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Improving Productivity, Quality and Antioxidant Capacity of Le-Conte Pear Fruits Using Foliar Tryptophan, Arginine and Salicylic Applications

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IN RESPECT to enhancing productivity and fruit quality of Le-Conte pear, a field study was carried out during two successive seasons (2015 and 2016). The solutions of amino acids treatments including arginine (100 and 200 ppm) and tryptophan (50 and 100 ppm), in addition to salicylic acid (100 and 200 ppm) and control (water only) were sprayed on mature trees untill run off twice, first at full bloom stage and second at initial fruit set stage (after 21 days of full bloom phase). The productivity and different fruit quality parameters were assessed, as well as, measurements of total phenols, total amino acids and antioxidant capacity during fruit development stages. Applying tryptophan, arginine and salicylic acid treatments attained a valuable effect on productivity and fruit quality of pear cv. Le-Conte. Moreover, tryptophan at 100 ppm showed the highest fruit set percentage, yield, fruit weight, L/D ratio, specific gravity, lightness of flesh colour, fruit peel colour, TSS and improved total sugars, total phenols and total amino acids content of pear fruits cv. Le-Conte, whereas salicylic acid at 200 ppm showed the lowest significant fruit abscission percentages, and maintained the highest significant values of antioxidant capacity, ascorbic acid and firmness of Le-Conte pear fruits.

Keywords: Pear, Arginine, Tryptophan, Salicylic acid, Amino acids, Antioxidant capacity.

Introduction

Pears (*Pyrus spp.*) are distinguished deciduous fruit trees which native to family Rosaceae. Le-Conte pear is a hybrid between *Pyrus communis* and *Pyrus pyrifolia*, it is the most widespread cultivated cultivar in Egypt. Improving pear productivity and enhancing fruit quality under the Egyptian environmental conditions is one of the main aims for local market demands. The yield of such trees are impressively influenced by several factors, among these factors nutrients deficiency, which could be considered one of the limiting issues for pear trees growth, fruit quality and yield. There are other effective variables include self-incompatibility, excessive flower abscission, low fruit retention and sensitivity for many diseases (Sherif et al., 2013).

Some amino acids are precursors of various plant hormones that play an important role in many biological processes in the plant such as, protein synthesis, stress resistance, photosynthesis, pollination and fruit development (Tegedera and Rentsch, 2010). Ortiz-Lopz et al. (2000) reported that, amino acids should be applied in L–amino acids image, owing to only L–amino acids are assimilated by plant tissues, D-amino acids are not recognized by the enzymatic receptors and therefore cannot take part in protein production.

Arginine is a precursor for synthesis of polyamines and cytokinin (Bagni and Tassoni, 2001), the polyamines such as putrescine and spermidine are essential for trees growth and stress tolerance of plants (Majumdar et al., 2013), mainly flower initiation and development, fruit setting and fruit ripening (Pathak et al., 2014). Rugni et al., (1986) decided that spraying L-arginine on olive trees whichever at full bloom or at the beginning of petals fall improved fruit set but did not affect fruitlet abscission, as well as it decreased ethylene influences on fruit cells. Fruits of trees treated by arginine at concentrations of 250 or 500 μM showed better fruit yield and quality characteristics compared with untreated ones including ascorbic acid content, total sugars, total phenolics, average fruit weight, anthocyanin content in addition to TSS (Mohseni et al., 2017).

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In this regard, tryptophan is a precursor of IAA (indole-3-acetic acid), that resulted in increased fruit set and size, L-tryptophan might be a safe, cheap alternative treatment compared with other synthetic auxins, that used in commercial fruit trees production (Pillitteri et al., 2010). In this way, Hanfy et al., (2012) found that L-tryptophan enhanced trees growth, productivity and fruit characteristics in regard to its impacts on physicochemical changes in total phenols, total amino acids and total sugars. Woijcik et al., (2016) found that tryptophan foliar sprays improved the concentrations of IAA and calcium concentration in fruits, in addition, Ahmed et al., (2017) found positive influences of foliar application with tryptophan on fruit set percentage and fruit yield (kg/ tree).

