at fruit set for both seasons (Figure, 19 & 20).

Table (1): Effect of different treatmets on the % final fruit set, fruit drop and yield (kg) of "MACKAWA JIRO" Kaki cultivar in 2006 and 2007 seasons

			Final fruit set %		Final fruit drop %		Yield / Tree (kg)	
			1st season	2nd season	1st season	2nd season	1st season	2nd season
(A)	(A1) Full bloom		60.60	72.47	28.29	16.42	30.99	39.37
	(A2) Fruit set		59.02	70.59	29.86	18.30	30.24	38.42
New L.S.D. (A) =			N.S	N.S	N.S	N.S	N.S	N.S
(B)	(B1) Control		52.78	63.12	47.22	36.88	26.81	34.07
	(B2) 10ppm GA_3		65.29	78.08	34.71	21.92	32.41	41.17
	(B3) 5ppm Sitofex		70.95	84.86	29.05	15.14	33.41	42.45
	(B4) 10ppm Sitofex		61.49	73.54	38.51	26.46	31.74	40.33
	(B5) 20ppm Sitofex		57.44	68.70	42.56	31.30	30.68	38.98
	(B6) 10ppm GA_3 + 5ppm Sitofex		79.31	94.86	20.69	5.14	42.93	54.54
	(B7) 10ppm GA_3 + 10ppm Sitofex		76.68	91.71	23.32	8.29	40.85	51.90
	(B8) 10ppm GA_3 + 20ppm Sitofex		74.36	88.93	25.64	11.07	36.67	46.59
New L.S.D. (B) =			4.53	5.36	4.53	5.36	1.65	1.55
(AXB)	A1	B1	52.78	63.12	47.22	36.88	26.81	34.07
		B2	67.09	80.23	32.91	19.77	32.50	41.29
		B3	71.23	85.19	28.77	14.81	34.06	43.27
		B4	62.58	74.84	37.43	25.16	31.86	40.47
		B5	59.40	71.04	40.60	28.96	31,22	39.66
		B6	79.91	95.58	20.09	4.42	43.84	55.70
		B7	77.16	92.28	22.84	7.72	41.16	52.30
		B8	75.23	89.97	24.77	10.03	37.43	47.55
	A2	B1	52.78	63.12	47.22	36.88	26.81	34.07
		B2	63.49	75.93	36.51	24.07	32.31	41.05
		B3	70.68	84.53	29.33	15.47	32.77	41.63
		B4	60.40	72.24	39.60	27.76	31.63	40.19
		B5	55.48	66.35	44.53	33.65	30.14	38.29
		B6	78.71	94.14	21.29	5.86	42.02	53.39
		B7	76.20	91.14	23.80	8.86	40.54	51.50
		B8	73.49	87.89	26.51	12.11	35.92	45.64
New L.S.D. (AXB) =			6.41	7.58	6.41	7.58	2.33	2.19

(A): Date of spray **(B):** Treatment **(AXB):** Interaction

DISCUSSION

The data of this investigation showed the effectiveness of the different applications of CPPU or GA_3 alone or the combination between the two plant growth regulators on kaki fruits are confirmed by the findings of (Lows and Woolley 1992). However, there not significant difference between spraying at full bloom or at fruit set.

CPPU has a positive effect on decreasing fruit drop percentage and significantly increase initial fruit set and yield, fruit weight, size length, diameter and fruit dimensions, all these findings are in agreement in this aspects with those of (Wickell, 1986; Devlin and Koszauski, 1988; Biasl *et al.*, 1991; Lows and Woolley 1992 and Guirguis *et al.*, 2003).

CPPU has proven to be highly effective of stimulating growth of such fruit species (grape, apple, cranberry, pear and persimmon).

