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Effect of Spraying Amino Acids and Micronutrients as Well as their Combination on Growth, Yield, Fruit Quality and Mineral Content of Canino Apricot Trees

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ABSTRACT

This work was conducted during 2016 and 2017 seasons in a private orchard at El-Khatatba region, Minofia Governorate, Egypt to study the effect of some foliar application of amino acids at 0.0, 1, 2 and 3 ml/L and micronutrients mixture i.e., Fe + Zn + Mn each at 0.0, 50, 100 and 150 ppm as well as their combination on growth, yield, quality and leaf mineral content of Canino apricot trees. The trees used in this experiment were eight-year-old planted at 4x5m apart and budded on local apricot rootstock, grown in a sandy soil under drip irrigation system and received the common cultural practices. The trees selected to be healthy and uniform in growth and yield as possible. The gained results showed that the longest shoots, the highest number of leaves/shoot and the largest leaf area were obtained from the combination of amino acids at the high rate (3 ml/L), particularly those sprayed with micronutrients at the high level (150 ppm) in the two seasons. The highest fruit set % was scored by the interaction of amino acids at the high rate, especially those received micronutrients foliar spray at the high level in the two seasons. The heaviest fruit and the highest yield/ fed. were noted by the combined treatment between amino acids at 3 ml/L and micronutrients at 150 ppm in the two seasons. The highest values of fruit firmness obtained from the combination of micronutrients at the high level, particularly those received amino acids at the high rate (3 ml/L) in both seasons. 3 ml/L amino acids sprayed plus micronutrients at 150 ppm induced the highest values of fruit T.S.S. %, fruit total sugars % and V.C (mg/ 100ml juice). The highest values of leaf N, P, K, Fe, Zn and Mn contents were obtained by using the mixed treatment between amino acids at 3 ml/L and micronutrients at 150 ppm in both seasons. Conclusively, spraying Canino apricot trees with amino acids at 3 ml/L and received micronutrients at 150 ppm foliar spray induced prospective effects on vegetative growth and fruits yield and quality.

Keywords: Canino apricot, amino acids, micronutrients, growth, yield, quality and chemical composition.

INTRODUCTION

Apricot (*Prunus armeniaca* L.) is one of the fruit tree species planted on a large scale over the world. Apricots have important nutritional properties; it is strongly recommended to consume them in cases of vitamin A and trace element deficiencies, anaemia, physical and mental fatigue, depression, neurosis, stress, etc. (Iordanescu, *et al.* 2012). Apricots are a tonic for the nervous system and improve the body's natural defence reaction. Hence, they have an alkaline action, apricots help maintain the acid-base balance in the blood and body tissues and reduce acidity resulting from a diet too rich in meat and flour products. Apricot fruits contain the major minerals K, Ca, and Mg (Drogoudi *et al.,* 2008). Apricot fruit contains lycopene, which helps to prevent cancer and protects the body from high cholesterol, thus preventing heart disease.

Recently, some cultivars of apricot have been evaluated for their antioxidant activity, suggesting their health-promoting effects in the human diet (Leccese *et al.,* 2010). Antioxidant compounds, such as carotenoids, polyphenols, and vitamin C, have been evaluated in high amounts in apricot fruit (Caliskan *et al.,* 2012 and Fratianni *et al.,* 2018).

Amino acids are considered as precursors and constituents of proteins which are necessary for promoting cell growth. They contain both acid and basic groups and act as buffers, which led to maintain favourable pH value within the plant cell (Davies, 1982). Amino acids can directly or indirectly affect the physiological activities in plant growth and development. Exogenous application of amino acids have been reported to improve the growth, yield and biochemical quality of grapes (Khan *et al.,* 2012), apples (Arabloo *et al.,* 2017) and pears (Fayek *et al.,* 2011).

