

## Effect of Gibberellic Acid Alone or Combined with Two Antioxidants on Fruit Set, Yield and Fruit Quality of "Hollywood" and "Golden Japanese" Plum Cultivars

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**T**HE PRESENT investigation was conducted during two successive seasons of 2011 and 2012 on "Hollywood" and "Golden Japanese" plum trees (*Prunus salicina*). The trees were 15 years old and grown in private orchard at Menofia governorate. Gibberellic acid at 25 and 50 ppm alone or combined with citric or ascorbic acid at 50 ppm were sprayed twice (at full bloom and 2 weeks later) on both plum cultivars.

All treatments increased fruit set (%) and fruit yield (Kg/tree) and improved fruit quality of the two cultivars in the two studied seasons. The most effective treatment on fruit yield increment and fruit quality improvement was spraying gibberellic acid at 50 ppm combined with citric or ascorbic acid at 50 ppm (at full bloom and 2 weeks later).

**Keywords:** Plum, Hollywood, Golden Japanese, Yield and Fruit set.

Plums (*prunus salicina*) are occupying an important tree share in the total fruit production of Egypt. The total area of plums in Egypt reached about 2645 Feddans, according to the census of the Ministry of Agriculture. Egypt produced 7376 tons of plum fruits with an average yield of 2.99 tons / Fed. (Ministry of Agriculture, 2010).

Gibberellic acid (GA) has an important role in fruit set. There are three important actions (mode of action) for GA. The first is that GA intensifies an organ ability to function as a nutrient sink. The second action is the ability of GA to increase the synthesis of IAA in plant tissues. The third one involves accelerating synthesis of hydrolytic enzymes as amylase in the aleurone layer of seeds (Addicott & Addicott, 1982).

In order to increase persimmon fruit set and reduce fruit abscission, trees were treated with various growth regulators. A spray of gibberellic acid at a concentration of 15–30 ppm at full bloom significantly increased yield (by 50–400%). In young persimmon trees (4–5 years old), a narrow (2–3 mm) girdling at the time of sprouting, together with GA<sub>3</sub>, gave best results (Blumenfeld, 1981). It has been found that mixing GA<sub>3</sub> with foliar fertilizer (N, P, K, Mn, Fe and Zn) increased the yield of "Valencia" orange trees (Soliman, *et al.*, 1985). It had been reported that the combination of GA<sub>3</sub> and AVG (aminoethoxylevinylglycine) delay fruit maturation, increase fruit size and improve storage life of 'Feicheng'

peaches (Zhiguo *et al.*, 1999). Abd El-Mageed, *et al.* (2007) on "Canino" apricot and Chitu *et al.* (2007) on pear found that the highest fruit set, yield and fruit quality were obtained by spraying GA<sub>3</sub> at 20 ppm at full bloom as compared with untreated trees (the control). Moreover, sweet cherry (*Prunus avium*) trees treated with the optimum concentration of GA<sub>3</sub> (25 ppm) in two different locations yielded fruits with 13.4% and 14.1% greater weight and 38% and 25% higher firmness compared to control (Canli and Orhan, 2009).

Ascorbic acid and citric acid are two natural and organic antioxidants have auxinic action, they provided disease control against most fungi infections on different fruit trees (Elad, 1992). These compounds had synergistic effect on improving growth and productivity of "Flame Seedless" grapes (Farag, 1996). Ascorbic and citric acids spraying at 200, 300 and 400 ppm and active dry yeast at 3 g/L increased yield as kg/tree, fruit weight, pulp firmness, total soluble solids (TSS), ascorbic acid, starch (%), reducing sugars, non-reducing sugars, total sugars and total phenols of "Alphonse" and "Badami" mango fruits (Awad, 2006). Ascorbic acid is a highly abundant metabolite and has an important role in plant stress physiology. It is a key antioxidant, enzyme co-factor and precursor for oxalate and tartarate as well as plays a role in photo-protection, wounding response, insect herbivory and cell expansion (Conklin, 2001). Moreover, "Anna" apple fruit physical and chemical characteristics were improved by spraying citric acid at 0.1% at three times: at growth start, just after fruit set and at 21 days later (Ahmed and Abd El-All, 2007). Moreover, Mohamed (2008) found that spraying "Kelsey" plum trees by some antioxidants (Tryptophan, ascorbic acid and vitamin E) increased yield and improved fruit quality as compared with the untreated trees. Recently, Wally, *et al.* (2012) found that spraying GA<sub>3</sub> plus two antioxidants (citric and ascorbic acids) increased "Canino" apricot crop and improved fruit quality. Also, applied antioxidants (ascorbic acid at 250 mg/l, salicylic acid at 250 mg/l, seaweed extract acid at 1000 mg/l and yeast extract at 1000 mg/l) by (pre-soaked or foliar spray) on soybean plant increased seed yield of plants grown under salinity stress compared with the control (Sakr *et al.*, 2013).