Table (2): Effect of different treatments on the physical and chemical characteristics of "MACKAWA JIRO" Kaki cultivar in 2006 and 2007 seasons

			Weight (g)		Size (cm^3)		Length (cm)		Diameter (cm)		Firmness (kg/cm^2)		TSS %		Acidity %	
			1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
(A)	(A1) Full bloom		89.9	82.7	62.0	56.2	4.07	3.94	6.23	6.06	4.11	3.74	13.66	13.38	0.14	0.12
	(A2) Fruit set		87.7	80.7	60.5	54.9	4.03	3.90	6.16	6.00	3.95	3.59	13.57	13.28	0.14	0.12
New L.S.D. (A) =			N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
(B)	(B1) Control		77.8	71.5	53.7	48.6	4.17	4.09	6.38	6.25	3.47	3.16	16.43	16.08	0.13	0.11
	(B2) 10ppm GA_3		94.0	86.5	64.8	58.8	4.50	4.37	6.88	6.71	4.16	3.78	15.35	15.03	0.16	0.14
	(B3) 5ppm Sitofex		96.9	89.1	66.9	60.6	4.63	4.48	7.08	6.88	4.47	4.06	15.04	14.72	0.16	0.14
	(B4) 10ppm Sitofex		92.1	84.7	63.5	57.6	4.37	4.26	6.68	6.52	3.90	3.54	15.85	15.51	0.15	0.13
	(B5) 20ppm Sitofex		89.0	81.9	61.4	55.7	4.26	4.17	6.52	6.37	3.73	3.39	16.19	15.85	0.14	0.13
	(B6) 10ppm GA_3 + 5ppm Sitofex		124.5	114.5	85.9	77.9	4.94	4.72	7.56	7.31	5.97	5.43	14.33	14.03	0.18	0.16
	(B7) 10ppm GA_3 + 10ppm Sitofex		118.5	109.0	81.7	74.1	4.85	4.65	7.42	7.19	5.55	5.05	14.57	14.26	0.17	0.15
	(B8) 10ppm GA_3 + 20ppm Sitofex		106.4	97.8	73.4	66.5	4.74	4.57	7.24	7.04	5.03	4.58	14.79	14.48	0.16	0.15
New L.S.D. (B) =			15.4	14.0	10.1	9.7	0.17	0.13	0.25	0.22	0.82	0.80	0.24	0.22	0.01	0.01
(AXB)	A1	B1	77.76	71.54	53.65	48.65	4.17	4.09	6.38	6.25	3.47	3.16	16.43	16.08	0.13	0.11
		B2	94.26	86.72	65.04	58.97	4.52	4.39	6.92	6.75	4.23	3.85	15.41	15.09	0.16	0.14
		B3	98.76	90.86	68.14	61.78	4.66	4.51	7.13	6.93	4.58	4.17	15.11	14.79	0.16	0.14
		B4	92.38	84.99	63.74	57.79	4.38	4.27	6.70	6.54	3.94	3.59	15.91	15.58	0.15	0.13
		B5	90.53	83.29	62.47	56.64	4.29	4.19	6.56	6.41	3.76	3.42	16.28	15.94	0.14	0.13
		B6	127.13	116.96	87.72	79.53	4.97	4.74	7.60	7.35	6.04	5.50	14.39	14.09	0.18	0.16
		B7	119.37	109.82	82.37	74.68	4.87	4.66	7.45	7.22	5.67	5.16	14.61	14.30	0.17	0.15
		B8	108.54	99.86	74.89	67.90	4.77	4.59	7.30	7.08	5.27	4.80	14.83	14.52	0.16	0.15
	A2	B1	77.76	71.54	53.65	48.65	4.17	4.09	6.38	6.25	3.47	3.16	16.43	16.08	0.13	0.11
		B2	93.71	86.21	64.66	58.62	4.47	4.35	6.84	6.67	4.08	3.71	15.29	14.97	0.15	0.14
		B3	95.03	87.43	65.57	59.45	4.59	4.44	7.02	6.83	4.35	3.96	14.96	14.65	0.16	0.14
		B4	91.73	84.39	63.29	57.39	4.35	4.25	6.66	6.50	3.85	3.50	15.78	15.45	0.15	0.13
		B5	87.41	80.42	60.31	54.68	4.23	4.14	6.47	6.34	3.69	3.36	16.09	15.75	0.14	0.12
		B6	121.87	112.12	84.09	76.24	4.91	4.69	7.51	7.27	5.89	5.36	14.27	13.97	0.17	0.16
		B7	117.56	108.16	81.12	73.55	4.83	4.64	7.39	7.16	5.43	4.94	14.53	14.22	0.17	0.15
		B8	104.17	95.84	71.88	65.17	4.70	4.54	7.19	6.99	4.79	4.36	14.75	14.44	0.16	0.15
new L.S.D. (AXB) =			21.73	19.87	14.31	13.76	0.24	0.19	0.35	0.31	1.16	1.13	0.34	0.31	0.02	0.01

