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EFFECT OF GIBBERELLINS APPLICATION ON FRUIT ANATOMY, YIELD AND FRUIT QUALITY OF "LE CONTE" PEAR

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ABSTRACT

This investigation was carried out during 2014 and 2015 seasons on nine years-old of Le conte pear trees budded on petchefolia rootstock to evaluate the effect of spraying trees with GA_3 or GA_{4+7} at 20 ppm once at full bloom or twice at full bloom and after fruit set on fruit anatomical characteristics, fruit set, yield and fruit quality of Le conte pear trees. The current results revealed that spraying trees with GA_3 or GA_{4+7} induced an increase in the number of cells in mesocarp which may be considered as indicator for finial fruit weight. Moreover, sprayed trees with GA_{4+7} twice at full bloom and after fruit set led to an increase in average fruit weight more than those sprayed with GA_3 or GA_{4+7} once at full bloom. Also, sprayed Le conte trees with GA_3 or GA_{4+7} significantly increased fruit set, number of fruits and yield/tree as compared to the untreated one. Furthermore, sprayed trees with GA_{4+7} at 20 ppm at full bloom and after fruit set gave a higher pronounced effect in this respect. Consequently, sprayed trees with GA_3 or GA_{4+7} gave a higher values of fruit firmness, total acidity but reduced the values of SSC and SSC/acid ratio in fruit juice as compared to the control.

INTRODUCTION

Pear (*Pyrus communis*, L) is considered one of the most important crops among the other deciduous fruit trees. Le conte is the main pear cultivar grown in Egypt since, the total cultivated area in Egypt reached about 8560 fed. with an annual total production of about 66403 metric tons according to FAO (2013). Le conte pear is one of late blooming coincides with weather period favorable for blight infections and fruit shedding (Stino, 1987) and was taken to have chilling requirements led to delay foliation, poor bud break, also delayed and prolonged the period of blooming (Erez, 1987). Dormancy breaking agents are being used in warm regions for controlling bud break of pear trees. Changes in endogenous bud substances play an important role in breaking dormancy (Shalan, 2009).

Pear growers aimed to improve the low productivity of the tree through various cultural practices as pruning, fertilizers and application of plant growth regulators. In this respect, Zhang *et al*. (2008) reveal that gibberellins play an important role in fruit set and development. Furthermore, Vladymyr and Michael (2005) found that spraying Le conte pear trees with GA_3 or GA_{4+7} increased the fruit set. Recently, GA_3 was used to improve fruit set and fruit quality of Le conte pear fruits (Yehia and Hassan, 2005 and Hegazi, 2011).

The fruit size in *Pyrus spp.* has mainly resulted from shifts in the ability of cells to divide rather than to enlarge (Zhang *et al.,* 2006).Also, Dreyer (2013) mentioned that cell division became very active in pear fruit approximately 7 to 14 days after full bloom with the main cell division period lasting until approximately 28 days after full bloom. Although actual size depends on the interaction between genetics and environment, the potential size of fruit is genetically determined. The cell number in the mesocarp at the cessation of the cell division is crucial for determining final fruit size in *Pyrus spp*. (Zhang et al., 2006).

Therefore, the anatomical characters of the Le conte pear fruit as well as its stalk (pedicel) during two developmental stages under the influence of the GA_3 and GA_{4+7} were investigated. In addition, the effect of these treatments on fruit set, yield and fruit quality of Le conte pear fruit were also evaluated.

MATERIALS AND METHODS

Plant materials and experimental procedure:

This experiment was carried out during the two successive seasons of 2014 and 2015 on le conte pear trees to evaluate the effect of spraying trees with GA_3 or GA_{4+7} on fruit anatomy, fruit set yield and fruit quality. Le conte pear trees were nine years - old budded on petchefolia rootstock, grown in a sandy soil, under drip irrigation system, cultivated at 4m between trees and 6m within rows at a private orchard, located at El-Khatatba City, Monofia Governorate. Forty trees in the same growth stage and vigor were selected for this study. Treatments were replicated four times, each replicate was represented by two trees in a complete randomized block design and presented in the following treatments:

No.	Treatments
1	Control (trees sprayed with tap water)
2	Trees sprayed with GA_3 at 20 ppm at full bloom stage.
3	Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage.
4	Trees sprayed with GA_3 at 20 ppm at full bloom stage and after fruit set.
5	Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage and after fruit set.