Salicylic acid, is a controller for many metabolites physiological activities in plants (Brar et al., 2014), Martinez et al., (2004) approved that salicylic acid enhance plant stress resistance, and it has used widely due to its valuable role in plant stress resistance against abiotic stresses. Abd El-Aziz et al., (2017) found that salicylic acid at 50-200 ppm was very effective in improving fruit quality of Manfalouty pomegranate trees, initial fruit setting and fruit retention. Abd El-Razek et al., (2013) recommended using salicylic acid foliar application at 40 µg/L for improving yield and fruit quality of olive trees cv. Egazy, owing to it increased blooming, pollen grains development and enhancement fruit features. Other effects of salicylic acid were observed on maintaining fruit firmness, reduced chilling injury incidence, and delayed membrane lipid peroxidation (Khademi and Ershadi, 2013), delayed fruit senescence through inhibiting ethylene biosynthesis which finally maintains pre and post-harvest fruit quality (Srivastava and Dwivedi, 2000).

Therefore, the principal aims of this work were to investigate the effects of foliar application of L-arginine, L-tryptophan and salicylic acid on pear cv. Le-Conte, mainly changes in fruit yield per tree and quality attributes, in addition to evaluate changes in antioxidant activity, phenols and total amino acids during fruit development.

Materials and Methods

Plant material and treatments

This study was carried out during 2015 and 2016 seasons on fifteen years old Le-Conte pear trees budded on Communis (*Pyrus communis*) rootstock, planted at 5×5 m apart and grown in loamy soil in the Experimental Research Station, Cairo University, Giza, Egypt. Trees were of normal growth, uniform in vigor and received standard irrigation, fertilization and cultural practices as scheduled in the program of the station.

The design of complete randomized block was followed in the present experiment on 63 trees in seven treatments. Each treatment was conducted on three replicates, whereas three trees represented each replicate. The applied treatments involved the following, control (water sprayed) (T1), arginine at 100 ppm (T2), arginine at 200 ppm (T3), tryptophan at 50 ppm (T4), tryptophan at 100 ppm (T5), salicylic acid at 100 ppm (T6) and salicylic acid at 200 ppm (T7).

Treatments were sprayed with the specified solutions with add of surfactants (Tween 20 at 0.1 ml per liter of solution) till running off on mature pear trees at full bloom stage which had 70% of flower buds in the stage of full open. The spraying process was repeated again three weeks after the first one. According to Kilany (1982) fruits were harvested at maturity stage.

Effect of various amino acids and salicylic acid treatments on productivity of Le-Conte pear trees

On each tree, five shoots distributed on different sides were chosen randomly and tagged at the start of the growing season in 2015 and 2016 seasons. All inflorescences on each tagged shoot were counted, and samples of 30 inflorescences were randomly collected to estimate average number of flowers/ inflorescence.

Initial fruit set percentage was calculated after 3 weeks of full bloom stage according to the following formula, Initial fruit set percentage = total fruits per shoot × 100 / (average flowers number per inflorescence × number of inflorescences per shoot).

Moreover, fruit abscission (%) = number of abscised fruits at harvest /total number of fruit set × 100 (Stino et al., 2011), number of abscised fruits = total number of fruit set - total number of fruit at harvest on the tagged branches for each considered tree.

The fruits yield in kg on each replicate tree resulting from the studied treatments was recorded at harvest stage, after 130 days of full bloom in both seasons of the study.

Effect of different amino acids and salicylic acid treatments on physicochemical characteristics of pear fruits

At harvest time, samples of 45 fruits from each treatment (fifteen fruits from each replicate i.e. five fruits from each tree) were randomly picked and used to determine average fruit weight (g), length / diameter ratio (L/D) in addition to specific gravity of fruits throughout determination of fruit weight and volume (g/ cm^3).

Fruit firmness was measured using the instrumental test (Mecmesin, force-torque tester, England) using 8 mm diameter probe, the measurements were made on each fruit check according to Mitcham et al., (2003), data were presented in Ib/ $inch^2$.

According to McGuire (1992), the instrumental colour was measured in respect to CIE L^* a^* b^* on different places of peel and flesh surfaces of fruit objectively using a Minolta colourmeter (Minolta, Japan) Model CR-400. The L^* value was used as an indicator of colour brightness, a^* point to chromaticity on a green direction (negative values) to red (positive values) axis.

Total soluble solids (TSS %) was determined using drops of the fruit juice, by hand refractometer according to Chen and Mellenthin (1981).