(A) : Date of spray (B) : Treatment (AXB) : Interaction

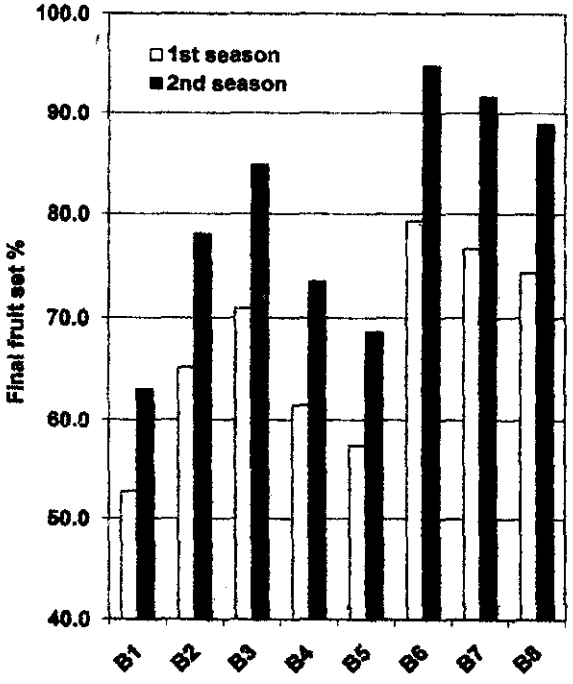

Fig (1): Effect of different treatments on the final fruit set % in both seasons

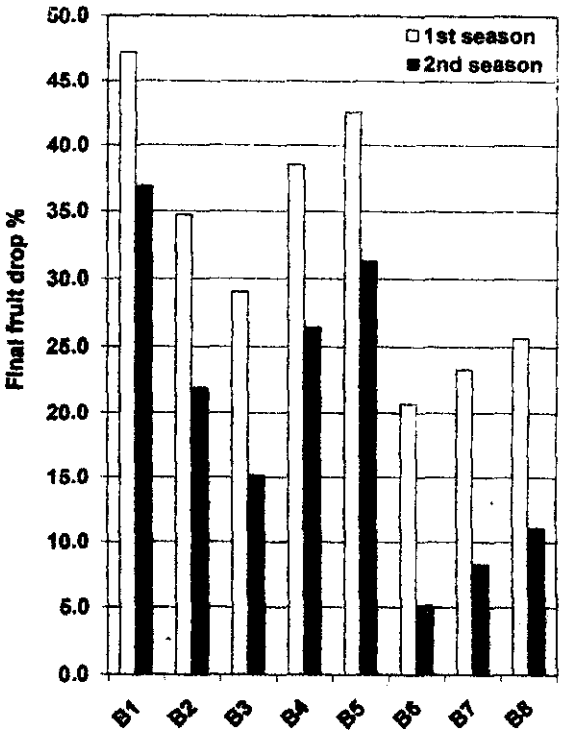

Fig (2): Effect of different treatments on the Final fruit drop % in both seasons