The aim of the present investigation was to study the effect of spraying gibberellic acid alone or combined with two antioxidants namely citric and ascorbic acids at different concentrations on fruit set, yield and fruit quality of "Hollywood" and "Golden Japanese" plum (*Prunus salicina*) cultivars during two successive seasons of 2011 and 2012

### Materials and Methods

The present investigation was conducted during the two successive seasons of 2011 and 2012 on "Hollywood" and "Golden Japanese" plum (*Prunus salicina*) cultivars grown at a private orchard in El-Monofia governorate. The selected trees were 15-years old, almost uniform in vigor, grafted on Mariana rootstock and planted at 6 x 6 m apart. Twenty one trees were chosen for each cultivar for

carrying out 7 treatments in this study, each treatment was replicated three times (one tree for each replicate) according to a Randomized Complete Block Design. Gibberellic acid, citric acid and ascorbic acid were sprayed twice (at full bloom and 2 weeks later) and the treatments were arranged as follows:

- Control (sprayed with tap water).
- GA<sub>3</sub> spraying at 25 ppm.
- GA<sub>3</sub> spraying at 50 ppm.
- Citric acid at 50 ppm.
- Ascorbic acid (vitamin C) at 50 ppm.
- GA<sub>3</sub> spraying at 50 ppm. + Citric acid at 50 ppm.
- GA<sub>3</sub> spraying at 50 ppm. + Ascorbic acid (vitamin C) at 50 ppm.

All the sprayed substances were sprayed until run off (5 L/tree).

During the two study seasons, four branches representing all tree sides were chosen at random and labeled before spraying. Fruit set (%) was measured by calculated the number of set fruits/100 flowers.

At picking date, average number of fruits/tree was counted and fruit yield (Kg/tree) was calculated by multiply number of fruits/tree x the average of fruit weight. Samples of twenty fruits from each replicate were taken to determine the following characteristics:

- Average fruit weight (gm).
- Average fruit volume (cm<sup>3</sup>).
- Average fruit dimensions (length and diameter cm).
- Average fruit firmness (lb/inch<sup>2</sup>) was estimated by Magness and Taylor (1925) pressure tester.
- Total soluble solids (%) of fruit juice was estimated by using hand refractometer.
- Total acidity (%) was calculated as mg malic acid/100g fresh weight (A.O.C.A., 1990).
- TSS/acid ratio was determined.

#### *Statistical analysis:*

All obtained data were statistically analyzed according to Steel and Torrie (1980). New L.S.D. at 5% test was used for comparison between means of the studied treatments.

## **Results and Discussion**

### *Fruit set*

Results in Table 1 show the effects of gibberellic acid at 25 and 50 ppm alone or combined with citric and ascorbic acids at 50 ppm on fruit set (%) of "Hollywood" and "Golden Japanese" plum. All sprayed treatments increased significantly fruit set (%) as compared with the unsprayed treatment (control). The highest fruit set values (25.8 and 24.8%) for "Hollywood" and (32.5 and 43.88%) for "Golden Japanese" were recorded by the treatment of spraying

gibberellic acid at 50 ppm combined with citric acid at 50 ppm as compared with the lowest values (17.29 and 16.9%) for “Hollywood” and (26.58 and 25.52%) for “Golden Japanese” which resulted from the control treatment, in the first and second seasons, respectively. The other treatments recorded in between fruit set values.

