

Effect of Sitofex (CPPU) and GA₃ Spray on fruit set, fruit quality, yield and monetary value of “Costata” Persimmon.

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ABSTRACT: The present investigation was carried out during 2009 and 2010 seasons on “Costata” persimmon trees (*Diospyros kaki L.*) to improve yield and fruit quality. The trees were twenty years old, budded on Tarabuls (*Diospyros virginiana*) rootstock, spaced at 4×4 meters, grown in clay soil under flood irrigation system, in a private orchard at Aga district, Dakahlia Governorate to study the effect of foliar treatment with Sitofex (CPPU) at full bloom or fruit set with 0.5 or 10 ppm was studied. Also, the effect of foliar treatment of gibberellic acid (GA₃) at 0, 10 or 20 ppm with or without CPPU on vegetative growth (shoot length and diameter, total chlorophyll and number of leaves / shoot), and the fruiting (fruit set, fruit number, yield, fruit quality and monetary value of the yield) was studied during 2009 and 2010 seasons. The obtained results significantly indicated the superiority of 5 and 10 ppm Sitofex foliar application at fruit set on the testes parameters. Moreover, 10 ppm GA₃ was promised with many vegetative and fruiting characters. So, it can be recommended to persimmon growers to spray their trees with 10 ppm GA₃ + 5 ppm CPPU at fruit set stage to increase growth, yield and their income.

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1. INTRODUCTION

Japanese Persimmon (*Diospyros KaKi L.*) is a deciduous fruit tree. It has been introduced to Egypt in 1911 by the Ministry of Agriculture (Baghdady and Mineasy, 1964) and successfully grown under the Egyptian environmental conditions due to its low chilling requirements. The cultivated area increased specially in last few years, since it reached 1826 feddans and the total annual production reached nearly 10118 tons of fruits according to Malr (2008).

Costata cultivar is the main persimmon variety progressively consumed in the Egyptian market and exportation. However, the problem of June drop and pre-harvest drop exists extensively in many Egyptian orchards, especially because the Costata persimmon is a parthenocarpic cultivar. Thus eliminating yield and fruit quality. (El-Shaikh, *et al.*, 1999). Different factors may cause persimmon fruit drop. Abd El-Ghany (2005) reported that, fruit drop before June (initial drop) occurred due to the competition among the fruits on the nutrients, water and the defect in hormonal balance.

The purpose of using plant growth substances as foliar applications is to improve flowering, producing maximum yield and fruit quality particularly fruit size, as well as, controlling fruit maturation. In addition, by hastening or delaying fruit maturation the growers can utilize peak demands, avoid unfavourable environmental conditions and extend

the market period (Hegazi, 1980). Also, the plant growth regulators (PGR) act as messenger and are needed in small quantities. Such as GA₃ affect fruit formation, abscission, cell elongation, apical dominance and photoperiod (Aboutalebi and Beharoznam, 2006). Moreover, El-shewy (1999) observed that 50 mg GA₃ per litre at full bloom and three months after 1st spray were the most effective treatments in reducing pre harvest fruit drop in Guava. Moreover, Ramteke, *et al.*, (2011) found that spraying GA₃ with concentration 40 and 30 ppm after berry set improve the quality of “Sharad seedless” Grapes.

Sitofex (CPPU) is a new plant growth regulator which has strong cytokinin activity by inducing fruit growth at low rates (Nickell 1985). It also increased fruit firmness and delayed maturation. Meanwhile, Stoper, *et al.*, (2011) mentioned that the single application of CPPU 5 ppm at petal fall resulted in strong thinning response of Jonagold apple trees. On the other hand, Serri and Hepp (2011) studied the effect of CPPU 10 mg/L at 10 to 15 days after 50% bloom on high bush Blueberries. The results showed that there was an increase in berry size and a slight delay in fruit ripening compared with non treated plants. Also, Guirguis, *et al.*, (2003) found that CPPU treatment with 20 ppm increased the percentage of fruit set and fruiting when applied at full bloom. In this respect, Xiao, *et al.*, (2007) studied the influence

of CPPU (with concentration 10 - 25 mg / L at 10 days after full bloom) on sugar and acid content of *Diospyros Kaki* cv. "Zenjimaru" fruit. The result showed that the treatment could increase weight of individual fruit, reducing TSS content and TSS / acid ratio of fruit, as well as, could promote starch degradation but had no effect on titrable acid content.

Therefore, the objective of this investigation was to study the possible effects of different concentration of CPPU and GA₃ at different application dates and their interaction on fruit set, yield and fruit quality of "Costata" persimmon trees grown in North Delta region.