The incidence of micronutrients deficiencies in fruit crops has increased markedly in the recent years due to intensive cropping, losses of micronutrients through leaching, decreased amounts of organic fertilizers application as compared to chemical fertilizers, increased purity of chemical fertilizers, soil erosion and use of marginal lands (with high pH and EC) for crop production (Zia *et al.,* 2006). The climate change by weather warming and drying might be another important reason for the disorders. Micronutrients play an important role in production and its deficiency reduce the productivity. Apricot plants, also shows micronutrients deficiency and could be responsible for lower yield and quality. Foliar feeding of nutrients to fruit plants has gained much importance in recent years which is quite economical and obviously an ideal way of evading the problems of nutrients availability and supplementing the fertilizers to the soil. Micronutrients such as Fe, Zn and Mn are not only essential but they are equally important like other macronutrients, in spite of their requirements in micro quantities. Micronutrients are key elements in plants growth and development. These elements play very important role in various enzymatic activities and synthesis. These micronutrients also help in the uptake of major nutrients and play a vital role in the plant metabolism process starting from cell wall development to respiration, photosynthesis, chlorophylls formation, enzyme activity, hormone synthesis, nitrogen fixation and reduction (Das, 2003). Fe plays a key role in several enzyme-systems, in which haeme or haemin is the prosthetic group (Khurshid *et al.,* 2008). Zn is involved in the biosynthesis of Tryptophan, a precursor of naturally occurring auxin, indole acetic acid (IAA) (Swietlik, 2002). Mn is required in the process of photosynthesis (Mengel and Kirkby, 1987).

The objective of this experiment was to investigate the effect of some foliar application of micronutrients and amino acids as well as their combination on growth, yield, quality and leaf mineral content of Canino apricot trees.

MATERIALS AND METHODS

This work was conducted during 2016 and 2017 seasons in a private orchard at El-Khatatba region, Minofia Governorate, Egypt. Eight-year-old 'Canino' apricot trees (planted at 4x5m a part and budded on local apricot rootstock), grown in a sandy soil under drip irrigation system and received the common cultural practices. Physical and chemical properties of the soil of the experimental region are presented in Table (1).

Table 1. Soil characteristics of Canino apricot trees at the start of the experiment.

Mechanical analysis	Value	Chemical analysis	Value	Anion and Cation (Meq/l)	Value
Coarse sand%	47.9	$CaCO_3$%	1.92	Ca^{++}	1.75
Fine sand%	37.1	Field capacity%	13.9	Na^{+}	1.85
Silt%	12.7	PH	7.81	Mg^{+}	0.83
Clay%	2.3	Organic matter%	0.29	K^{+}	0.20
Soil texture	sandy	EC (ds/m)	0.46	CO_3^{--}	0.0
		Total N%	0.10	HCO_3^{-}	2.37
				Cl^{-}	1.44
				SO_4^{--}	0.82

The trees used in this experiment were selected to be healthy and uniform in growth behaviour and yield as possible. The trees were trained and pruned uniformly to an open centre shape. The selected trees were subjected to the following treatments:

Amino acids treatments: Canino apricot trees were foliar sprayed with Bioflow (commercial compound containing 27.3 % amino acids) at the rate of 0.0, 1, 2 and 3 ml/L for each three times a year started from the first week of March with two weeks intervals.

Micronutrients treatments: Canino apricot trees were foliar sprayed with a mixture of iron, zinc and manganese sulphate each at 0.0,50, 100 and 150ppm three times a year started from the first week of March with ten days intervals.

Tween twenty at 0.01% was applied as a wetting agent to all sprayed solutions including the control. The trees were sprayed with the previous solutions till runoff. The apricot trees received the recommended agricultural practices regularly followed in commercial orchards at this region.

- **Experiment layout**

The design of the experiment was factorial experiments in a complete randomize block design with 16 treatments (4 micronutrients concentrations x 4 amino acids concentrations). Each treatment was replicated three times, with three trees for each replicate.

The response of Canino apricot trees to the studied treatments was evaluated through the following data measurements: Eight branches selected around every tree were chosen and labelled before spraying to estimate the different gained data in the two seasons.

- **Vegetative growth aspects**

Data were recorded on shoot length, number of leaves/ shoot and leaf area were measured using planimeter during August.

- **Fruit yield aspects**

Fruit set was calculated in relation to the total number of flowers and then the percentages were calculated as follow: Fruit set (%) = No. of developing fruitlets x 100 /Total No. of flowers. Fruits were collected at maturity stage late of June from each tree of various replicates to determine fruit weight (g) and yield (ton/fed).

- **Fruit physical aspects**

Twenty fruits from each tree under study were chosen for estimating the fruit firmness which determined as lb/inch^2 using the pressure tester of 5/16 inch plunger.