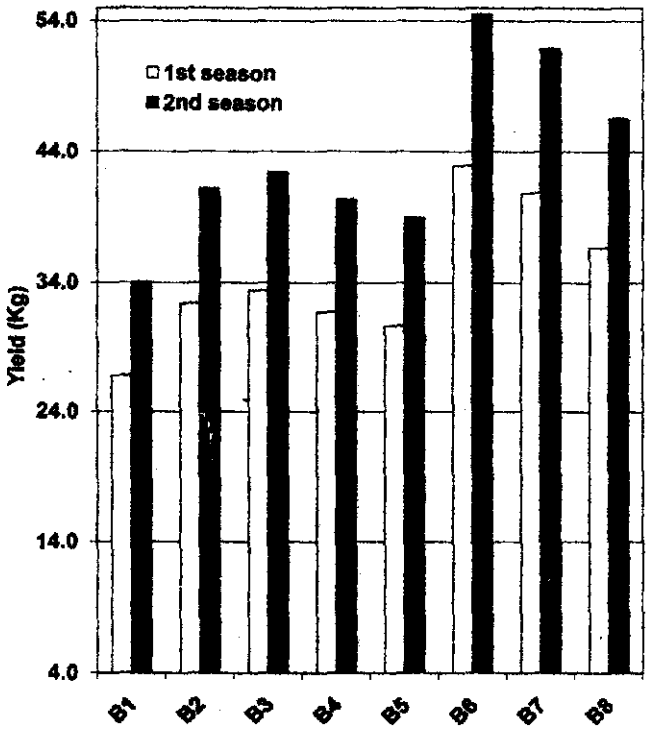

Fig (3): Effect of different treatments on yield (Kg) in both seasons

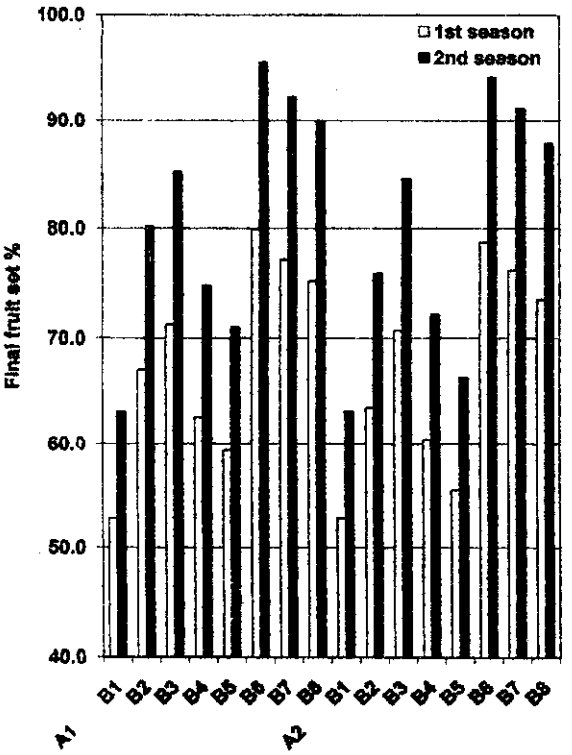

Fig (4): Effect of the interaction between date of spray and treatments on the final fruit set % in both seasons

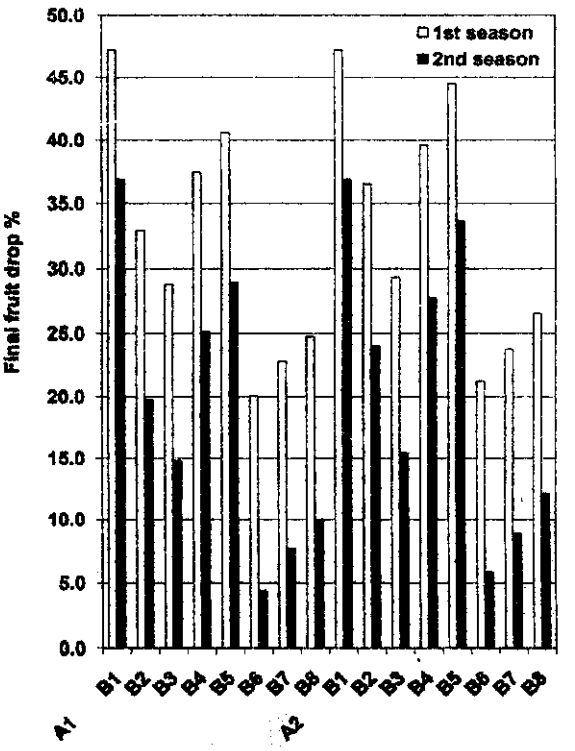

Fig (5): Effect of the interaction between date of spray and treatments on the final fruit drop % in both seasons