According to Malik and Singh (1980) procedure, total sugars were extracted from 5 g of fruit flesh samples, and determined using sulfuric acid reaction colourimetric method, the results of total sugars content were expressed as g per 100 g fresh fruit flesh.

Ascorbic acid was examined via titration against a dye solution of 2,6 dicholorophenol-indophenol solution (Mazumdar and Majumder, 2003), the results were expressed as mg ascorbic acid per 100 g FW (fresh fruit weight).

Determination of total phenols, total amino acids and antioxidant capacity

In this regard, samples of 5 fruits from each replicate tree for each of the applied treatments were picked randomly and assessed at 70, 80, 90 and 100 days after full bloom to determine total phenols, total amino acids and antioxidant capacity.

Total phenols were determined colourimetrically by Folin Denis reaction method, using tannic acid for standard solution (AOAC, 2012), and expressed as mg per 100 g fresh fruit flesh.

Total amino acids contents in fruits (mg/100 g FW) were extracted by 0.1 M HCl as solvent extraction, and determined using ninhydrin reagent according to Otter (2012) method.

Antioxidant capacity was determined depending on the free radicals scavenging capacity of the samples and reading at 515 nm according to Brand-Wiliams et al., (1995), results were presented as ascorbic acid units equivalent antioxidant capacity units in fruits.

Statistical analysis

All data of the studied parameters were analyzed statistically as a factorial randomized complete block design. The differences between means were evaluated using LSD (least significant difference) range test at a probability level of 5% as described by Snedecor and Cochran (1989).

Results and Discussion

The productivity

The results in Table 1. show the influence of arginine, tryptophan and salicylic acid treatments on the fruit production. All conducted treatments exhibited higher initial fruit set percentages compared with untreated trees. Tryptophan at 100 ppm exhibited the highest significant fruit set percentages (16.05 and 17.94%) in the first and the second season, respectively.

The tested treatments significantly decreased fruit abscission compared with control, spraying salicylic acid at 200 ppm showed the least significant fruit abscission percentages (40.38 and 40.66%) in both investigation seasons.

Tryptophan, arginine and salicylic acids treatments attained higher significant yield compared with untreated trees, applying 100 ppm tryptophan resulted in the highest significant yield (70.55 and 72.24 Kg/tree) during 2015 and 2016 seasons, respectively. Also, in the both seasons of the current study, all conducted treatments enhanced fruit weight. Spraying tryptophan at 100 ppm showed the highest significant fruit weight (146.43 and 151.75 g) compared to control which recorded the lowest fruit weight values (121.56 and 125.62 g) in 2015 and 2016 seasons, respectively.

TABLE 1. Impact of arginine, tryptophan and salicylic acid treatments on initial fruit set %, fruit abscission %, yield and fruit weight of Le-Conte pear during 2015 and 2016 seasons.

Treatments	Initial fruit set (%)		(٪) Fruit abscission		Yield (Kg/tree)		Fruit weight (g)	
	2015 season	2016 season	2015 season	2016 season	2015 season	2016 season	2015 season	2016 season
Control	5.02	6.98	78.70	76.93	36.55	37.73	121.56	125.62
Arginine 100 ppm	12.04	12.96	49.55	52.24	58.81	58.32	129.33	145.58
Arginine 200 ppm	14.05	16.94	46.53	47.82	65.35	66.38	137.62	145.69
Tryptophan 50 ppm	13.55	17.04	48.55	50.20	65.98	70.96	144.42	147.41
Tryptophan 100 ppm	16.05	17.94	46.64	46.75	70.55	72.24	146.43	151.75
Salicylic 100 ppm	7.53	8.57	42.61	42.00	48.54	60.67	132.29	129.06
Salicylic 200 ppm	8.03	8.87	40.38	40.66	49.57	59.84	125.14	126.35
L.S.D at 0.05	0.68	0.21	1.66	1.22	9.68	6.99	20.32	19.57

Generally, the trees treated by tryptophan at 100 ppm showed more superior fruit set percentages, fruit weight and yield /tree than other treatments. However, the obtained outcomes were in line with Woijcik et al., (2016) who found significant increment in apple trees yield that sprayed with tryptophan at pre-bloom or at post-bloom stages, and such treatment also increased the concentrations of free IAA in fruitlets by about twofold compared with control.