- **Fruit chemical aspects**

Data of chemical aspects were recorded for total soluble solids in fruit juice using a hand refractometer. Moreover, fruit titratable acidity (malic acid g/ 100ml fruit juice) and ascorbic acid (V.C) content (ascorbic acid mg/ 100ml fruit juice) were scored according to A.O.A.C. (1995). Fruit total sugars (%) of fresh weight were determined using the Nelson arsenomolybdate colorimetric method as described by Malik and Singh (1980).

- **Leaf mineral content**

Leaf mineral content were measured in mid-April of both seasons. Samples of 30 leaves/tree were taken at random from the previously tagged shoots of each tree. Leaf samples were washed with tap water and distilled water twice, dried at 70 ºC to a constant weight and then ground. The ground samples were digested with sulphuric acid and hydrogen peroxide. Total nitrogen was determined by using micro-kjeldehl method as described by Pregl (1945). Phosphorus was estimated according to Evenhuis and Dewaored (1980). Potassium was determined photometrically as described by Brown and Lilleland (1946). Fe, Zn and Mn were determined by Perking–Elmer Atomic Absorption Spectrophotometer model 2380, according to Johnston and Ulrich (1959). The concentration of Fe, Zn and Mn were expressed as part per million (ppm) on dry weight basis.

Statistical analysis:

All data obtained in both seasons of study were subjected to analysis of variance as factorial experiments in a complete randomize blocks design. L.S.D. method was used to differentiate between means according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Effect of some amino acids and micronutrients treatments on growth, yield, fruit quality and chemical compositions of Canino apricot trees

1- Vegetative growth aspects

Data in Table (2) showed that the different amino acids had significantly affected the tested vegetative growth parameters of Canino apricot trees i.e. shoot length, leaves number/ shoot and leaf area, especially using the high rate (3 ml/L) combined with the other rates in the two seasons. Data concerning the effect of micronutrients on vegetative growth parameters obviously revealed that increasing micronutrients levels from 0.0 to 150 ppm caused a gradual increment in these parameters, with little significant differences in most cases in the two seasons. The interaction effect between amino acids and micronutrients on vegetative growth parameters showed that the longest shoots, highest number of leaves/ shoot and the largest leaf area were obtained from the combination of amino acids at the high rate (3 ml/L), particularly those sprayed with micronutrients at the high level (150 ppm) in the two seasons. Irrespective untreated Canino apricot trees "control", the lowest values of these parameters were registered by those sprayed with the low level of micronutrients (50 ppm) and received no amino acids treatment in the two seasons. The other treatments came in between the abovementioned treatments in the two seasons.

The obtained results may be due to the role of amino acids as they are considered as precursors and the build blocks of protein synthesis, which could be enzymes important for metabolic activities to promote cell growth (Aberg, 1961). Also, Davies (1982) indicated that amino acids contained both acid and basic groups and act as buffers, that help to maintain favorable pH value within the plant cell. Amino acids can impact directly or indirectly the physiological activities in plant growth and development. Promoting effect of amino acids on protecting plant cells from oxidation and all stresses as well as enhancing the biosynthesis of proteins, plant pigments, natural hormones such as IAA, gibberellin and cytokinines and cell division is reflected on stimulating vegetative growth, chemical composition and productivity (Davies, 1982; Yagodin, 1990 and Rai, 2002).

The obtained results regarding the positive effect of foliar sprays with amino acid on some vegetative growth parameters of Canino apricot trees are in agreement with those of Hanafy *et al.,* (2012) on Valencia orange and Khattab *et al.,* (2012) on Manfalouty pomegranate.

Moreover, enhancing vegetative growth aspects in response to micronutrients may be due to their positive effect on increasing cell division in the meristematic tissues and accelerating carbohydrates and proteins formation (Ghanta and Metra, 1993). Additionally, Nijjar (1985) indicated that these elements play an important role in the multi-biological processes such as the role of Zn in the synthesis of trptophan, a precursor of indole acetic acid (IAA), as well as zinc deficiency causes a reduction in RNA synthesis and ribosome stability.

The uses of micronutrients by many researchers have shown enhanced vegetative growth of different fruit species (Wassel *et al.,* 2007; Maklad 2010 and Seyam, 2012 and Razzaq *et al.,* 2013). They reported that Fe, Zn and Mn lonely or in combinations as foliar application enhanced vegetative growth parameters of different fruit trees.