Trees were sprayed with GA_3 or GA_{4+7} at full bloom stage (when 80% of flowers reached full opening) and the others were immediately after fruit set. Twenty spurs on each tree were tagged randomly before treatment to estimate average fruit set after 60 days from full bloom as number of fruits/ spur.

Samples of fruits (4 fruits and their stalks (pedicel)) from each treatment were collected at 30 and 45 days after full bloom from trees treated twice with GA_{4+7} in addition to control at full bloom and after fruit set during the 2nd growing season 2015 since, it showed the most remarkable effect as compared to all other treatments or the control during the first season. The fruit was cut along the equatorial region in addition to fruit pedicel (5mm long) at its middle part. All specimens of fruits and stalks (pedicel) were immediately killed and fixed in F.A.A

solution (ethanol 70% : formalin : glacial acetic acid , 85:10:5) washed, dehydrated in series of ethanol (50,.70,80,90 and 100%), cleared in series of ethanol : xylene (3:1 – 1:1- 1:3 and 100% xylene) then embedded in paraffin wax (52-54 C^0.m.p). Cross sections were done at 15 μm thickness using a rotary microtome followed by double staining with saffranin – light green combination, cleared in clove oil and mounted in Canada balsam (Gerlach, 1977). Finally, sections were microscopically examined using microscope, model CX41 RF, Code No. QCSF 505/01/04. The cross sections of fruits and their pedicels treated twice with GA_{4+7} were only photographed and illustrated since it showed the most remarkable effects as compared to all other treatments or the control.

The measurements of cell number and cell length in the mesocarp were done according to Zhang et al. (2005b). The mesocarp width was calculated from the difference between the longest width of the transverse section of fruit and the core. Cell length as an indicator of cell size was measured from the length of seven adjacent cells from the core to the fruit surface, then the average cell length was calculated. A cross sectional cut was made through the widest part of the fruit and the core. Cell number along the equatorial region of mesocarp was then calculated by dividing the mesocarp width by the average cell length which was used as an indicator of the total number of cells in the fruit.

At harvest time when fruit firmness was about 14-15 lb/ $inch^2$ and when SSC of berry juice was about 13-14% according to (Swindeman, 2002), number of fruits from each tree was counted to estimate yield/ tree (kg) with knowing average weight of fruit. Samples of 20 fruits from each replicate of

each treatment were taken and transported to the laboratory of Pomology Dept., Agric. Fac., Mansoura Univ. to determine the following measurements:

1- Average fruit weight (g).
2- Average fruit firmness (Lb/inch^2) by using a hand Effegi- penetrometers supplemented with plunger (8mm) diameter (Harker *et al*., 1996).
3- Soluble solids content (SSC%): It was measured by using a hand refractometer.
4- Titratable acidity (TA%): Five ml of berry juice was titrated against 0.1 N sodium hydroxide solution using phenolphthalein as indicator. Total acidity was expressed as gram malic acid/100 ml juice according to (A.O.A.C., 1980).
5- SSC/acid ratio was calculated from the results recorded on juice SSC and titratable acidity.

Statistical analysis of data:

The obtained data were statistically analyzed, and the differences between treatments were tested by analysis of variance (ANOVA) according to Snedecor and Cochran (1980). Means of treatments were compared using L.S.D value at 5 % level of probability.