2.MATERIALS AND METHODS

-“Costata” persimmon trees: The present investigation was carried out during 2009 and 2010 seasons on twenty years old "Costata" persimmon trees (*Diospyros kaki* L.) to improve yield and fruit quality. The trees were budded on Tarabuls (*Diospyros virginiana*) rootstock, spaced at 4×4 meters, grown in clay soil under flood irrigation system, in a private orchard at Aga district, Dakahlia Governorate, Egypt. Thirty three uniform and healthy fruiting trees, randomly selected to study the effect of concentration and application date of CPPU {N-(2-chloro-4-pyridinyl)-N-phenyl urea} by using Sifofex compound (a.i. 0.01% CPPU) as source of CPPU and GA₃ individual or combined with them as follows:-

A-Spraying Sifofex (CPPU) at full bloom or after fruit set :-

1- Control:- Check trees were sprayed with tap water.

2- CPPU at 5 or 10 ppm concentrations were applied at full bloom or fruit set through the two studied seasons.

B.Spraying Sifofex (CPPU) with GA₃ at full bloom:-

1-Control: Check trees were sprayed with tap water.

2- CPPU at 5 or 10 ppm concentrations as single treatments or GA₃ treatment.

3- GA₃ at 10 or 20 ppm concentrations as single treatments or with CPPU treatment.

Treatments:

The treatments were arranged in a completely randomized design. Each treatment was replicated three times and each replicate was represented by one tree. Four main branches of each tree in different directions were labelled. The following measurements were carried out:-

2.I.The fruiting:-

a-Fruit set percentage:-

Number of flowers, fruitless at initial set (i.e. 15 days after full bloom) and were counted on the selected main branches and calculated fruit set by the

following equation according to Westwood (1993) and El-Azzouni *et al.*, (1975).

$$\text{fruit set \%} = \frac{\text{No. of fruitlets}}{\text{No. of flowers}} \times 100$$

b-Fruit number per tree:- At harvest time, the total number of fruits per tree was counted.

c- Yield per tree (Kg):- Yield weight was estimated by multiplying number of fruits * average weight of fruit.

d- Fruit quality:-

Samples of fruits were collected from each treatment (30 fruits / tree) for the determination of fruit characteristics at the same time (Picking dates at October 6th and October 7th) in 2009 and 2010 seasons respectively according to Ben -Arice and Guelfat- Reich (1973) to determine physical and chemical characters.

- **Fruit weight (g) – size (cm³) and dimensions (cm).**

- **Peel color (Hue angle).**

Skin color measurement (Hue angle) was determined by using a Hunter colorimeter type (DP-9000) for the estimation of a, b and hue angle (h°). In this system of color representation the values a*, and b* describe a uniform two-dimensional color space, where a* is negative for green, and positive for red, and b* is negative for blue and positive for yellow. From a & b values, a/b were calculated Hue angle (h°= arc tan b*/a*) determines the red, yellow, green, blue, purple, or intermediate colors between adjacent pairs of these basic colors Hue angle (0°= red-purple, 90° = yellow, 180°=bluish-green, 270°= blue), as described by McGuire (1992).

-**Fruit firmness** was measured with Effeg, Pentrometer 11.1 mm diameter prop, Effeg, Alfonsing, Italy and expressed as Lb/inch²

- **Soluble Solids content (SSC%)** Handy refractometer the TSS % in fruit juice according to A.O.A.C. (1990).

-**Juice acidity (%)** was determined according to A.O.A.C.(1990) and calculated as gram anhydrous Malic acid /100ml juice.

- **Total tannin content** according to A.O.A.C. (1990).

2.II.Vegetative growth:-

-**Total chlorophyll:-** At the end of the growing season, total chlorophyll content was recorded using a SPD 502 chlorophyll meter (Minolta Corporation, Ramsey N. J.,USA) as chlorophyll readings (Yadava 1986).

- Length and diameter of shoot with (cm).

- Number of leaves per shoot.

2.III.Yield monetary value (EL):-

At picking date, numbers of fruits / tree were used to calculate yield monetary value = fruit yield (Kg) /

tree \times farm - gate price (LE 1.5 for Kg fruit weighing > 120 g , LE 1.25 for Kg fruits weighing 100 - 120 g and LE 1.0 for Kg fruits weighing < 100 g.

2.IV-Statistical analysis:-

The obtained data were subjected to statistical analysis according to Snedcor and Cochran (1990). Averages were compared using L.S.D. test at 5% probability.

3.RESULTS AND DISCUSSION

3.A.Spraying Sitofex (CPPU) at full bloom or after fruit set :-

3.A.I.The fruiting:-

3.A.I.a) Fruit set percentage:-

Data presented in Table (1) revealed that, all treatments of Sitofex concentrations significantly increased fruit set percentage as compared to the control (0 ppm). The highest values recorded with concentrations (5, 10 ppm) at fruit set. In this respect, Guirguis *et al.*, (2003) stated that CPPU treatment with 20 ppm increased the percentage of fruit set when applied at full bloom on Le-Conte pear cultivar. Moreover, Nie Lei *et al.*, (2006) and Guirguis *et al.*,

(2010) revealed that, the CPPU has a promoting effect on fruit set and reducing ABA content, due to the physiological basis of CPPU action in promoting fruit setting and fruit enlargement.