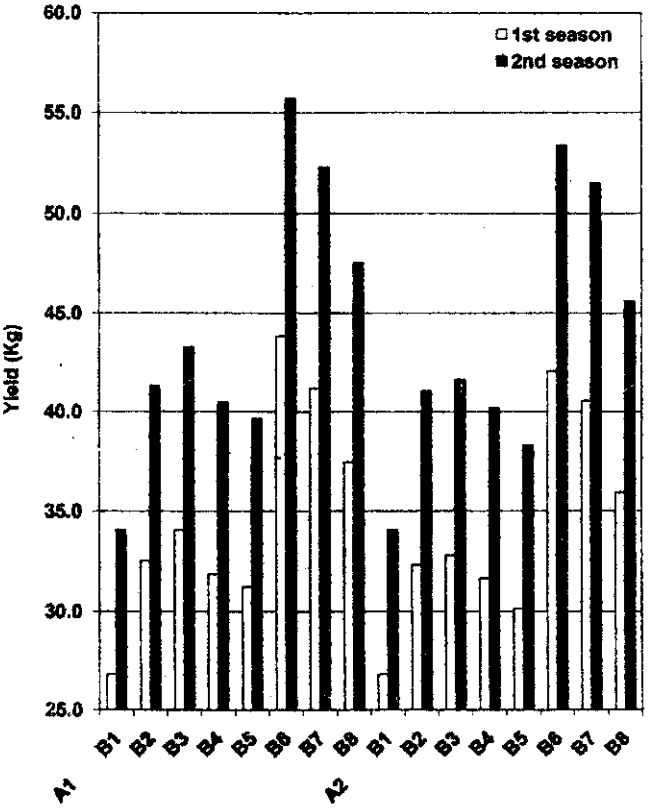

Fig (6): Effect of the interaction between date of spray and treatments on yield (Kg) in both seasons