RESULTS AND DISCUSSION

I. Fruit anatomical characters :

Data presented in Table (1) indicated that application of GA_3 or GA_{4+7} at full bloom clearly induced the mesocarp width and average cell length along the equatorial region of the mesocarp. Furthermore, application of GA_3 or GA_{4+7} twice at full bloom and after fruit set showed the most remarkable effect in this respect. Consequently, the number of cells along the equatorial region of the mesocarp was also increased at the two developmental stages and the effect was more pronounced when GA_{4+7} was applied twice at full bloom and after fruit set. In respect of the fruit anatomical characters, it is worthy to mention that fruit growth in *Pyrus spp*. is characterized by an initial period of rapid cell division followed by a long period of cell expansion primarily by vacuolation (Jackson, 2003). Many studies focused on the two stages of fruit growth and suggested that cell number and cell size are very important factors determining the final fruit size (Harada et al., 2005). It showed that photosynthate availability is crucial for fruit growth particularly during the period of cell division. Thus, the number of cells in the mesocarp is closely correlated with final fruit size (Zhang et al., 2005a). It has been proposed that GA is closely related to cell division and cell enlargement during fruit development in Japanese Pear (Zhang et al., 2005b).

As shown in Fig.(1), it is clear that stone cells are differentiated and could be detectable either at 30 or 45 days after full bloom and appeared in cluster structures throughout the mesocarpic cells. Since, at 30 days after full bloom, it was clear that the majority of stone cells are grouped in small clusters. The stone cell clusters were randomly distributed throughout the mesocarpic cells and appeared to be concentrated to a greater extent close to the outer epidermis of the pericarp with no detectable regular pattern. At 45 days after full bloom, stone cells tended to develop in clusters scattered irregularly throughout the mesocarp but appeared to be more concentrated in some areas than in others. The light microscopic examination showed that the number of stone cell clusters in the mesocarp tended to decrease during fruit development after cell division period.

In this connection, Choi and Lee (2013) reported that stone cells appeared in cluster structures at 60 days after full bloom. The relative decrease in the quantity of stone cell clusters in the mesocarp was attributed to the fact that stone cells were no longer being generated and the mesocarpic parenchymatous cells increased markedly in size. They added that the stone cells are subjected to delignification and reduction of cell wall thickness during the fruit maturity. However, the first clear appearance of stone cells in the mesocarp of pear fruit could not be observed until 14 days after full bloom (Choi et al., 2003) and initially differentiated among the parenchymatic cells approximately two weeks after flowering.(Cabrejas et al., 1994) may be attributed the presence of stone cells in unripened spanish pear fruits to the unusually high level of glucose and xylose in the fruits. Moreover, Choi et al.(2007) reported that existence of stone cells in pear fruits induced hardness that increased whereas sucrose content decreased.

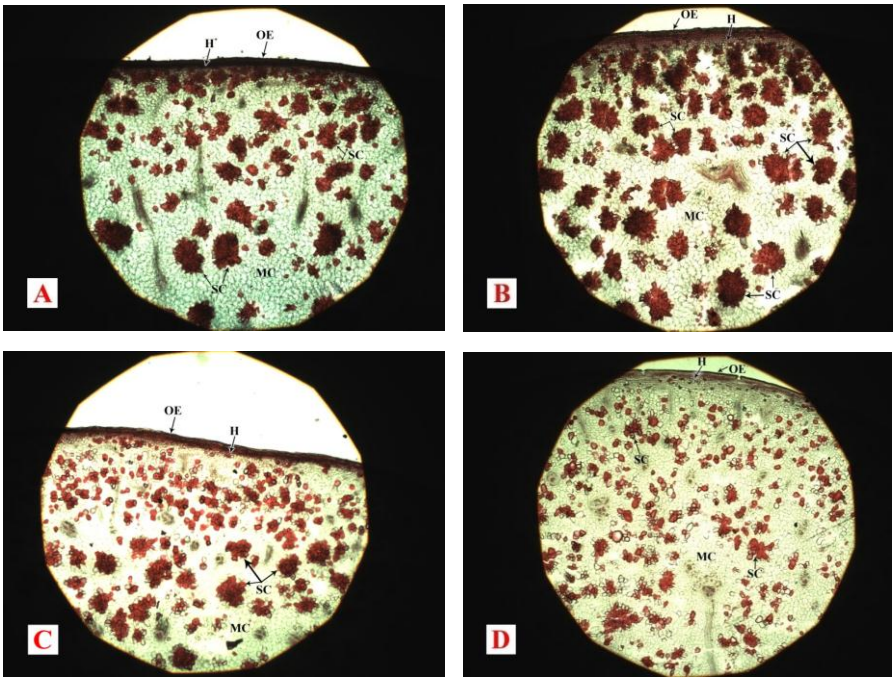

Fig.1. Cross Sections of Le conte pear fruit at 30 or 45 days after full bloom.
A) Control at 30 days. **B) GA_{4+7} twice at 30 days**
C) Control at 45 days **D) GA_{4+7} twice. at 45 days**
X40. OE: Outer Epidermis , H: Hypodermis , SC: Stone Cells, MC: Mesocarp.