The current results agree with those obtained by Blumenfeld (1981) and El-Sheikh *et al.* (1999) using gibberellic acid at 15-30 ppm at full bloom on persimmon; and those reported by Abd El-Megeed *et al.* (2007) and Chitiu *et al.* (2007) who used GA<sub>3</sub> and boron on “Canino” apricot and pear and with those indicated by Canli and Orhan, (2009) applying gibberellic acid on sweet cherry. As for antioxidants effects, the present results are in line with the results of Farag (1996) on grapevine, the results revealed on “Anna” apple by spraying citric acid at 0.1% at three times: at growth start, just after fruit set and at 21 days later (Ahmed and Abd El-All, 2007) and the previous results of Mohamed (2008) who found that spraying “Kelsey” plum trees by some antioxidants (Tryptophan, ascorbic acid and vitamin E) increased yield and improved fruit quality as compared with the untreated trees. Also, the present results are in harmony with those of Wally *et al.* (2012) who studied the effect of gibberellic acid and two antioxidants (citric and ascorbic acids) on yield and fruit quality of “Canino” apricot trees.

**TABLE 1. Effect of spraying GA<sub>3</sub> alone or combined with two antioxidants on fruit set (%) for plum fruits during 2011 and 2012 seasons.**

Treatments	Fruit set (%)			
	Hollywood		Golden Japanese	
	2011	2012	2011	2012
Control	17.29 c*	16.90 c	26.58 c	25.52 c
GA <sub>3</sub> at 25 ppm	21.23 b	20.10 b	28.27 b	39.36 b
GA <sub>3</sub> at 50 ppm	22.11 b	21.25 b	29.10 b	39.56 b
Citric acid at 50 ppm	22.15 b	21.70 b	29.90 b	41.20 b
Vitamin C (ascorbic acid) at 50 ppm	22.78 b	22.75 b	29.5 b	40.90 b
GA <sub>3</sub> at 50 ppm + Citric acid at 50 ppm	25.80 a	24.80 a	32.5 a	43.88 a
GA <sub>3</sub> at 50 ppm + Vitamin C at 50 ppm	23.93 a	24.10 a	31.9 a	42.36 a

\*Values having the same letter(s) within the same column are not statistically significant using new L.S.D. at 5%.

#### *Fruit yield*

Results in Table 2 indicate the effect of gibberellic acid at 25 and 50 ppm alone or combined with citric and ascorbic acids at 50 ppm on fruit number/tree and yield (Kg/tree) of “Hollywood” and “Golden Japanese” plum cultivars. The fruit number/tree was different from season to season and from cultivar to another and that reflect to fruit weight. The high number of fruits results from small fruits. The good indicator of the yield was the yield weight (Kg /per tree).

All sprayed treatments increased significantly yield (Kg/tree) as compared with the unsprayed treatment (control). As regard to "Hollywood" cultivar, the highest yield (Kg/tree) value (19.96 Kg/tree) in the first season was recorded by the treatments of spraying gibberellic acid at 50 ppm combined with citric acid at 50 ppm and (24.18 Kg/tree) in the second season was recorded by the treatment of gibberellic acid alone at 50 ppm as compared with the lowest values (13.87 and 16.00 Kg/tree) which resulted from the control treatment, in both first and second seasons, respectively. The other treatments recorded in between yield (Kg/tree) values. As regard to "Golden Japanese" cultivar, the highest yield (Kg/tree) values (39.63 and 25.46 Kg/tree) were recorded by the treatment of gibberellic acid at 50 ppm combined with ascorbic acid at 50 ppm as compared with the lowest values (25.70 and 19.41 Kg/tree) which resulted from control treatment, in the first and second seasons, respectively. The other treatments recorded in between yield (Kg/tree) values.