3.A.I.b) Fruit number per tree:-

With regard to the fruit number per tree the data of both seasons presented in table (1) indicated that, all spraying treatments with CPPU significantly increased fruit number per tree when compared with the control in both seasons. In addition, 5, 10 ppm CPPU at fruit set recorded the highest values in comparison with the other dates and concentrations. These results are in line with those of Cai Lihong (1996) and Guirguis *et al.*, (2010). They found that, spraying "Fujiminori" grape and "Costata" persimmon trees with CPPU 5-20 mg/L after full bloom significantly increased yield per tree by 20% to 48.6% and the quality was improved as well. On the other hand, Koron *et al.*, (2011) have good thinning of high bush blueberry with 10 or 20 ppm CPPU when applied two weeks after bloom. However, too high concentrations on flowers and fruits were injured and caused late fruiting.

Table (1):- Effect of CPPU concentration , date of application and their interaction on fruit set percentage, fruit number per tree, Yield per tree, fruit weight and fruit dimensions of " Costata " persimmon trees in 2009 and 2010 seasons.

Treatments	F. S. (%)		F, N, p. tree		Y. p. tree (kg)		F.W.(g)		F. Size (cm ³)		F. Length (cm)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Control	28.67 E	15.36 E	131.33 E	121.33 E	11.52 D	14.35 E	88.67 E	119.84 D	93.22 D	95.78 E	5.600 E	5.670 E
5 (F.B.)	30.27 D	40.32 D	319.33 D	296.33 C	39.43 B	38.74 C	117.50 D	119.07 D	90.23 E	98.67 D	5.900 D	5.920 D
10 (F.B.)	33.81 C	61.72 C	324.33 C	290.33 D	38.35 C	34.64 D	129.27 B	134.56 B	101.78 C	107.11 B	6.140 B	5.970 C
5 (F.S.)	64.44 A	88.31 B	327.00 B	352.67 A	45.06 A	48.85 A	121.45 C	133.59 C	105.00 B	100.57 C	6.080 C	6.120 A
10 (F.S.)	56.94 B	96.72 A	348.67 A	342.33 B	44.96 A	45.96 B	139.37 A	140.46 A	106.33 A	107.47 A	6.180 A	6.100 B

F. B. = Full bloom, F. S. = Fruit set

Means in each column followed by the same letter(S) are not significantly different at 5% level.

N.B. Fruit set:-were estimated two weeks after 80 % of complete full bloom.

Fruit Number per tree: - were calculated at June month.

3.A.I.c Yield per tree (Kg) :-

Concerning the effect of CPPU concentrations and date of application on number of fruits/ tree and fruit weight Kg /tree in table (1) showed that, CPPU significantly improved the yield of "Costata" persimmon trees compared to the control. There was a gradual and significantly increase in the yield with concentrations of Sitofex 5 ppm at fruit set (45.06, 48.85 kg /tree)and 10 ppm (44.96 , 45.96 kg/ tree)in

the two seasons respectively. Meaningless, the yield was attributed in the other date (at full bloom) with the same concentrations 5 and 10 ppm (39.43, 38.74 kg/tree) and (38.35, 34.64 kg /tree) in the two seasons respectively. The untreated trees recorded the minimum values (11.52 and 14.34 kg /tree) in both seasons, respectively. These results are in line with those obtained by Stem *et al.*, (2006) who stated that the improving effect of Sitofex on fruit weight and

dimensions, as well as, on reducing pre-harvest fruit drop may explain the present results. These findings are in agreement with those obtained by Nickell (1986), Rizk (1998) and Fawzi *et al.*, (2004) on graviens. Also, Faissal *et al.*, (2007) and Guirguis *et al.*, (2010) studied the effect of concentrations and date of spraying Sitofex (CPPU) on yield and quality of Le-Conte pear fruits. Results showed that using CPPU at 5,10 ppm at one, two, three or four weeks after setting caused appreciable promotion on yield.

3.A.I.d. Fruit quality:-

-Fruit weight, size, and dimensions.

According to data presented in table (1). It is clear that, the highest value of fruit weight (g), fruit size (cm³), Fruit diameter and length (cm) were obtained from spraying Sitofex at fruit set with 5 ppm followed by 10 ppm at full bloom. The untreated trees recorded the minimum values. Therefore, the increase in

“Costata” persimmon fruit size could be attributed directly to the CPPU effects. Exogenous application of CPPU acts early on cell division in the fruitlet and also on subsequent growth. Thus, the fruit becomes bigger in size due to the efficiency of cells, the building blocks of fruit mass and also because the cells have been able to attract so much water, minerals and carbohydrates that enable the fruit to expand to large size (Kano, 2003). Moreover, the increase in both fruit weight and dimensions due to application of Sitofex may be described to its positive action on enhancing both cell division and cell elongation, as well as, its great role in activating the biosynthesis of proteins, RNA and DNA (Nickell, 1985). However, the interaction between date of spray and CPPU concentrations, was significant in both 2009 and 2010 seasons. The heaviest and largest fruits were obtained

mostly by the application of CPPU (10 ppm) at fruit set. The same trend was noticed by Guirguis *et al.*, (2010) on “Costata” persimmon fruits.