Also, Ahmed et al., (2017) on Washington navel orange, reported that tryptophan at 25 and 50 ppm improved fruit set percentage and yield (kg/ tree) as well as improved vegetative growth characteristics. On the other hand, Woijcik et al., (2016) mentioned that tryptophan-spraying treatments had no effect on average fruit weight of apple fruit cv. Red Jonaprince at the harvest.

Ozga and Dennis (2003) proposed that biological processes are controlled and regulated by plant growth regulators through the increment in mobility of plant fluid, it may stimulate transport of nutrients in the phloem, increase the ability for sugar mobility from the phloem. Alternatively, they may act on metabolism and assortment of sugar and its metabolites (Brenner and Cheikh, 1995). The increment in fruit weight in response to tryptophan treatments might be due to activation of synthesis of the important components for fruit development and maturity (Sahota and Arora, 1981). In addition, Yogeratnam and Greenham (1982) attributed the enhancement happened in fruit quantity due to providing trees with tryptophan to its effects on improving construction and mobilization of carbohydrate substances and its related enzymes in plant tissues.

Also, the role of salicylic acid in clearly decrease fruit abscission was in agreement with Nimbolkar et al., (2016) who found similar effects in pear cv. Gola treated with salicylic acid at 50 and 100 ppm. Also, Abd El-Aziz et al., (2017) found that spraying 100 ppm salicylic acid at growth start and after fruit set minimized fruit abscission of Manfalouty pomegranate.

This effect of salicylic acid may be in regard to the decline in the amount of cellulase enzyme which has been shown to be ethylene sensitive and is considered the main responsible enzyme for fruit abscission in point of view of Bonghi et al., (1992) and Ferrarese et al, (1995 and 1996), or the involvement of salicylic acid in strengthening cell walls located in the abscission layer through activating the biosynthesis of proteins according to Nimbolkar et al. (2016).

The physicochemical characteristics of fruits

Table 2 shows the effect of the conducted treatments on L/D ratio, specific gravity, firmness, a^* peel and L^* flesh values of Le-Conte pear fruits during 2015 and 2016 seasons. The differences between the investigated treatments were non-significant in respect to L/D ratio of pear fruits, anyhow applying tryptophan at 100 ppm showed higher L/D ratios compared with the other treatments as it recorded 1.25 and 1.26 during 2015 and 2016 experimental seasons, respectively.

Specific gravity of fruits was affected significantly by the different applied treatments compared with the control in the first season,

while the differences were non-significant in the second season. Tryptophan at 100 ppm showed the highest specific gravity of pear fruits as 1.073 and 1.009 g/cm^3 in both seasons.

Untreated trees showed the significantly lower value of fruit firmness compared with arginine, tryptophan and salicylic acid treatments in both seasons. The salicylic level at 200 ppm recorded the highest hardness with 26.71 and 26.50 Ib/inch^2 in the first and the second season, respectively.

Instrumental colour values of fruit declared that salicylic acid at 200 ppm showed the lowest a* colour values of fruit peel (the highest green colour direction) compared with untreated trees that showed the highest values, salicylic acid at 200 ppm recorded -14.93 and -15.58 during 2015 and 2016 seasons, respectively.

Values of L* flesh of fruits were significantly affected by the different conducted treatments, whereas tryptophan at 100 ppm showed the highest significant L* flesh values (68.46 and 67.93), while salicylic at 200 ppm showed the lowest significant values of L* flesh (67.29 and 66.83) in both seasons, respectively.

The present data are in line with that obtained by Mohseni et al., (2017) who found that arginine at concentrations of 250 or 500 µM enhanced fruit quality and productivity characteristics compared to control treatment. Woijcik et al., (2016) mentioned that tryptophan spray treatments enhanced fruit skin colour of apple fruits at harvest. Also, salicylic acid effects on fruit colour and firmness were similar to findings that mentioned by Peppi et al., (2006) and Zoffoli et al., (2009).

Changes that happened in fruit firmness and colour of peel and flesh could be owing to the rapid increase in ethylene production (Bonghi et al., 1993), also, it might be due to the interactions between polyamines and cell wall components that responsible for changes in cell turgidity and the other changes in protopectin substances, calcium accumulation in cell wall layer and changes in pigments (Berta et al., 1997).