Regarding the effect of GA on the stone cells, the microscopic investigation revealed that no changes occurred in the distribution pattern of stone cells throughout the mesocarpic tissues. However, the relative decrease noticed in the quantity of stone cell clusters in the mesocarp particularly under the highest GA_3 concentration may be due to the noticeable increase recorded in cell length caused by the double application of GA_{4+7} (Table 1).

As regard to the fruit stalk (pedicel), the anatomical investigation revealed that GA_3 or GA_{4+7} application increased the fruit stalk diameter in cross section as well as cortex thickness either applied at full bloom or twice at full bloom and after fruit set (Tab.2). However, the application of GA_{4+7} twice at full bloom and after fruit set proved to be more effective at the two developmental stages in this respect. The increase in the fruit stalk (pedicel) diameter and cortex thickness under GA application may be due to its role in cell division and enlargement (Zhang *et al.,* 2005b).

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The anatomical investigation showed also that the fruit pedicel is characterized by the presence of stone cell clusters that randomly distributed mainly in the cortex (Fig.2). However, stone cell clusters firstly differentiated in the cortex, thereafter began to appear in the pith region. Furthermore, differentiation of stone cells either in the cortex or in pith region may induce hardness in the fruit stalk

To conclude. GA_3 or GA_{4+7} markedly induced the mesocarpic width, average cell length and consequently the number of cells along the equatorial region of the mesocarp. However, the effect was more pronounced when GA_3 or GA_{4+7} was applied twice as compared to the untreated trees or those treated only at full bloom, and GA_{4+7} application at full bloom and after fruit set showed the most beneficial effects in this regard. Furthermore, the increase in cell number along the equatorial region of mesocarp could be regarded as an indicator of fruit fresh weight and is crucial for determining the final fruit size.

Table (2): Certain anatomical measurements (µm) in the Le conte pear fruit stalk (pedicel) at 30 and 45 days after full bloom as affected by foliar application GA_3 or GA_{4+7} during the growing season 2015.

Treatment	C.S. diameter (µm)				Cortex thickness (µm)			
	30 days	% over control	45 days	% over control	30 days	% over control	45 days	% over control
Control (sprayed with tap water)	4020	_	5423	_	1135	_	1524.6	_
Trees sprayed with GA_3 at 20 ppm at full bloom stage.	4215	4.9	5854	8.0	1290	13.7	1529.2	0.3
Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage.	5115	27.2	6983	28.8	1336	17.7	1801.8	18.2
Trees sprayed with GA_3 at 20 ppm at full bloom stage and fruit set.	6070	51.0	7161	32.1	1926	69.7	2260.8	48.3
Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage and fruit set.	7100	76.6	8163	50.5	2031	79.0	2774.2	81.9