Table 2. Effect of spraying some amino acids and micronutrients treatments on some vegetative growth aspects of Canino apricot trees during 2016 and 2017 seasons.

		First season					Second season				
		Micronutrients					Micronutrients				
		0.0 ppm	50 ppm	100 ppm	150 ppm	Mean*	0.0 ppm	50 ppm	100 ppm	150 ppm	Mean*
Amino acids		Shoot length (cm)									
0.0 ml/L		39.6	41.2	42.6	43.1	41.63	42.3	42.9	43.7	43.9	43.2
1 ml/L		43.7	44.3	45.1	45.8	44.72	45.2	45.8	46.7	46.9	46.15
2 ml/L		46.7	47.5	48.0	48.2	47.60	48.6	49.2	49.8	50.2	49.45
3 ml/L		48.7	49.1	49.6	49.8	49.30	51.1	51.5	52.1	52.4	51.78
Mean**		44.67	45.53	46.33	46.72		46.8	47.35	48.08	48.35	
	Micronutrients			1.319					1.968		
L.S.D at 0.05 for	Amino acids			1.319					1.968		
	Interaction			2.639					3.937		
Amino acids		Leaves number/shoot									
0.0 ml/L		34.5	34.9	35.6	35.8	45.2	36.9	37.4	37.9	38.2	37.6
1 ml/L		36.7	37.1	37.8	38.0	37.4	39.3	39.9	41.8	42.0	40.8
2 ml/L		39.8	41.3	41.9	42.3	41.3	43.7	43.8	44.6	45.1	44.3
3 ml/L		43.6	45.2	48.1	46.8	45.4	46.2	43.8	47.2	47.8	46.3
Mean**		38.7	39.6	40.4	40.7		41.5	41.2	42.9	43.3	
	Micronutrients		1.346						1.611		
L.S.D at 0.05 for	Amino acids		1.346						1.611		
	Interaction		3.693						3.223		
Amino acids		Leaf area (cm^2)									
0.0 ml/L		31.7	31.9	32.4	32.4	32.1	31.4	31.8	32.6	32.9	32.2
1 ml/L		33.2	33.1	33.9	34.2	33.6	33.8	34.1	34.6	34.8	34.3
2 ml/L		35.8	36.3	37.1	37.5	36.7	36.2	36.5	36.9	37.1	36.7
3 ml/L		37.6	38.2	38.5	38.9	38.3	38.4	38.5	38.7	38.9	38.6
Mean**		34.6	34.9	35.5	35.8		44.0	35.2	35.7	35.9	
	Micronutrients			1.395					1.169		
L.S.D at 0.05 for	Amino acids			1.395					1.169		
	Interaction			2.790					2.337		

2- Fruiting aspects

Data in Table (3) indicated that all used amino acids and micronutrients as well as their combinations had a pronounced effect on increasing fruit set of Canino apricot trees in the two seasons. However, the highest fruit set % was scored by the interaction of amino acids at the high rate, especially those received micronutrients foliar spray at the high level in the two seasons. Regardless control trees, the lowest fruit set % was gained by those sprayed with amino acids at the low rate (1 ml/L) and received no micronutrients treatment in the two seasons. Furthermore, all tested amino acids and micronutrients treatments as well as their combinations increased fruit yield/ fed. in both seasons. However, the highest rate of amino acids (3 ml/L) or the highest level of micronutrients (150 ppm) recorded the highest fruit yield/ fed. as compared with the other concentrations in the two seasons. In general, the highest yield/ fed. was detected by the combined treatment between amino acids at 3 ml/L and micronutrients at 150 ppm in the two seasons of this study. Irrespective un-treated trees, the lowest yield/ fed. was gained by those received the combined treatment between the lowest level of amino acids and sprayed with distilled water in the two seasons. The remained treatments came in between the abovementioned treatments in the two seasons.