-Peel color (Hue angle) and Fruit firmness :-

Results in table (2) cleared an evident increase in skin color (Hue angle) was noticed with the CPPU 5 ppm at fruit set in the two seasons. The least significant of Hue angle value was obtained by control in both seasons.

With regard to the Fruit firmness, data of both seasons exhibited higher firmness (lb/in²) value with control followed by CPPU spray at fruit set with two concentrations 5 and 10 ppm. Spraying at full bloom with 5 or 10 ppm recorded the minimum values. In this line Arteaga (1990) mentioned that, in most cases exogenous application of cytokinin counteracts the promote effects of ethylene on the senescence process. Also, 10 ppm CPPU sprayed two weeks after full bloom improved “Costata” persimmon fruit quality (Guirguis *et al.*, 2010).

- Soluble Solids content(SSC%), Juice acidity (%) and Total tannins content :-

From the revealed mentioned soluble solids content results in table (2), it could be concluded that application of Sitofex expressed promoted variation effects between treatments, this may be due to maturity date. These findings confirmed with those obtained by Fawzi *et al.*, (2004) on grapevines. On the contrary, Retamales *et al.*, (1995) who reported that Sitofex (CPPU) application resulted in lower TSS content of Thompson seedless grapes. Furthermore, Sitofex application with 5 or 10 ppm at full bloom or at fruit set, significantly reduced fruit juice acidity while increases total tannins content than control specially with 5 ppm CPPU at fruit set.

Table (2):- Effect of CPPU concentration, date of application and their interaction on fruit diameter, peel color (Hue angle), Firmness, SSC%, Acidity % and Total tannins of” Costata “persimmon fruit in 2009 and 2010 seasons

Treatments	F. Diam. (cm)		Hue Angle(h*)		Firmness		SSC (%)		Acidity (%)		Total tannin	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Control	5.62 D	6.02 C	73.90 D	74.19 C	19.12 A	17.53 A	13.00 E	12.33 E	0.931 A	0.931 A	2.000 D	1.830 D
5 (F.B.)	6.30 C	6.16 B	75.96 C	74.32 C	13.40 D	14.03 D	19.00 C	23.33 A	0.818 C	0.745 D	2.110 B	1.840 D
10 (F.B.)	6.45 B	6.26 A	77.45 B	75.74 B	12.63 E	10.46 E	21.53 A	19.33 C	0.743 E	0.707 E	1.940 E	2.040 C
5 (F.S.)	6.23 C	6.23 AB	84.81 A	86.20 A	16.01 B	15.47 C	19.50 B	21.50 B	0.892 B	0.866 C	2.200 A	2.370 A
10 (F.S.)	6.68 A	6.17 AB	75.45 C	74.41 C	14.25 C	16.62 B	14.00 D	17.50 D	0.781 D	0.89 B	2.070 C	2.270 B

F. B. = Full bloom F. S. = Fruit set

Means in each column followed by the same letter(S) are not significantly different at 5% level.

3.A.II. Vegetative growth:-**-Total chlorophyll:-**

Leaf chlorophyll content of all the sprayed trees with CPPU significantly increased when compared with the control in both seasons especially with 5 and 10 ppm at fruit set.

- Length and diameter of shoot:-

Shoot length and diameter were affected by CPPU spraying. Results in table (3) cleared that highest significantly values obtained increased with 5 and 10 ppm CPPU treatments at fruit set in the two

seasons. Whereas, in shoot diameter the highest significantly value increased with 5 and 10 ppm at full bloom in the two seasons. The untreated trees have the lowest shoot length and diameter in the two seasons.

- Number of leaves per shoot.

There were differences between all treatments under study. The highest significant values with 5 ppm at full bloom . While, minimum significant value with control in the two seasons.

Table (3):- Effect of CPPU concentration, date of application and their interaction on some vegetative growth of "Costata" persimmon fruit in 2009 and 2010 seasons.

Treatments	Chlorophyll % in leaf		Shoot Length(cm)		Shoot Diam.(cm)		N. of Leaf / Shoot	
	2009	2010	2009	2010	2009	2010	2009	2010
Control	42.80 E	48.33 E	30.67 E	31.67 E	0.63 D	0.63 D	9.33 E	11.00 E
5 (F.B)	50.70 B	50.70 B	41.67 D	40.00 D	0.83 B	0.93 A	22.33 A	24.67 A
10 (F.B)	48.50 D	48.50 D	42.00 C	41.33 C	0.90 A	0.80 B	13.33 C	20.67 B
5 (F.S)	51.18 A	48.85 C	53.33 A	43.33 B	0.77 C	0.80 B	17.67 B	11.67 D
10 (F.S)	48.85 C	51.13 A	46.67 B	45.00 A	0.83 B	0.77 C	11.67 D	13.67 C

F. B. = Full bloom F. S. = Fruit set

Means in each column followed by the same letter(S) are not significantly different at 5% level.