**TABLE 2. Effect of spraying GA<sub>3</sub> alone or combined with two antioxidants on tree yield for plum fruits during 2011 and 2012 seasons.**

Treatments	Number of fruits/tree				Yield (Kg/tree)			
	Hollywood		Golden Japanese		Hollywood		Golden Japanese	
	2011	2012	2011	2012	2011	2012	2011	2012
Control	400b*	475 c	802 b	648 a	13.87 b	16.00 c	25.70 c	19.41 c
GA <sub>3</sub> at 25 ppm	402 b	568 b	939 a	548 b	14.89 b	20.10 b	34.89 b	21.24 b
GA <sub>3</sub> at 50 ppm	500 a	622 a	893 b	594 b	17.29 a	24.18 a	35.90 a	22.58 b
Citric acid at 50 ppm	458 a	510 b	800 b	570 b	18.10 a	18.72 b	28.74 b	20.34 b
Vitamin C (ascorbic acid) at 50 ppm	484a	486 c	779 b	502 c	18.35 a	17.65 b	28.49 b	22.50 b
GA <sub>3</sub> at 50 ppm + Citric acid at 50 ppm	508a	510 b	1000a	550 b	19.96 a	19.20 b	36.98 a	24.42 a
GA <sub>3</sub> at 50 ppm + Vitamin C at 50 ppm	470a	539 b	957 a	497 c	18.20 a	19.79 b	39.63 a	25.46 a

\*Values having the same letter(s) within the same column are not statistically significant using new L.S.D. at 5%.

The current results were in harmony with those obtained by Blumenfeld (1981) using gibberellic acid at 15-30 ppm at full bloom on persimmon; and those reported by Abd El-Megeed *et al.* (2007) who used GA<sub>3</sub> and boron on "Canino" apricot and with those of Canli and Orhan, (2009) applying gibberellic acid on sweet cherry. As for antioxidants effects, the present results were in line with the results of Farag (1996) on grapevine, the results revealed on "Anna" apple by spraying citric acid at 0.1% at three times at growth start, just after fruit set and at 21 days later (Ahmed and Abd El-All, 2007) and the previous results of Mohamed (2008) who found that spraying "Kelsey" plum trees by some antioxidants increased yield and improved fruit quality as compared with the untreated trees. Also, the present results agree with those of Wally *et al.* (2012) who studied the effect of gibberellic acid and two antioxidants (citric and ascorbic acids) on yield and fruit quality of "Canino" apricot trees. Moreover, Sakr *et al.* (2013) on soybean plant and Khafagy *et al.* (2013) on hibiscus.

### *Fruit physical characteristics*

#### *Fruit weight, volume and dimensions*

The effects of gibberellic acid at 25 and 50 ppm alone or combined with citric and ascorbic acids at 50 ppm on fruit weight, volume and dimensions of "Hollywood" and "Golden Japanese" plum cultivars are presented in Table 3. All treatments increased significantly fruit weight (g), volume (cm<sup>3</sup>) and fruit dimensions (length and diameter (cm) as compared with the control (untreated trees). The most effective treatment on increments of fruit weight, volume and dimensions of fruit for both cultivars; "Hollywood" and "Golden Japanese" plum was spraying gibberellic acid at 50 ppm combined with citric or ascorbic acid at 50 ppm followed by the treatments of using gibberellic acid alone.

As regard to gibberellic acid effects on fruit weight, volumes and dimensions, the obtained results were in agreement with those obtained by Abd El-Megeed *et al.* (2007) using gibberellic acid and boron on "Canino" apricot and with those reported by Canli & Orhan (2009) of applying gibberellic acid on sweet cherry. However, GA<sub>3</sub> application may stimulate cell expansion and thus increase fruit weight (Zilkah *et al.*, 1997). Zhiguo *et al.* (1999) stated that GA<sub>3</sub> application can delay fruit maturation on the tree, increase fruit weight and prolong the marketing season by four weeks. As for antioxidants effects, the present results were in line with the results obtained on "Anna" apple fruit physical and chemical characteristics which were improved by spraying citric acid at 0.1% at three times: at growth start, just after fruit set and at 21 days later (Ahmed & Abd El-All, 2007) and the previous results of Mohamed (2008) who found that spraying "Kelsey" plum trees by some antioxidants (tryptophan, ascorbic acid and vitamin E) increased yield and improved fruit quality as compared with the untreated trees. Conklin (2001) stated that ascorbic acid was involved in plant cell division where its level is high in meristematic tissues and low in zones with little active cell division. Moreover, the present results were in harmony with those of Wally *et al.* (2012) who studied the effect of gibberellic acid and two antioxidants (citric and ascorbic acids) on yield and fruit quality of "Canino" apricot trees.