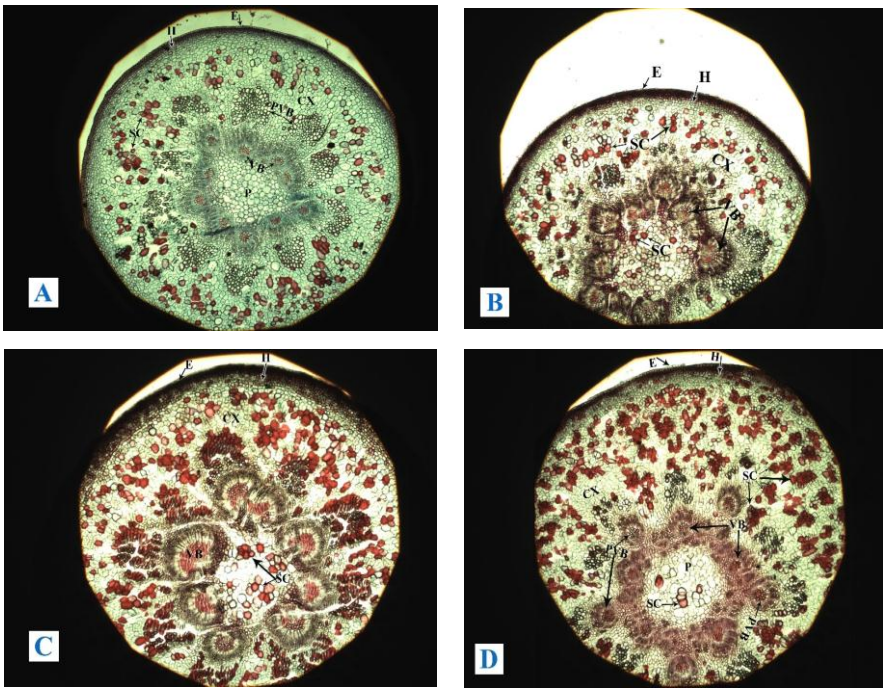

Fig.2. Cross Sections of Le conte pear fruit stalk (Pedicel) at 30 or 45 days after full bloom.

A) Control at 30 days. **B) GA_{4+7} twice at 30 days**
C) Control at 45 days **D)GA_{4+7} twice. at 45 days**
X40. E: Epidermis, H: Hypodermis, PVB: Peripheral Vascular Bundle, VB: Vascular Bundle, SC: Stone Cells, P: Pith.

II. Effect of gibberellins on fruit set, yield and fruit quality of Le conte pears:

Effect on fruit set:

The effects of spraying Le conte pear with GA_3 or GA_{4+7} on average fruit set during the two seasons of 2014 and 2015 were presented in Table (3). From this table it is clear that sprayed Le conte pears with GA_3 or GA_{4+7} at 20 ppm at full bloom and after fruit set significantly increased the average fruit set per spur as compared to the control. Furthermore, trees sprayed with GA_{4+7} at full bloom and after fruit set produced a higher percent of average fruit set than the other used treatments or the control. Since, this treatment increased the average fruit set by about 40.6 % more than the control.

The data also revealed that trees sprayed with GA_{4+7} once at full bloom or twice at full bloom and after fruit set gave a higher significant values of fruit set than those sprayed with GA_3. Furthermore, trees treated with GA_3 alone at full bloom gave the lowest fruit set in comparison with other treatments used. So, this treatment increased the average fruit set by about 22.9% more than the control as mean of the two seasons of study.

Table (3): Effect of gibberellins on fruit set and number of fruits/ tree of Le conte pears:

Treatments	Av. fruit set/ spur			% over control	No. Fruits/ tree			% over control
	2014	2015	Mean		2014	2015	Mean	
Control (sprayed with tap water)	0.49 c	0.47d	0.480	--------	159c	138d	149	------
Trees sprayed with GA_3 at 20 ppm at full bloom stage.	0.61b	0.57c	0.590	22.9	184b	164c	174	16.8
Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage.	0.67a	0.64ab	0.655	36.5	196a	174b	185	24.2
Trees sprayed with GA_3 at 20 ppm at full bloom stage and fruit set.	0.61b	0.58bc	0.595	24.0	188b	170b	179	20.1
Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage and fruit set.	0.69a	0.66a	0.675	40.6	199a	184a	192	28.9
L.S.D at 5%	0.04	0.04	-----	---------	4.21	4.33	--------	------

Effect on number of fruits/ tree:

It is obvious from Table (3) that the effect of sprayed Le conte pear trees with GA_3 or GA_{4+7} on average fruits per tree was almost similar to those obtained from average fruit set. Moreover, trees sprayed with GA_{4+7} at full bloom and after fruit set gave a higher significant number of fruits per tree than those sprayed with GA_3 at the same time of application. Since, these treatments increased the number of fruits per trees by about 28.9% as compared to the control. Also, GA_3 application at full bloom alone or after fruit set gave a higher number of fruits per trees in comparison with the control. Furthermore, these treatments produced a higher number of fruits per tree by about 16.8 or 20.1% than the control. In this respect, the data also revealed that sprayed Le conte pear tree with GA_3 or GA_{4+7} at full bloom and after fruit set gave a higher number of fruits than those treated at full bloom , that is may be due to the effect of these treatments on reducing the number of fruits dropped after fruit set in comparison with the other treatments or the control. In this respect, Zhang et al (2008) mentioned that gibberellins play an important role in fruit set and development. Our data are in agreement with those found by Yehia and Hassan (2005) which revealed that treated Le conte fruits with GA3 improved fruit set and quality. Moreover, Vladymyr and Michael (2005) mentioned that spraying trees with GA_3 in combination with GA_{4+7} increased fruit set of Japanese pear under unfavorable weather conditions. Furthermore, Hegazi (2011) reported that sprayed Le conte pear trees with GA_3 or BA before full bloom increased fruit set, fruit weight, diameter and fruit firmness in comparison with the control.

Effect on fruit weight:

It is clear from Table (4) that treated Le conte pears with GA_3 or GA_{4+7} showed a slight effect on average fruit weight as compared to the control. Moreover, trees sprayed with GA_3 or GA_{4+7} at full bloom led to reduction in average fruit weight as compared to control. Yet, trees sprayed with GA_{4+7} at full

bloom and after fruit set gave a higher weight of fruits in comparison with the other treatments. Since, these treatments gave an increase in the number of cells in mesocarp. Hence, this treatment gave insignificant difference in comparison with the control. That is not astonishing since, these treatments increased average number of fruits per trees so, the effect on average fruit weight was unpronounced. Also, it could be added that GA_3 or GA_{4+7} treatments and the time of application had no definite trend on this aspect. In this respect, gibberellins are widely used to improve fruit size (Ozga and Reinecke, 2003). Also, Bangerth (2004) found that Cytokinins alone or in combination with gibberellins increased fruit size. Furthermore, Zhang et al (2008) stated that GA_3, GA_7 and CPPU increased fruit size of Japanese pear without increasing cell size in the flesh and stimulating cell division. Whereas, Canli et al (2009) mentioned that no significant differences were found between control and treated fruits with BA+ GA_{4+7} on fruit weight.

Table (4): Effect of gibberellins on fruit weight and yield/ tree of Le conte pears:

Treatments	Fruit weight (g)			% less than control	Yield/ tree (kg)			% over control
	2014	2015	Mean		2014	2015	Mean	
Control (sprayed with tap water)	187.7a	192.8a	190.3	-------	29.8e	26.6d	28.2	------
Trees sprayed with GA_3 at 20 ppm at full bloom stage.	182.2b	176.7d	179.5	5.0	33.6d	28.9c	31.3	11.0
Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage.	185.3a	185.0c	185.2	2.7	36.3b	32.1b	34.2	21.3
Trees sprayed with GA_3 at 20 ppm at full bloom stage and fruit set.	185.1ab	187.7b	186.4	2.1	34.8c	31.9b	33.4	18.4
Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage and fruit set.	187.1a	193.1a	190.1	0.1	37.6a	35.5a	36.6	29.8
L.S.D at 5%	3.0	2.11	-----	-------	0.98	0.72	------	------

Effect on the yield / tree :

Data presented in Table (4) showed that sprayed Le conte pear trees with GA_3 or GA_{4+7} once at full bloom or twice at full bloom and after fruit set significantly increased the average yield per tree as compared to the control. Moreover, trees sprayed with GA_{4+7} at full bloom and after fruit set gave a higher significant effect than those sprayed with GA_3 at the same time of applications. Since, these treatments increased the yield per trees by about 21.3 and 29.8 % more than the control as mean of two seasons.