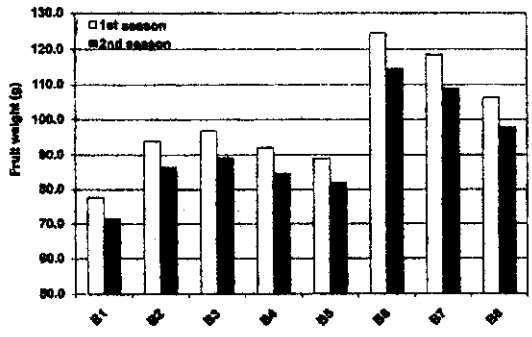

Fig (7): Effect of different treatments on the fruit weight (g) in both seasons

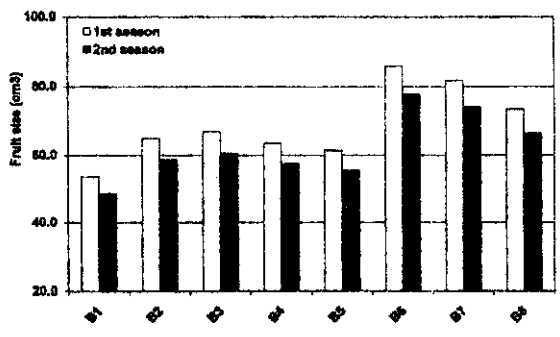

Fig (8): Effect of different treatments on the fruit size (cm3) in both seasons

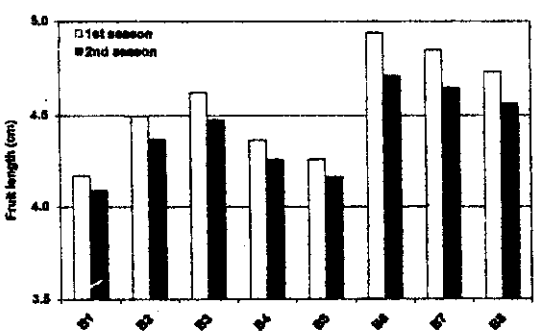

Fig (9): Effect of different treatments on the fruit length (cm) in both seasons

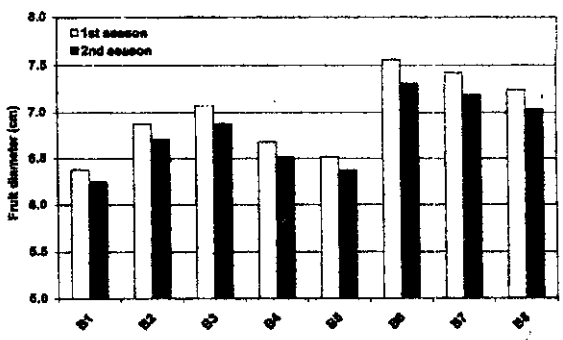

Fig (10): Effect of different treatments on the fruit diameter (cm) in both seasons

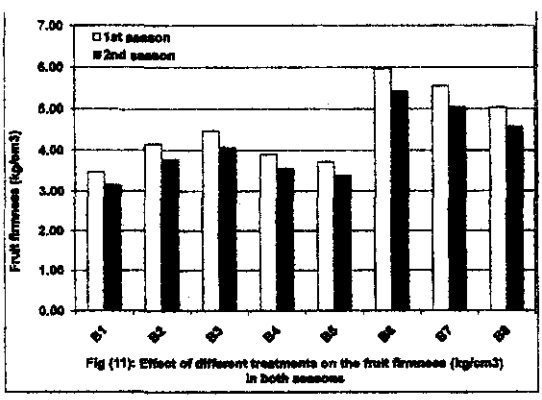

Fig (11): Effect of different treatments on the fruit firmness (kg/cm3) in both seasons

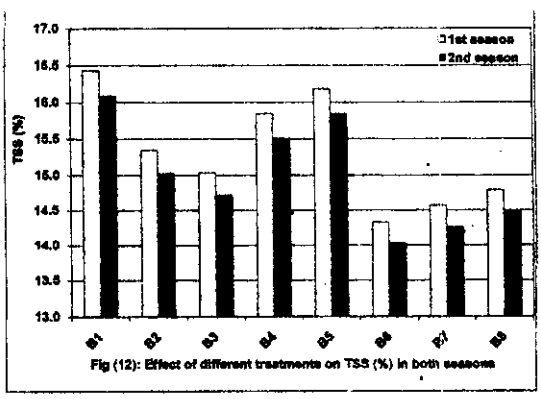

Fig (12): Effect of different treatments on TSS (%) in both seasons

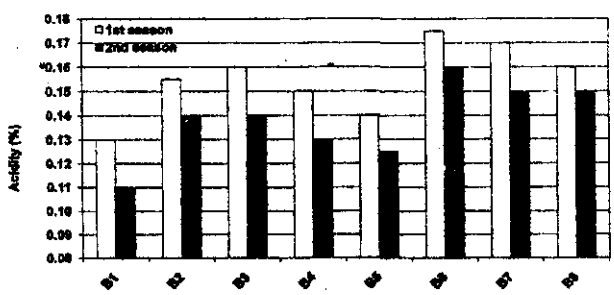

Fig (13): Effect of different treatments on acidity (%) in both seasons

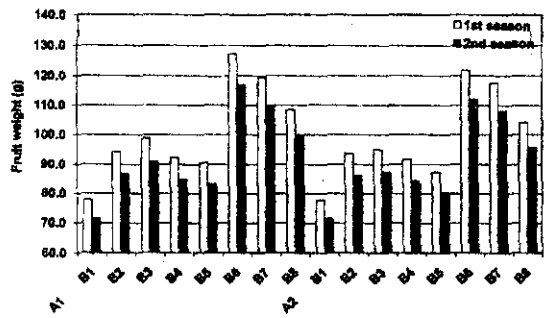

Fig (14): Effect of the interaction between date of spray and treatments on the fruit weight (g) in both seasons