#### *Fruit firmness*

Fruit firmness (lb/Inch<sup>2</sup>) of "Hollywood" and "Golden Japanese" plum cultivars as affected by spraying gibberellic acid at 25 and 50 ppm alone or combined with citric acid and ascorbic acid at 50 ppm are presented in Table 4. Some sprayed gibberellic acid treatments and two antioxidants treatments increased fruit firmness (Lb/Inch<sup>2</sup>) compared to unsprayed treatment (control) for the two studied cultivars in both studied seasons.

However, Facticeau (1982) found a positive effect of GA<sub>3</sub> on pectin fractions in fruits where GA<sub>3</sub> may increase flesh firmness or delay fruit softness by some mechanisms involving less methylation of pectins which would leave more sites for Ca binding. Also, the present results were in agreement with the previous results of Mohamed (2008) who found that spraying "Kelsey" plum trees by some antioxidants (Tryptophan, ascorbic acid and vitamin E) increased yield and improved fruit quality as compared with the untreated trees. Moreover, the

present results were in harmony with those of Wally *et al.* (2012) who studied the effect of gibberellic acid and two antioxidants (citric and ascorbic acids) on yield and fruit quality of "Canino" apricot trees.

#### *Chemical Characteristics*

##### *Total Soluble Solids*

Results in Table 4 indicate the effects of gibberellic acid at 25 and 50 ppm alone or combined with citric acid and ascorbic acid at 50 ppm on TSS (%) of "Hollywood" and "Golden Japanese" plum fruit cultivars. There were no significant differences between all treatments and the control.

##### *Acidity*

Fruit juice acidity percentages of "Hollywood" and "Golden Japanese" plum fruit cultivars as affected by gibberellic acid at 25 and 50 ppm alone or combined with citric acid and ascorbic acid at 50 ppm were presented in Table 4. All treatments decreased fruit juice acidity (%) without significant differences compared to the control (0.76 and 0.89%) for "Hollywood" as well as (1.07 and 1.10%) for "Golden Japanese" cultivars. However, GA<sub>3</sub> at 50 ppm in 2011 season (0.56%) as well as vitamin C (0.80 and 0.85%) in 2011 and 2012 seasons decreased acidity significantly.

##### *TSS/acid ratio*

Results in Table 4 reveal the effects of spraying gibberellic acid at 25 and 50 ppm alone or combined with citric acid and ascorbic acid at 50 ppm on TSS/ acid ratio of "Hollywood" and "Golden Japanese" plum fruit cultivars. All sprayed treatments increased significantly fruit TSS/acid ratio of fruits of the two cultivars as compared with the unsprayed treatment (control) during the two studied seasons (15.79, 15.80, 9.91 and 9.09). The most effective treatment on TSS/acid ratio was the spraying of gibberellic acid at 50 ppm on "Hollywood" cv. (18.46 and 16.62) as well as vitamin C "Golden Japanese" (13.38 and 12.12) as compared with the lowest values of the control in the two studied seasons on the two cultivars.

The presented results were in harmony with those obtained by Blumenfeld (1981) using gibberellic acid at 15-30 ppm at full bloom on persimmon; and those reported by Abd-El-Megeed *et al.* (2007) who used GA<sub>3</sub> and boron on "Canino" apricot and with those indicated by Canli and Orhan (2009) applying gibberellic acid on sweet cherry. As for antioxidants effects, the present results were in line of the results of Farag (1996) on grapevine, the results revealed on "Anna" apple by spraying citric acid at 0.1% at three times: at growth start, just after fruit set and at 21 days later (Ahmed and Abd El-All, 2007) and the previous results of Mohamed (2008) who found that spraying "Kelsey" plum trees by some antioxidants (Tryptophan, ascorbic acid and vitamin E) increased yield and improved fruit quality compared to control. Also, the present results were in agreement with those of Wally *et al.* (2012) who studied the effect of gibberellic acid and two antioxidants (citric and ascorbic acids) on yield and fruit quality of "Canino" apricot trees.