Also, trees sprayed with GA_3 at both times of application increased the yield per tree significantly than the control. So, the increments of yield due to these treatments were about 11.0 and 18.4% over the control. Furthermore, sprayed Le conte pear trees with GA_3 or GA_{4+7} twice at full bloom and after fruit set produced a higher significant yield than those treated once at full bloom. In this respect, trees sprayed with GA_{4+7} twice at full bloom and after

fruit set showed a more pronounced effect since, this treatment gave a higher significant yield per tree in comparison with the other treatments. The increment in tree productivity may be due to an increase in fruit set and the number of fruits/tree than the other treatments which has reflected its effect on the average fruit weight. Similarly, Vladymyr and Michael (2005) found that sprayed pear trees with GA_3 or GA_{4+7} before full bloom significantly increased fruit set and reduced the fruit dropping so, these treatments increased the yield/tree. Moreover, Ouma (2008) mentioned that GA_3 alone or with GA_{4+7} gave significantly higher fruit yield than the control. He also showed that these treatments increased fruit set since it is a major factor in determining the fruit yield.

Effect on fruit firmness:

Data presented in Table (5) showed that sprayed le conte pear trees with GA_3 or GA_{4+7} once at full bloom or twice at full bloom and after fruit set significantly increased the values of fruit firmness more than the untreated ones. Yet, no marked differences on fruit firmness were found between trees sprayed with GA_3 or GA_{4+7} once at full bloom or twice at full bloom and after fruit set. In this respect, Zhang et al. (2008) showed that GA_{4+7} gave a high flesh hardness of pear fruits. Similarly, Hegazi (2011) mentioned that sprayed Le conte pear trees with GA_3 at full bloom or 7 days later significantly increased the values of fruit firmness as compared to the control.

Effect on SSC, total acidity and SSC/acid ratio

Effect of spraying Le conte pear trees with GA3 or GA4+7 at full bloom and after fruit set on SSC, total acidity and SSC/acid ratio are presented in Table (5). It could be noticed from this table that spraying trees with GA_3 or GA_{4+7} at two times of application showed a significant reduction in the values of SSC as compared to the control. Whereas, no significant differences in SSC were detected between fruits produced from trees sprayed with GA_3 or GA_{4+7} during the two growing seasons.

Table (5): Effect of gibberellins on fruit firmness, SSC, total acidity and SSC/acid ratio of Le conte pears.

Treatments	Fruit firmness Lb/Inch^2		SSC %		Total acidity %		SSC/ acid ratio	
	2014	2015	2014	2015	2014	2015	2014	2015
Control (sprayed with tap water)	13.2d	12.7b	13.3a	13.8a	0.275b	0.249b	48.4a	55.4a
Trees sprayed with GA_3 at 20 ppm at full bloom stage.	13.9c	14.4a	12.6ab	12.5b	0.288ab	0.275ab	43.8b	45.5b
Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage.	14.4a	14.7a	12.2b	11.9c	0.286ab	0.278ab	42.7bc	42.8b
Trees sprayed with GA_3 at 20 ppm at full bloom stage and fruit set.	14.1bc	14.5a	12.1b	12.3bc	0.292ab	0.289a	41.4bc	42.6b
Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage and fruit set.	14.4a	14.7a	12.0b	11.9c	0.309a	0.283a	38.8c	42.1b
L.S.D at 5%	0.300	0.372	0.79	0.57	0.03	0.03	4.19	4.77

The data also revealed that all GA_3 or GA_{4+7} treatments tended to increase the values of total acidity in fruit juice more than the control. Furthermore, trees sprayed twice with GA_3 or GA_{4+7} showed a somewhat increment in total acidity as compared to those sprayed once at full bloom. Whereas, no significant differences in total acidity had obtained between GA_3 or GA_{4+7} applications.

As regard to SSC/ acid ratio, it is obvious that similar trends were recorded as obtained for those found on SSC in fruit juice. Since, these treatments gave a lower significant values of SSC/acid ratio than the control. Yet, no significant differences were found between those sprayed with GA_3 or GA_{4+7} once at full bloom or at fruit set. The reduction attributed for SSC/acid ratio was mainly due to the effect of these treatments on reducing the values of SSC with increasing total acidity on fruit juice. Likewise, Canli et al (2009) indicated that fruit treated with BA + GA_{4+7} at 25 ppm gave a higher significant values of SSC and titratable acidity as compared to the control. In addition, Khurshid *et al*. (1997) mentioned that GA applications had no significant effect on ^{o}Brix than the control. Whereas, Hegazi (2011) presented that GA_3 gave a somewhat increment in the value of SSC in fruit juice.