Table 3. declares the effect of different amino acids and salicylic acid treatments on TSS, ascorbic acid and total sugars of pear fruits cv. Le-Conte in 2015 and 2016 seasons. During both seasons of the current study, tryptophan at 100 ppm showed the highest TSS values significantly (13.52 and 13.39%), while salicylic acid at 200 ppm showed the lowest TSS values significantly of fruits (12.63 and 12.57%) in both seasons, respectively.

All treatments significantly maintained ascorbic acid content of Le-Conte pear fruits compared with fruits in untreated trees, salicylic at 200 ppm maintained the highest ascorbic acid values 6.46 and 7.03 mg/100 g FW during 2015 and 2016 seasons, respectively.

Concerning the content of total sugars of the resulting fruits, tryptophan at 100 ppm showed the highest total sugar values (6.54 and 6.60%) in both seasons, while salicylic acid at both used two concentrations (100 or 200 ppm) showed the lowest total sugar values of fruits compared to the other tested treatments as 6.05 and 6.06%, respectively in the first season, and 6.24 and 6.22%, respectively in the second season.

TABLE 2. Impact of varied amino acids and salicylic acid treatments on length/diameter (L/D) ratio, specific gravity, firmness, a* peel and L* flesh values of Le-Conte pear fruits in 2015 and 2016 seasons.

Treatments	L/D ratio (shape index)		Specific gravity (g/cm^3)		Firmness (Ib/inch^2)		a* peel value		L* flesh value	
	2015 season	2016 season	2015 season	2016 season	2015 season	2016 season	2015 season	2016 season	2015 season	2016 season
Control	1.16	1.16	0.986	0.948	21.73	23.07	-14.63	-15.11	67.41	66.94
Arginine 100 ppm	1.21	1.23	0.992	1.006	26.27	25.43	-14.83	-15.34	67.73	67.29
Arginine 200 ppm	1.21	1.24	0.996	1.007	24.40	26.23	-14.30	-15.00	68.09	67.63
Tryptophan 50 ppm	1.23	1.26	1.052	1.007	25.71	24.13	-14.74	-15.16	68.34	67.92
Tryptophan 100 ppm	1.25	1.26	1.073	1.009	23.40	23.37	-14.29	-14.64	68.46	67.93
Salicylic 100 ppm	1.19	1.20	0.999	0.999	26.34	26.10	-14.91	-15.55	67.32	66.91
Salicylic 200 ppm	1.18	1.19	0.995	0.996	26.71	26.50	-14.93	-15.58	67.29	66.83
L.S.D at 0.05	NS	NS	0.056	NS	4.53	2.58	0.13	0.37	0.82	0.86

TABLE 3. Effect of arginine, tryptophan and salicylic acids treatments on TSS, ascorbic acid and total sugars of Le-Conte pear during 2015 and 2016 seasons.

Treatments	TSS (%)		Ascorbic acid (mg per 100 g FW)		Total sugars (%)	
	2015 season	2016 season	2015 season	2016 season	2015 season	2016 season
Control	12.98	12.78	5.99	6.27	6.30	6.32
Arginine 100 ppm	13.08	12.88	6.32	6.75	6.34	6.37
Arginine 200 ppm	13.25	13.19	6.18	6.62	6.40	6.52
Tryptophan 50 ppm	13.29	13.19	6.22	6.73	6.43	6.53
Tryptophan 100 ppm	13.52	13.39	6.18	6.77	6.54	6.60
Salicylic 100 ppm	12.70	12.60	6.32	6.96	6.06	6.24
Salicylic 200 ppm	12.63	12.57	6.46	7.03	6.05	6.22
L.S.D at 0.05	0.19	0.06	0.12	0.23	0.09	0.11

Changes in TSS and total sugars content (Table 3) indicated that tryptophan accelerated sugars accumulation compared with salicylic acid treatment, in the point of view of Tattsuki et al. (2013) the role of salicylic acid is mainly due to its influence on ethylene biosynthesis and functions. Ethylene is the key of fruit ripening via coordinating the genes expression in plant cells (Oetiker and Yang, 1995) that are responsible for a variety of processes, including texture, respiration rate, colour, aroma and flavour changes.

On the other hand, Leslie and Romani (1988) indicated that ethylene formation was inhibited after salicylic acid treatment, Fan et al., (1996) mentioned that salicylic acid role is in regard to inhibition of 1-aminocyclopropane 1-carboxylic acid oxidase activity. The pre-harvest salicylic acid application was found to be effective in suspending the ripening and senescence processes through suppression of ethylene production rate (Vijay and Sharma, 2016).