**TABLE 3. Effect of spraying GA<sub>3</sub> alone or combined with two antioxidants on weight, volume and dimensions of plum fruits during 2011 and 2012 seasons.**

Treatments	Fruit weight (g)						Fruit volume (ml)						Fruit dimensions						
	Hollywoood			Golden Japanese			Hollywoood			Golden Japanese			Fruit length (cm)			Fruit diameter (cm)			
	2011	2012		2011	2012		2011	2012		2011	2012		2011	2012		2011	2012		
Control	34.68 b*	33.67 b	32.05 b	29.94 c	34.44 b	33.66 b	31.10 b	28.88 b	3.80 b	3.82 b	3.80 b	3.80 b	3.53 b	3.60 b	3.69 b	3.68 b	3.57 b		
GA <sub>3</sub> at 25 ppm	37.00 a	35.38 a	37.14 a	38.93 ab	36.88 a	36.66 a	35.55 a	36.66 a	3.91 a	3.99 a	3.90 b	3.86 a	3.81 a	3.84 a	3.91 a	3.84 a			
GA <sub>3</sub> at 50 ppm	38.43 a	35.89 a	40.19 a	38.00 ab	36.55 a	36.88 a	36.88 a	35.88 a	3.98 a	4.01 a	4.03 a	3.97 a	3.84 a	3.85 a	3.95 a	3.96 a			
Citric acid at 50 ppm	39.54 a	36.71 a	35.93 a	35.66 b	37.55 a	35.77 a	36.88 a	35.55 a	3.98 a	3.97 a	3.99 a	3.93 a	3.92 a	3.84 a	3.88 a	3.76 a			
Vitamin C (ascorbic acid) at 50 ppm	37.90 a	36.28 a	36.59 a	44.82 a	36.66 a	36.00 a	35.55 a	36.67 a	3.97 a	4.00 a	3.81 a	3.99 a	3.83 a	3.85 a	3.89 a	4.10 a			
GA <sub>3</sub> at 50 ppm + Citric acid at 50 ppm	39.25 a	36.26 a	36.97 a	44.42 a	36.90 a	37.44 a	36.66 a	40.33 a	3.98 a	4.08 a	3.99 a	4.20 a	3.87 a	3.86 a	3.96 a	4.13 a			
GA <sub>3</sub> at 50 ppm + Vitamin C at 50 ppm	38.70 a	36.68 a	41.43 a	51.22 a	37.10 a	37.88 a	37.66 a	41.10 a	3.95 a	3.99 a	4.05 a	3.40 a	3.81 a	3.87 a	3.99 a	4.18 a			

\*Values having the same letter(s) within the same column are not statistically significant using new L.S.D. at 5%.

**TABLE 4. Effect of spraying GA<sub>3</sub> alone or combined with two antioxidants on firmness, TSS, acidity and TSS/acid ratio of plum fruits during 2011 and 2012 seasons.**

Treatments	Fruit firmness (lb/inch <sup>2</sup> )						TSS (%)						Acidity (%)						TSS/acid ratio					
	Hollywood		Golden Japanese		Hollywood		Golden Japanese		Hollywood		Golden Japanese		Hollywood		Golden Japanese		Hollywood		Golden Japanese					
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012				
Control	6.40b*	5.39b	4.00b	4.18b	12.0a	11.4a	10.9a	10.0a	0.76a	0.88a	1.10a	1.10a	15.79b	12.80b	9.91b	9.09b								
GA <sub>3</sub> at 25 ppm	6.77a	6.82a	4.63a	4.84a	11.7a	11.9a	11.7a	9.8a	0.64a	0.87a	1.00a	0.90a	18.28a	13.67a	11.70a	10.88a								
GA <sub>3</sub> at 50 ppm	6.79a	5.94a	4.88a	4.87a	12.0a	12.3a	11.0a	10.2a	0.56b	0.74a	1.00a	1.01a	18.46a	16.62a	11.00a	10.10a								
Citric acid at 50 ppm	7.03a	6.87a	4.78a	4.85a	12.0a	11.6a	10.7a	10.0a	0.74a	0.65a	0.90a	1.02a	16.22a	13.65a	11.89a	9.90a								
Vitamin C at 50 ppm	6.86a	5.96a	4.72a	4.80a	11.7a	12.0a	10.7a	10.3a	0.67a	0.74a	0.80b	0.80b	17.46a	16.22a	13.38a	12.12a								
GA <sub>3</sub> at 50 ppm + Citric acid (ascorbic acid) at 50 ppm	7.15a	5.96b	4.82a	4.97a	11.5a	12.0a	10.9a	10.1a	0.67a	0.82a	0.94a	0.94a	17.16a	14.63a	11.60a	10.86a								
GA <sub>3</sub> at 50 ppm + Vitamin C at 50 ppm	7.31a	5.92a	4.74a	4.99a	11.5a	11.6a	10.2b	10.0a	0.67a	0.85a	0.95a	1.02a	17.16a	13.64a	10.74a	10.43a								