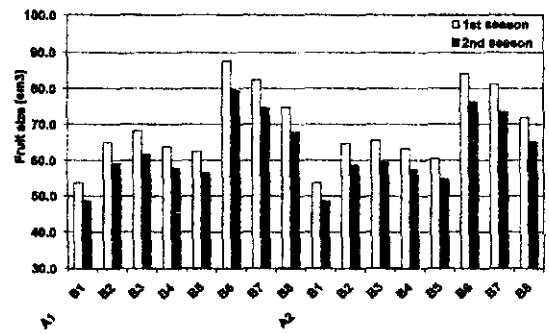

Fig (15): Effect of the interaction between date of spray and treatments on the fruit size (cm3) in both seasons

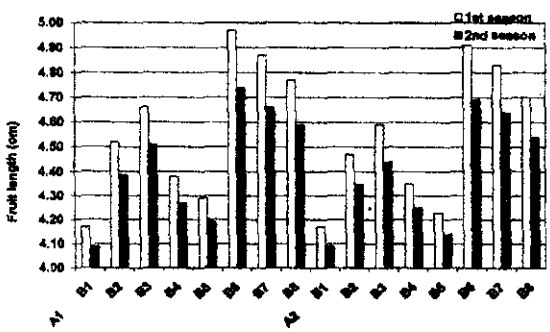

Fig (16): Effect of the interaction between date of spray and treatments on the fruit length (cm) in both seasons

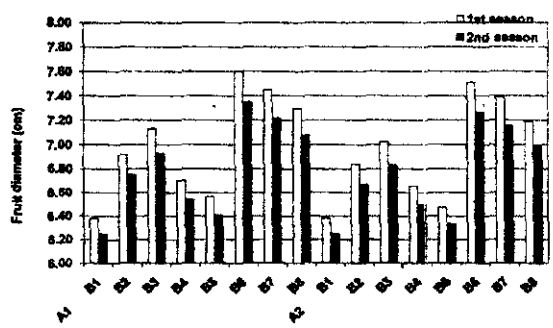

Fig (17): Effect of the interaction between date of spray and treatments on the fruit diameter (cm) in both seasons

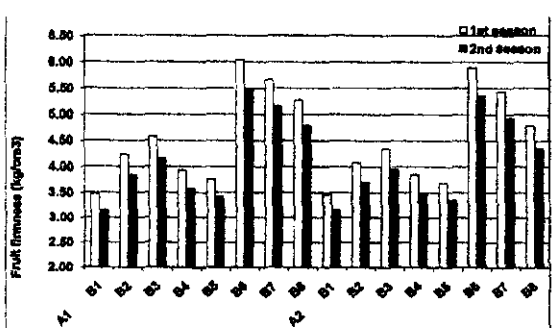

Fig (18): Effect of the interaction between date of spray and treatments on the fruit firmness (kg/cm3) in both seasons

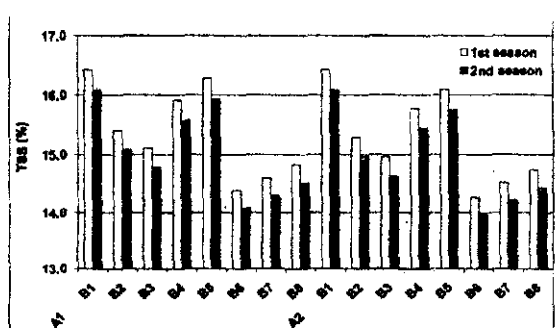

Fig (19): Effect of the interaction between date of spray and treatments on TSS (%) in both seasons