Moreover, ascorbic acid is very sensitive to degradation due to its oxidation compared to other nutrients. According to Srivastava and Dwivedi (2000) the decrease of ascorbic acid is mainly because of the alteration of de-hydroascorbic to di-ketogulonic acid via oxidation by ascorbate oxidase activity, which is reduced by salicylic acid.

Assessment of total phenols, total amino acids and antioxidant capacity content

Figure 1. declares the effect of arginine, tryptophan and salicylic treatments on total phenols content (mg/100 g FW) of Le-Conte pear fruits in different development stages in 2015 and 2016 seasons.

The tryptophan treatments significantly increased total phenols of Le-Conte pear fruits compared with control that showed the lowest, phenolics declined gradually with fruit growth advancement. After 100 days of full bloom, trees treated by salicylic at 200 ppm exhibited the highest significant total phenols content 40.03 and 41.02 mg/100 g FW in the first and the second season, respectively, as compared to untreated trees (control) that showed the lowest content during both studied seasons.

The obtained data are in line with Galvis-Sanchez et al. (2003) in pear fruits and Woijcik et al. (2016) who found that pre-bloom and post-bloom tryptophan foliar application enhanced the content of total phenols in apples fruits, this increment might be due the role of many amino acids such as tryptophan in phenols formation.

Figure 2 declares the effect of some amino acids and salicylic acid treatments on the total amino acids content of Le-Conte pear fruits in different development stages in 2015 and 2016 seasons. In this concern, total amino acids content decreased sharply during fruit development stages. The tryptophan at 100 ppm was effective in accumulate the highest content of amino acids compared with control which accumulate the lowest content, where fruit content of total amino acids reached to 80.27 and 79.60 mg/100 g FW after 100 days of full bloom during the first and the second season, respectively in pear trees that treated by tryptophan at 100 ppm.

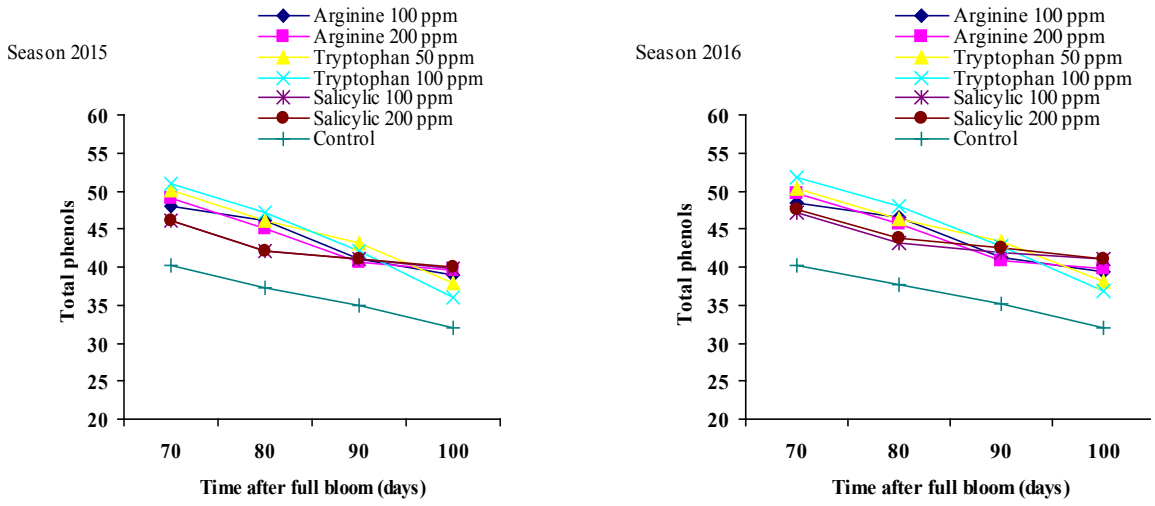

Fig. 1. Effect of arginine, tryptophan and salicylic acid treatments on the total phenols content (mg/100 g FW) of Le-Conte pear fruits in different development stages during 2015 and 2016 seasons.