3.B. Spraying Sitofex(CPPU) and GA₃ at full bloom:-**3.B.I. The fruiting:-****3.B.I.a) Fruit set percentage:-**

However, GA₃ treatments (10 or 20 ppm) at full bloom significantly increased fruit set than control. Also, CPPU at 10 ppm gave higher fruit set. The best combination was GA₃ at ppm +CPPU at 5 ppm (86.28 and 85.86 %) through the two studied seasons respectively (Table 4). In this line. Wally *et al.*, (1999) stated that GA₃ intensifies an organ ability to function as a nutrient sink, it also increases the biosynthesis of IAA in plant tissues ,delays the formation of separation layer (Wasfy , 1995), thus enhancing fruit retention. Kassem *et al.*, (2010) stated that, GA₃ affected fruit formation.

3.B.I.b. Fruit number per tree:-

As regard to the effect of GA₃ at full bloom in Table (4), data showed that, 10ppm was better than both 0 or 20 ppm. While CPPU at 5 ppm gave more fruits than other treatments . Moreover, 10 ppm GA₃ + 5 ppm CPPU at full bloom induced the highest fruit number / tree (358 and 345) in 2009 and 2010 seasons respectively. The previous results agreed with those of Kassem *et al.*, (2010) who reported that GA₃ recorded the highest number of fruits per tree when sprayed at 25 ppm once at pea stage (5 mm fruitlet diameter) and marble stage (15 mm fruitlet diameter) of Costata trees and he stated that GA₃

may influence several entirely different processes as fruit formation, photoperiod and abscission cell elongation.

3.B.I.c.) Yield per tree (Kg):-

Concerning to the effect of sprayed combination of GA₃ and CPPU on yield per tree as number of fruits/ tree and weight (Kg) / tree , table (4) indicated that, all treatments significantly improved the yield of persimmon trees. Generally, GA₃ spray at full bloom has not definite trend, while CPPU at 5 ppm gave better fruit yield than the other treatments. However, GA₃ at 10 ppm + CPPU at 5 ppm was the best combination where the fruit yield was 43.32 and 44.75 Kg /tree in the two studied seasons respectively. These results are in conformity with those of El-Shewy (1999) , Kabeel (1999) and Wally *et al.*, (1999) who observed that 50 mg / L GA₃ at full bloom and three months after 1st spray were most effective treatments in reducing pre harvest fruit drop, as well as ,fruit seed contents in guava and persimmon . Similar results were obtained by Moore (1979) and Kassem *et al.* , (2010) who stated the stimulation of both cell division and cell enlargement due to GA₄ foliar sprays is surely reflected on increasing fruit weight , consequently fruit yield . Moreover, Mervet *et al.*, (2001) found that, the Sitofex treatment in combination with GA₃ or alone significantly increased the total yield of "Thompson seedless" grapevines.

3.B.I.d.Fruit quality:-**-Fruit weight and size:-**

Data presented in Table (4) disclosed that, GA₃ and the combination with CPPU treatments have not obvious trend on fruit weight while Sitofex spray alone at 5 ppm at full bloom affect heavier fruits than the other treatments (125.1 and 130.9 g/ fruit) in 2009 and 2010 seasons respectively. These results are in complete agreement with those obtained by Westwood (1993) who stated that, yield increment of deciduous fruit trees was attributed to the depressing of fruit drop percent caused by the application of Auxins and Gibberellins. Moreover, Rizk (1998) who mentioned that Sitofex treatments in combination with GA₃ or without GA₃ significantly increased bunch weight of

“Thompson seedless” grapes. These are due to the effect of GA₃ and CPPU on increasing cell division and elongation.

As for fruit size, table (4) indicated that GA₃ sprays (10 or 20 ppm) enhanced “Costata” persimmon fruit size than control when sprayed at full bloom. While Sitofex affected relative decrease of fruit size. However, we obtained larger fruits with 20 ppm GA₃ + 0 ppm CPPU combination (109.47 and 116.88 cm³) respectively through the present trial. These results are in line with those of Retamales *et al.*, (2001) who found that inclusion of CPPU resulted in an additional increase in berry growth when added GA₃ with a reduction in berry drop.

Table (4):- Effect of GA₃ and CPPU concentrations and their combination on fruit set percentage, fruit number per tree, Yield per tree, fruit weight, and fruit size of “Costata” persimmon trees in 2009 and 2010 seasons.