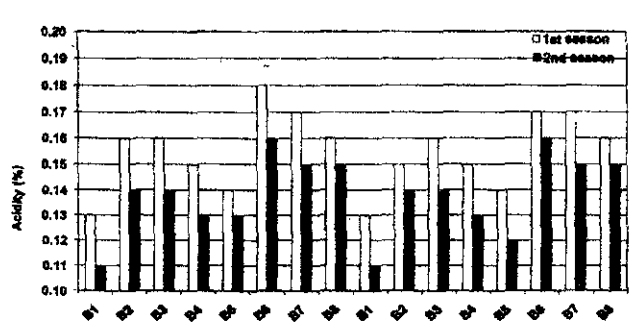

Fig (20): Effect of the interaction between date of spray and treatments on acidity (%) in both seasons

The material CPPU (cytokinin-like effect) is a synthetic plant growth regulator, it acts early cell division in the fruitlet and also on subsequent cell division or it does through changing natural known activity. it has been shown that CPPU application to kaki fruit shortly after fruit set stimulate cell division and hence also establish a potential for greater subsequent fruit expression. This potential is realized when high metabolism of the increased cell number attracts greater amount of assimilates (water, minerals and carbohydrates) gets bigger size because it has enough cell, that enabled the fruit to expand to a large size (Biasl *et al.*, 1991 and Lows and Woolley 1992). Hence, it is clear that, our results are in agreement with the previous findings.

Halial, (1986) on pear trees reported that, the promotions effects of GA_3 on fruit set, fruiting and fruit quality or improving fruit size were supported by many investigators. Similar results were obtained on persimmon (Alumenf *et al.*, 1986; Early, 1986; Yamanara *et al.*, 1989; Kintajima *et al.*, 1992 and El-Sheikh *et al.*, 1999).

CONCLUSION

During our two years of study on the effect on persimmon kaki fruit, indicate CPPU's effectiveness and suggest it's suitability as a tool for inducing a significant improvement in kaki cropping. The use of CPPU compound opens the door widely as a new opportunity managing kaki fruit production.

Results revealed that the best of treatment was spraying with GA_3 (10ppm) + Sitofex (5ppm) either at full bloom or at fruit set.

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تأثير الرش بالسيتوفكس والجبريلين ومواعيد الإضافة على نسبة العقد والمحصول وجودة الثمار لأشجار الكاكى صنف "ماكاواجيرو"

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معهد بحوث البساتين – مركز البحوث الزراعية

أجرى هذا البحث لدراسة تأثير الرش بكلا من السيتوفكس بتركيزات مختلفة (٥، ١٠، ٢٠ جزء فى المليون) والجبريلين بتركيز ١٠ جزء فى المليون سواء بصورة منفردة أو مشتركة فى ميعادين مختلفين وهما عند قمة التزهير أو بعد عقد الثمار وذلك على نسبة العقد والمحصول وجودة ثمار أشجار الكاكى صنف "ماكاواجيرو" والمنزرعة بمزرعة جروبى – محافظة الجيزة – وكانت عمر الأشجار ٨ سنوات وذلك خلال موسمى ٢٠٠٦، ٢٠٠٧.

وقد أشارت نتائج الدراسة إلى أنه لاتوجد فروق معنوية بين ميعادى الإضافة. وأن معاملة الرش بكلا من الجبريلين بتركيز ١٠ جزء فى المليون + السيتوفكس بتركيز ٥ جزء فى المليون قد أعطت أفضل النتائج فعند إضافتها قد أعطت أعلى نسبة عقد مع أقل نسبة تساقط ، بالاضافة إلى أعلى محصول وكذلك تحسين الصفات الطبيعية للثمار (الوزن، الحجم، الطول، القطر، الصلابة)، كما أدت هذه المعاملة المشتركة إلى تأخير النضج نسبيا وكذلك أقل نسبة من المواد الصلبة الذائبة الكلية وأعلى نسبة من الحموضة فى العصير الأمر الذى قد يكون له أهمية كبيرة فى تأخير الحصاد، لزيادة فترة عرض الثمار فى الأسواق وزيادة المقدرة التخزينية للثمار.