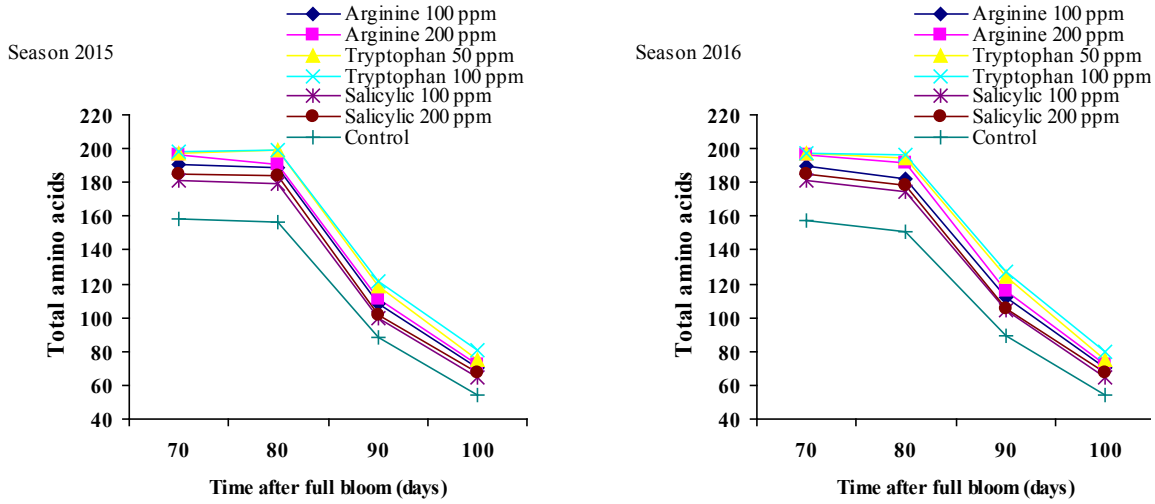

Fig. 2. Impact of arginine, tryptophan and salicylic acids treatments on total amino acids (mg/100 g FW) of Le-Conte pear fruits in different development stages during 2015 and 2016 seasons.

Anyhow, Pillitteri et al. (2010) on 'Washington' navel orange and Hanfy et al. (2012) on Valencia orange trees stated similar effects of amino acids applications, including tryptophan and arginine. Moreover, Darwesh et al. (2014) approved the relation between total amino acids content and tryptophan treatment in date palm.

Data presented in Fig. 3 show the effect of tryptophan and arginine amino acids and salicylic acid treatments on the antioxidant capacity of Le-Conte pear fruits in different fruit development stages in 2015 and 2016 seasons. The antioxidant capacity decreased continually during fruit growth progress, untreated trees showed the lowest antioxidant capacity of pear fruits cv. Le-Conte in both studied seasons compared with the conducted applications. After 100 days of full bloom, trees treated by salicylic acid at 200 ppm significantly showed the highest antioxidant capacity (44.84 and 42.62 mg/100 g FW) in both experiment seasons, respectively.

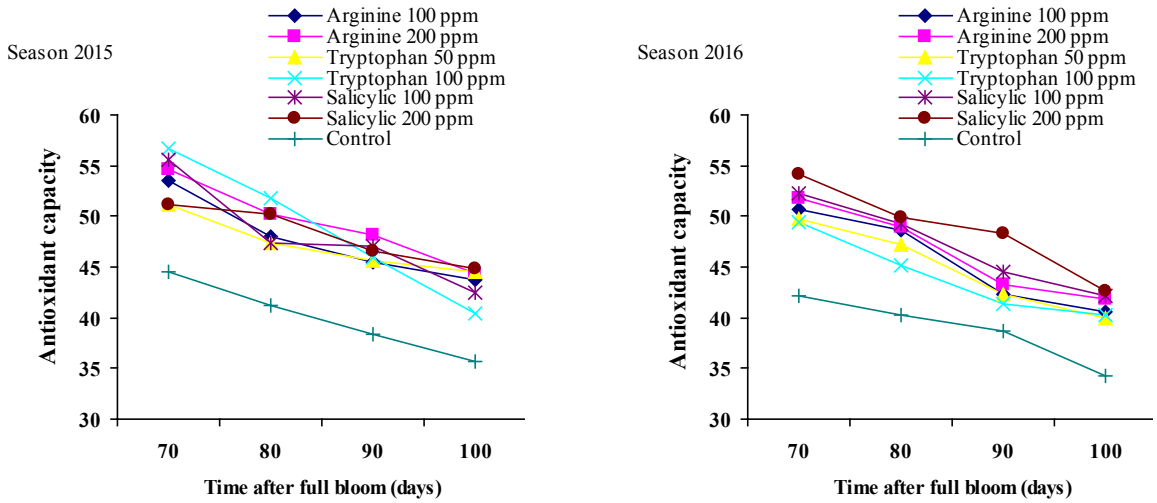

Fig. 3. Effect of arginine, tryptophan and salicylic acids treatments on antioxidant capacity (mg/100 g FW) of Le-Conte pear fruits in different development stages during 2015 and 2016 seasons.