GA ₃ (A)	CPPU (B)	Fruit set %		F.N. per tree		Yield per t. (kg)		F. weight (g)		F. size (cm ³)	
		2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
0	0	28.67 E	15.36 E	131.33 G	121.33 F	11.52 C	14.35 E	88.67 E	119.84 DE	93.22 D	95.78 C
	5	30.27 D	40.32 D	319.33 D	296.33 C	39.43 C	38.74 C	117.50 D	119.07 D E	90.23 DE	98.34 C
	10	33.81 C	61.72 C	324.33 C C	290.33 D	38.35 C	34.64 D	129.27 B	134.56 AB	101.78 BC	107.11 B
Ave. (A)		41.13 B	39.13 C	265.78 B	272.11 B	33.85 A	36.41 A	119.10 A	131.66 A	95.08 B	100.41 B
10	0	67.28 B	69.86 B	297.00 C	292.33 C	34.08 A B	37.94 B	143.76 A	129.98 BC	107.34 AB	109.44 B
	5	86.28 A	85.86 A	358.00 A	345.00 AB	43.32 A	44.75 A	115.07 C	128.22 BC	86.67 E	94.47 C
	10	46.01 C	73.37 B	205.33 E	223.33 D	20.13 BC	27.27 C	97.97 D	119.87 DE	99.43 C	113.23 AB
Ave. (A)		66.74 A	76.39 B	286.78 A	286.89 A	32.51 A	36.66 A	118.93 A	126.02 B	97.81 B	105.71 A
20	0	34.24 CD	69.76 B	141.00 F	207.67 E	17.88 BC	27.13 C	135.99 AB	130.33 BC	109.47 A	116.88 A
	5	35.98 CD	56.49 C	238.00 D	231.00 D	28.53 A-C	28.50 C	120.87 C	124.07 CD	104.28 A-C	110.11 B
	10	43.86 C	70.76 B	293.33 C	336.00 B	21.23 BC	38.38 B	75.17 F	114.42 E	91.47 DE	99.45 C
Ave. (A)		38.03 B	65.67 A	224.11 C	258.22 C	22.55 B	31.34 B	110.67 B	122.94 B	101.74 A	108.81 A
Ave (B)	0	49.95 AB	57.02 B	189.4 C	207.1 C	24.24 B	26.47 C	122.8 A	126.8 AB	103.34 A	107.37 A
	5	44.51 B	55.56 B	304.8 A	309.6 A	35.89 A	40.74 A	125.1 A	130.9 A	93.73 C	100.97 B
	10	51.44 A	68.62 A	282.4 B	300.6 B	28.77 AB	37.2 B	100.8 B	122.9 B	97.56 B	106.60 A

Means in each column followed by the same letter(S) are not significantly different at 5% level.

N.B. Fruit set:-were taken two weeks after 80 % of complete full bloom.Fruit Number per tree: - were taken at June month.

-Dimensions, Peel color (Hue angle) and firmness of fruit:-

Data in table (5) showed that, GA₃ sprays at full bloom increased persimmon fruit dimensions especially in the second season. Also, CPPU at 5ppm positively increased the fruit dimensions. However, the combination treatments did not allow clear trend. However, persimmon fruit color gradually increased with GA₃

concentration, while 5 ppm Sitofex spray gave better fruit color. But no clear attendant was obtained with combination treatments. Furthermore, persimmon fruit firmness was better with GA₃ applications than control. On the other hand, CPPU treatments significantly reduced fruit firmness, while the combination between GA₃ and CPPU sprays showed better fruit firmness with 0 ppm GA₃ + 10ppm CPPU

Table (5):- Effect of GA₃ and CPPU concentrations and their combination on dimensions, Peel color (Hue angle) and Fruit firmness of "Costata" persimmon fruits in 2009 and 2010 seasons.

GA ₃ (A)	CPPU (B)	Fruit diameter (cm) diameter		Fruit length(cm)		Color Hue		Firmness	
		2009	2010	2009	2010	2009	2010	2009	2010
0	0	5.62 BC	6.02 D	5.60 C	5.67 E	73.90 F	74.32 F	19.12 A	17.53 A
	5	6.68 A	6.16 C	6.18 A	6.10 BC	75.96 E	74.19 F	13.40 DE	14.03 C
	10	6.45 A	6.26 BC	6.13 A	5.97 D	77.45 D	75.74 E	12.63 E	10.46 D
Ave (A)		6.25 A	6.15 B	5.97 A	5.91 B	75.77 C	74.75 C	15.05 B	14.01 B
10	0	6.60 A	6.42 A	5.78 B	6.00 CD	79.86 BC	80.45 C	17.66 A	13.63 C
	5	6.42 A	6.27 BC	5.57 C	6.30 A	82.99 A	81.52 B	15.11 C	13.26 C
	10	5.93 B	6.20 BC	5.83 B	6.00 CD	79.74 C	77.49 D	16.02 BC	15.45 B
Ave (A)		6.32 A	6.30 A	5.73 B	6.10 A	80.86 B	79.82 B	16.27 A	14.11 B
20	0	6.35 A	6.50 A	6.20 A	6.03 B-D	82.14 A	82.79 A	14.55 CD	18.42 A
	5	6.40 A	6.23 BC	6.17 A	6.13 B	80.94 B	80.11 C	17.57 AB	18.24 A
	10	5.30 C	6.30 B	5.30 D	6.07 B-D	82.13 A	80.98 BC	15.36 C	17.61 A
Ave (A)		6.02 B	6.34 A	5.89 A	6.08 A	81.73 A	81.29 A	15.83 AB	18.09 A
Ave (B)	0	6.19 B	6.31 A	5.86 B	5.90 C	78.63 B	79.18 A	17.11 A	16.53 A
	5	6.50 A	6.22 B	5.97 A	6.18 A	79.96 A	78.60 B	15.36 B	15.18 B
	10	5.89 C	6.25 AB	5.76 C	6.01 B	79.77 A	78.07 B	14.67 B	14.51 C