CONCLUSION

It could be concluded that sprayed Le conte pear trees with GA_3 or GA_{4+7} once at full bloom or twice at full bloom and after fruit set increased yield/ tree as compared to the control. The increment in yield may be due to the effect of these treatments on increasing average of fruit set and number of fruits/trees. Furthermore, trees sprayed with GA_{4+7} gave a higher effect in this respect than those sprayed with GA_3. Also, this treatment produced fruits with higher firmness and total acidity but gave a somewhat reduction in SSC and SSC/acid ratio on fruit juice.

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تـأثير الـرش بـالجبريللين علـى الصـفات التشـريحية للثمـار و المحصـول و صـفات الجودة لثمار الكمثرى الليكونت

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أجريت هذه الدراسة خلال عامي ٢٠١٤ و ٢٠١٥ على أشجار الكمثرى الليكونت عمرها ٩ سنوات مطعومة على أصل البيتشفولياً لدراسة أثر رش الأشجار بكل من (GA_3 & GA_{4+7}) بتركيز ٢٠ جزء في المليون مرة عند اكتمال التزهير و مرتين عند اكتمال التزهير و بعد العقد على تشريح الثمار ونسبة العقد وكذا المحصول و صفات الجودة للثمار وقت الجمع.

و لقد أوضحت الدراسة أن رش الأشجار بكل من (GA_3 & GA_{4+7}) قد أدى إلى زيادة عدد الخلايا فى النسيج الوسطى للثمرة و هذا ما يمكن اعتباره مؤشرا على الوزن النهائي للثمرة و هو ما ظهر جليا في زيادة وزن الثمار المعاملة بـ GA_{4+7} مقارنة بتلك المعاملة بـ GA_3 ، علاوة على ذلك فإن رش الأشجار بكل من(GA_3 & GA_{4+7}) أدى إلى زيادة نسبة العقد و كذا عدد الثمار على الأشجار و المحصول النهائى للأشجار مقارنة بتلك غير المعاملة.

و لقد أظهرت النتائج أيضا أن رش الأشجار بال GA_{4+7} بتركيز ٢٠ جزء فى المليون عند اكتمال التزهير و بعد العقد أظهر نتائج أفضل من باقى المعاملات الأخرى، علاوة على أن رش الأشجار بكل من (GA_3 & GA_{4+7}) أظهر قيما أعلى فى صلابة الثمار و كذا الحموضة الكلية فى حين أدى إلى خفض المواد الصلبة الذائبة و كذا نسبتها إلى الحموضة فى عصير الثمار مقارنة بالكنترول.

Table (1):Certain anatomical measurements (µm) in the Le conte pear fruit at 30 and 45 days after full bloom as affected by foliar applications of GA_3 or GA_{4+7} during the growing season 2015.

Treatments	Mesocarp width (µm)				Average cell length (µm)				No. of cells in mesocarp			
	30 days	% over control	45 days	% over control	30 days	% over control	45 days	% over control	30 days	% over control	45 days	% over control
Control (sprayed with tap water)	8330	_	17092	_	30.4	_	43.8	_	274.1	_	390.3	_
Trees sprayed with GA_3 at 20 ppm at full bloom stage.	10641	27.7	20570	20.4	36.5	20.0	48.8	11.4	291.7	6.4	421.9	8.1
Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage.	10426	25.2	21862	27.9	35.8	17.8	47.1	7.5	290.9	6.1	464.2	18.9
Trees sprayed with GA_3 at 20 ppm at full bloom stage and fruit set.	11240	34.9	26836	57.0	35.8	17.8	55.5	26.7	313.9	14.6	483.1	23.8
Trees sprayed with GA_{4+7} at 20 ppm at full bloom stage and fruit set.	14846	78.2	31470	84.1	42.4	39.6	62.4	42.5	350.1	27.7	504.5	29.3