The current results were in line with the results that had reported on pear fruits (Cao et al., 2006), strawberry (Shafiee et al., 2010) and apricot (Ardkani et al., 2013). Salicylic acid increased antioxidant activity potential via the expression of oxidase genes, eliminated toxic effects of free radicals and protected plant cell interactions against all classes of stresses (Thurnham, 1990).

Applying salicylic acid accelerated the activity of phenylalanine ammonia lyase enzyme, which is considered the main enzyme in different metabolisms (Schieber et al., 2001) and it encouraged the synthesis and accumulation of vital phenolic compounds with antioxidant actions (Pila et al., 2010).

Conclusion

Overall, Arginine, tryptophan and salicylic acids treatments attained highest significantly fruit set, yield and fruit quality as compared to untreated ones. Applying the tryptophan at 100 ppm showed the highest significant fruit set percentage, yield and fruit weight. Also, tryptophan at 100 ppm resulted in higher L/D ratios, specific gravity, L^* flesh values, a^* colour values, TSS, total sugar and total amino acids contents of pear fruits cv. Le-Conte. In addition, the tryptophan treatments increased total phenols of Le-Conte pear fruits significantly compared with control that showed the lowest. While, salicylic acid at 200 ppm showed the lowest significant fruit abscission percentages, maintained the highest significant fruit content of ascorbic acid and antioxidant capacity, and reduced pears softness. Tryptophan, salicylic acid and arginine treatments attained valuable effects on productivity and fruit quality of Le-Conte pear.

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تحسين الإنتاجية و صفات الجودة و المحتوى من مضادات الاكسدة لثمار الكمثرى الليكونت باستخدام الرش الورقى بالتربتوفان و الارجنين و الساليسيليك

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أجريت هذه الدراسة بهدف تحسين الإنتاجية و جودة الثمار للكمثرى صنف الليكونت خلال موسمين متتالين (٢٠١٥ و ٢٠١٦). و قد شملت المعاملات كلا من الحامض الامينى الارجنين بتركيزات ١٠٠ و ٢٠٠ جزء في المليون ، و بتركيزات ٥٠ و ١٠٠ جزء في المليون من الحامض الامينى التربتوفان ، و حامض الساليسيليك بتركيزات ١٠٠ و ٢٠٠ جزء في المليون بالإضافة الى الكنترول (ماء فقط) و ذلك رشا على اوراق الأشجار البالغة عند اكتمال التزهير و في مرحلة العقد المبدئى (بعد ٢١ يوم من اكتمال التزهير). تم تقييم الإنتاجية و بعض خصائص الجودة للثمار ، فضلا عن تتبع محتوى الثمار من الفينولات الكلية و الاحماض الامينية الكلية و مضادات الاكسدة خلال نمو الثمار. ووجد أن المعاملة بالتربتوفان و الساليسيليك و الارجنين أعطت فروق معنوية في إنتاجية الأشجار و جودة الثمار للكمثرى الليكونت. كما أدت المعاملة بالتربتوفان بتركيز ١٠٠ جزء في المليون الى أعلى نسب من حيث عقد الثمار و كمية المحصول و وزن الثمرة و نسبة الطول/العرض في الثمار و الكثافة النوعية و درجة سطوع لون اللحم و لون القشرة و المواد الصلبة الذائبة الكلية و السكريات الكلية والاحماض الامينية الكلية بالإضافة الى الفينولات الكلية في ثمار الكمثرى الليكونت ، في حين ان حامض الساليسيليك بتركيز ٢٠٠ جزء في المليون أدى الى اقل نسب من حيث تساقط الثمار، كما حافظ معنويا على محتوى مضادات الاكسدة و حمض الاسكوربيك و الصلابة في ثمار الكمثرى الليكونت.