Means in each column followed by the same letter(S) are not significantly different at 5% level.

-Soluble Solids content (SSC%), Juice acidity (%) and Total tannins content :-

Data in table (6) showed that, spraying GA₃ at 10 ppm was responsible in delaying maturity of increase SSC % compared to the control and GA₃ at 20 ppm. Also, CPPU significantly increase at 5 and 10 ppm in the two seasons under study. Moreover, combined applications of Sitofex and GA₃ were different from season to another. Whereas, this difference was significantly improve of SSC% compared to the untreated trees. However, Guirguis *et al.*, (2010) found low TSS content in "Costata persimmon fruit juice studied seasons due to CPPU applications and thus delayed harvest date

Also, it is clear the obtained data in table (6) that the application of GA₃ on at 10 ppm significantly equal to control. But, 20 ppm of GA₃ has lower juice acidity compared to the untreated trees in both seasons under study. However, acidity did not differ significantly with both GA₃ or CPPU treatments. With regarding to the combination, the data presented indicated different effect observed in both seasons under study. Guirguis *et al.*, (2010) obtained high acidity content in "Costata" persimmon fruit juice due to Sitofex treatments.

Concerning the effect of GA₃ on total tannins. It had significant increase effect at 10 and 20 ppm compared with the control. But CPPU had not

significant effect on tannins content. With regarding to the combination , the data presented in table (6) showed different results in both seasons under study , These findings might be due to the role of Sitofex and

GA₃in confirmed with those obtained by Guirguis *et al.*, (2009) on persimmon.

Table (6):- Effect of GA₃ and CPPU concentrations and their combination on Soluble Solids content (SSC %), Juice acidity (%) and Total tannins content of "Costata" persimmon fruits in 2009 and 2010 seasons.

GA ₃ (A)	CPPU (B)	SSC (%)		Acidity (%)		Total tannin	
		2009	2010	2009	2010	2009	2010
0	0	13.00 E	12.33 C	0.93 AB	0.93 A	2.00 AB	1.83 BC
	5	19.00 C	23.33 A	0.82 A-C	0.75 AB	2.12 AB	1.84 BC
	10	21.53 B	19.33 B	0.74 A-C	0.71 B	1.94 B	2.04 A-C
Ave (A)		17.84 B	18.33 AB	0.83 A	0.79 A	2.02 B	1.91 B
10	0	19.67 BC	19.00 B	0.67 BC	0.78 AB	1.81 B	2.28 AB
	5	17.77 CD	20.17 B	0.56 C	0.82 AB	2.35 AB	2.53 A
	10	24.80 A	18.67 B	1.04 A	0.82 AB	2.19 AB	1.93 A-C
Ave (A)		20.74 A	19.28 A	0.76 AB	0.80 A	2.12 B	2.25 A
20	0	16.50 D	12.83 C	0.60 BC	0.38 C	2.50 AB	2.40 AB
	5	17.67 CD	18.67 B	0.78 A-C	0.74 AB	2.57 AB	2.13 A-C
	10	18.50 CD	20.33 B	0.49 C	0.78 AB	2.71 A	1.57 C
Ave (A)		17.56 B	17.28 B	0.62 B	0.63 B	2.59 A	2.03 AB
Ave (B)	0	16.39 C	14.72 C	0.73 A	0.70 A	2.10 A	2.17 A
	5	18.14 B	20.72 A	0.72 A	0.77 A	2.35 A	2.17 A
	10	21.61 A	19.44 B	0.76 A	0.77 A	2.28 A	1.85 A

Means in each column followed by the same letter(S) are not significantly different at 5% level

3.B.II Vegetative growth:-

-Total chlorophyll, Length and diameter and number of leaves per shoot:-

The promotion on total chlorophyll was different between treatments and seasons in table (7). But, GA₃ at 10 ppm alone was highest significant value in two seasons. Also, GA₃ at 20 ppm + CPPU at 10 ppm and CPPU at 5 ppm treatments were higher than other

treatments. Whereas, the minimum total chlorophyll was untreated trees in the first season. While, in the second season was equal with CPPU at 10 ppm and GA₃ at 20 ppm + CPPU at 5 ppm . However, these results were in line with those of Igbal *et al.*, (2009) who stated that GA₃ affected photoperiod.