\*Values having the same letter(s) within the same column are not statistically significant using new L.S.D. at 5%.

### Conclusion

It can be concluded that, the best treatment to increase fruit set, yield and improve fruit quality of "Hollywood" and "Golden Japanese" plum cultivars can be obtained by spraying 50 ppm of gibberellic acid mixed by 50 ppm of citric or ascorbic acid twice (at full bloom and two weeks later).

Table (3): Effect of spraying GA<sub>3</sub> alone or combined with two antioxidants on weight, volume and dimensions of plum fruits during 2011 and 2012 seasons.

### Reference

- Association of Official Agricultural Chemists (A.O.A.C.) (1990)** *Official Methods of Analysis*. Benjamin Franklin Station, Washington D.C., USA pp. 495-510.
- Abd El-Mageed Nagwa A. Malka S. Naeima and Wally, A.S.M. (2007)** Effect of gibberellic acid and boron spraying on yield and fruit quality of "Canino" apricot trees grown in calcareous new reclaimed soils. *The 1<sup>st</sup> international Conference on desert cultivation. Future of desert cultivation problems & solutions. 27-29 March, Minia Univ.* pp 317 – 326.
- Addicott, F.T. and Addicott, A.B. (1982)** Abscission. Un. Ca. Press. Ltd. London, England. pp. 130-135.
- Ahmed, F.F. and Abd El-Ail, A.M.K. (2007)** Influence of spraying seaweed extract and citric acid on yield and fruit quality of "Anna" apple trees. *1<sup>st</sup> Inter. Conf. Desert Cultivation Problems and Solutions, Minia Univ. 27-29 March:* pp. 253-261.
- Awad, R.U.A. (2006)** Effect of some natural preharvest treatments on mineral content, yield, fruit quality and storability of mango fruits. *Ph.D. Thesis, Fac. Agric., Alex. Univ.* p. 111.
- Blumenfeld, F.A. (1981)** Increasing persimmon yields with gibberellic acid. *Acta Hort. (ISHS)* **120**, 237-239.
- Canli, A. and Orhan, H. (2009)** Effects of Preharvest Gibberellic Acid Applications F on Fruit Quality of '0900 Ziraat' Sweet Cherry. *Hort Technology*, **19**, 5-229.
- Chitu, V., Chitu, E. and Braniste, N. (2007)** Effect of GA<sub>3</sub> and paclobutrizol treatments on fruit set and yield of : "Beurre Bosce" and "Triumpf" pears cultivars. *Acta Hort.*, **800**, 452-465.
- Conklin, P.L. (2001)** Recent advances in the role and biosynthesis of Ascorbic acid in plants. *Plant, Cell and Environment*, **24**, 383-394.
- Elad, Y. (1992)** The use of antioxidants to control gray mould (*Botrytic cinera*) and white mould (*Sclerotinia Sclerotiorum*) in various crops. *Plant Pathol.*, **141**, 417-426.
- El-Sheikh, A.R., Bahan, M.K. and Hamza, A.Y. (1999)** The effect of girdling and some growth regulators in fruit drop of persimmon. *Acta Agriculturae Universitatis Jiangxieensis*, 2004 (rd26) No. **5**, 754-758.