With regards to the length and diameter, results in table(7) indicated that when concentration increased

of GA₃. It will be pervious length in two seasons. Whereas, diameter was different between treatments. The highest significant values of shoot length with GA₃ at 20 ppm +CPPU at 5 ppm. While, the significant value of shoot diameter with GA₃ at 20 ppm + CPPU at 5 ppm in two seasons study.

With regarding to the number of leaves per shoot, spraying of CPPU at 5 ppm alone was the best treatment. But, concentration increased of CPPU to 10 ppm gave Lower value. While, GA₃, applying with CPPU at 5 ppm reducing number of leaves per shoot. However, Wally *et al.*, (1999) reported an increase in vegetative growth of "Anna" apple by spraying GA₃.

3.III. Yield monetary value (EL):-

Concerning monetary value of the fruit yield, data in table (7) showed a significant better income due to

GA₃ at 0 and 10 ppm than at 20 ppm through the two studied seasons. Also, 5 ppm Sitofex significantly increased yield monetary value. Generally, the best yield monetary value was gained by: 0 ppm GA₃ +5 ppm CPPU (LE 65.09 and 69.8), 0 ppm GA₃ + 10 ppm Sitofex (LE 67.64 and 68.91) through 2009-2010 seasons respectively. However, Dutta and Banik (2007) as well as Kassem *et al.*, (2010) found that GA₃ increased the fruit weight, dimensions and ultimately crop yield by affected cell elongation.

CONCLUSION

So, it is recommended that "Costata" persimmon growers should spray their trees with 10 ppm GA₃ + 5ppm CPPU at fruit set stage to enhance the tree growth, yield and fruit characteristics, as well as, subsequently to increase crop monetary value.

Table (7):- Effect of GA₃ and CPPU concentrations and their combination on Total chlorophyll, Length, diameter, number of leaves per of shoot and Monetary value of "Costata" persimmon fruits in 2009 and 2010 seasons.

GA ₃ (A)	CPPU (B)	Chlorophyll		Shoot length (cm)		Shoot Diameter(cm)		N. of leaves /sh.		Monetary y v. (LE)	
		2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
0	0	42.80 D	48.33 CD	30.67 F	31.67 H	0.63 D	0.63 B	9.33 F	11.00 D	11.52 D	19.10 D
	5	50.70 A	50.70 AB	41.67 E	40.00 G	0.83 BC	0.93 A	22.33 A	24.67 A	65.09 A	69.80 A
	10	48.50 B	48.50 CD	42.00 E	41.33 F	0.90 B	0.80 AB	13.33 CD	20.67 B	67.64 A	68.91 A
Ave (A)		47.33 C	50.18 A	38.11 C	37.67 C	0.79 B	0.79 B	15.00 A	18.78 A	48.08 A	52.60 A
10	0	51.30 A	51.30 A	46.67 D	45.00 E	0.80 B-C	0.80 AB	15.00 C	14.67 D	64.98 A	56.92 B
	5	49.60 AB	49.60 BC	45.33 D	47.33 D	0.80 B-C	0.87 AB	19.67 B	16.33 C	46.66 B	67.13 A
	10	49.70 AB	49.70 BC	50.00 C	39.00 G	0.70 CD	0.87 AB	11.00 EF	11.33 E	22.20 C	39.81 C
Ave (A)		50.20 A	50.20 A	47.33 B	43.78 B	0.77 B	0.84 AB	15.22 A	14.11 B	44.61 A	54.62 A
20	0	46.15 C	46.15 E	55.67 B	55.33 C	0.83 BC	1.00 A	11.00 EF	13.33 D	24.58 C	40.70 C
	5	47.88 B	47.88 D	60.67 A	62.00 B	1.23 A	1.00 A	11.00 EF	14.00 D	40.11 B	39.38 C
	10	50.98 A	50.98 AB	59.33 A	65.67 A	0.80 B-D	0.80 AB	12.67 DE	17.00 C	21.23 C	38.38 C
Ave (A)		48.34 B	48.34 B	58.56 A	61.00 A	0.96 A	0.93 A	11.56 B	14.78 B	28.64 B	39.49 B
Ave (B)	0	46.75 B	49.59 A	44.33 C	44.00 C	0.76 B	0.81 A	11.78 B	13.00 C	33.69 B	38.9 C
	5	49.39 A	49.39 A	49.22 B	49.78 A	0.96 A	0.93 A	17.67 A	18.33 A	50.62 A	58.77 A
	10	49.73 A	49.73 A	50.44 A	48.67 B	0.80 B	0.82 A	12.33 B	16.33 B	37.03 B	37.03 B

Means in each column followed by the same letter(S) are not significantly different at 5% level.

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