- Facteau, T.J. (1982)** Levels of pectic substances and calcium in gibberellic acid treated Sweet cherry fruit. *J. Amer. Soc. Hort. Sci.*, **107**(1),148-151.
- Farag, K.M. (1996)** Use of urea, phenylalanine, thiamine or their combination to accelerate anthocyanin development and their effect on the storage life of flame seedless grapes. *The first Egyptian Hungarian Hort. Conf. Kafr EL-Sheikh, Egypt. 15-17 Sept.*
- Khafagy, M.A., Abd alla, M.Y.A. Hussein, H.A.A. and Sara Ahmed, A.M. (2013)** Response of Hibiscus rosa-Sinensis L. to the interactive effect of Seawater salinity and Ascorbic acid. *J. Plant Production, Mansoura Univ.*, **4**(1), 51-78.
- Magness, J.R. and Taylor, C.F. (1925)** An improved type of pressure for the determination of fruit maturity. U.S. Dept. Agric., pp. 350–358.
- Ministry of Agriculture Statistics, (2010)** Central Management of Horticulture., Egypt.
- Mohamed, H.M.A. (2008)** Response of "Kelsey" plum trees to application of some antioxidants. M. Sci. Fac. Agric., Minia University.
- Sakr, M.T., Heba M. Abd El-Salam, Marouah I. Atta and M.A.A. Abd El-Aal (2013)** Alleviating the harmful effect of salinity stress on Soybean plants by using some promoters. *J. Plant Production, Mansoura Univ.*, **4**(2), 205-218.
- Soliman, A. F., Saad-Alla, M. A. and El-Nokrashi M. A. (1985)** Effect of foliar sprays of some nutrients, GA<sub>3</sub> and 2,4-D on "Valencia" orange trees. *Agric. Res. Review*, **63** (3), 35-48.
- Steel, R.G.D. and Torrie, T.H. (1980)** *Principles and Procedures of Statistics*. 2<sup>nd</sup> ed. McGraw Hill, N.Y. USA.
- Wally, A.S., Nagwa, A. Abd El-Megeed and Fattma Abou-Grah (2012)** Effect of gibberellic acid and two antioxidants on yield and fruit quality of "Canino" apricot trees. *Minia International Conference for Agriculture and Irrigation in the Nile Basin Countries, 26 -29 March 2012, El-Minia, Egypt.*
- Zhiguo, J., Yousheng, D. and Zhiqiang, J. (1999)** Combinations of GA<sub>3</sub> and AVG delay fruit maturation, increase fruit size and improve storage life of 'Feicheng' peaches. *J. Hort. Sci. and Biotech*,**74**(5), 579-583.
- Zilkah, S., Lurie, S., Lapsker, Z., Zuthi, Y., David, G., Yesselson, Y., Antman, S. and Ben Aric, R. (1997)** The ripening and storage quality of nectarine fruits in response preharvest application of gibberellic acid. *J. Hort. Sci.*, **72**, 355-362.

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تأثير حمض الجبريليك منفرداً أو مخلوطاً مع إثنين من مضادات  
الأكسدة على العقد والإنتاج وصفات الجودة لثمار البرقوق صنفى  
"هوليود" و"ياباني ذهبى"

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تم اجراء البحث فى مزرعة برقوق خاصة فى محافظة المنوفية خلال موسمى  
٢٠١١ و٢٠١٢. حيث تم رش حمض الجبريليك منفردا بتركيز ٢٥ و ٥٠  
جزء بالمليون أو مخلوط بـ حمض الستريك أو حمض الأسكوربيك (فيتامين C)  
بتركيز ٥٠ جزء بالمليون مرتين (عند تمام الإزهار وبعده بأسبوعين) على أشجار  
برقوق عمر ١٥ سنة صنفى (هوليود و ياباني ذهبى).

وقد أدت كل المعاملات إلى زيادة معنوية فى عقد الثمار (%) وكمية الإنتاج  
(كجم/شجرة) وتحسين صفات الجودة للثمار عند المقارنة بالأشجار الغير معاملة  
(الشاهد). وكانت أفضل المعاملات لغرض زيادة العقد والإنتاج وتحسين جودة  
الثمار هي رش حمض الجبريليك بتركيز ٥٠ جزء بالمليون مخلوطاً بـ حمض  
الستريك أو حمض الأسكوربيك (فيتامين C) بتركيز ٥٠ جزء بالمليون مرتين  
(عند تمام الإزهار وبعده بأسبوعين).