In general, the positive effects of amino acid foliar spray applications could be attributed to improve pollen tube ovule penetration and delay ovule senescence, which enhance fruit set and yield of Golden Delicious and Granny Smith apples (Arabloo *et al.,* 2017). Foliar sprays of amino acids that gave positive effects on tree fruiting parameters of Canino apricot trees are in harmony with those findings of Fayek *et al.,* (2011) pear, Khattab *et al.,* (2012) pomegranate, Belal *et al.,* (2016) on grapevine, Khattab *et al.,* (2016) on mango, Ilie *et al.,* (2017) on apple and Ahmed *et al.,* (2017) on orange. They mentioned that foliar application of amino acids increased the fruit set and fruit yield. The obtained results concerning the positive effect of micronutrients mixture (Fe, Zn and Mn) in this regard are in agreement with those reported by El-Seginy *et al.,* (2003) on apple , El-Kosary *et al.,* (2011) on mango, El-Sheikh *et al.,* (2007) and Yadav *et al.,* (2013) on peach, Tariq *et al.,* (2007) and Kazi *et al.,* (2012) on orange, Khorsandi *et al.,* (2009) on pomegranate, Hassan *et al.,* (2010) on plum , Seyam (2012) on mandarin, Razzaq *et al.,* (2013), Nirmaljit *et al.,* (2015) and Ilyas *et al.,* (2015) on Kinnow mandarin, Saadati *et al.,* (2016) on olive and Suman *et al.,* (2016) and Zagade *et al.,* (2017) on guava. They indicated that foliar application of micronutrients such as, Fe, Zn and Mn alone or in combinations enhanced fruiting parameters of the different fruit trees.

Table 3. Effect of spraying some amino acids and micronutrients treatments on fruit set and fruit yield/fed. of Canino apricot trees during 2016 and 2017 seasons.

		First season					**Second season**				
		Micronutrients					**Micronutrients**				
		0.0 ppm	**50 ppm**	**100 ppm**	**150 ppm**	**Mean***	**0.0 ppm**	**50 ppm**	**100 ppm**	**150 ppm**	**Mean***
Amino acids		Fruit set %									
0.0 ml/L		16.4	21.9	26.2	28.4	23.2	18.7	20.4	25.9	27.1	23.0
1 ml/L		16.9	22.7	28.1	29.3	24.3	19.3	21.2	26.8	28.3	23.9
2 ml/L		18.2	24.0	29.7	32.1	26.0	21.1	24.3	27.9	28.8	25.5
3 ml/L		18.8	25.7	31.9	33.8	27.6	21.7	25.1	29.3	30.4	26.6
Mean**		17.6	23.6	29.0	30.9		20.2	22.8	27.5	28.7	
	Micronutrients			1.001					1.125		
L.S.D at 0.05 for	Amino acids			1.001					1.125		
	Interaction			2.002					2.251		
		Fruit yield (ton/fed.)									
0.0 ml/L		6.94	7.86	8.37	8.81	8.00	7.11	7.81	8.32	8.70	7.99
1 ml/L		7.05	7.96	8.39	8.92	8.08	7.21	8.17	8.31	8.80	8.12
2 ml/L		7.17	8.14	8.46	8.61	8.10	7.26	8.19	8.36	8.39	8.05
3 ml/L		7.24	8.37	8.64	8.92	8.29	7.32	8.24	8.31	8.43	8.08
Mean**		7.10	8.08	8.47	8.82		7.23	8.10	8.33	8.58	
	Micronutrients			0.1318					0.2501		
L.S.D at 0.05 for	Amino acids			0.1318					0.2501		
	Interaction			0.2637					0.5003		

3- Fruit physical parameters

It was interest to notice that there was a positive relationship between the values of fruit weight and fruit firmness and amino acids or micronutrients treatments. Hence, as the rates of amino acids or micronutrients increased the values of fruit weight and fruit firmness increased up to the maximum increasing at the high rates of amino acids or micronutrients in the two seasons (Table, 4).

In general, the highest values of fruit weight and fruit firmness were recorded by using the combination of micronutrients at the high level, particularly those received amino acids at the high rate (3 ml/L) in both seasons. Regardless control trees, the lowest fruit weight and fruit firmness were gained by those sprayed with the low level of micronutrients and received no amino acids in the two seasons.

4- Fruit chemical parameters

It was found that the values of fruit chemical quality i.e. T.S.S. %, total sugars % and V.C (mg/ 100 ml juice) are proportionally increased with increment of amino acids or micronutrients levels in the two seasons (Tables, 5 and 6).

Therefore, the high level of amino acids or micronutrients scored the highest values in this respect as compared with untreated trees in the two seasons. In general, all resulted combinations between amino acids and micronutrients increased the values of these parameters with significant differences in most cases when compared with control trees (untreated) in the two seasons. However, 3 ml/L amino acids-sprayed trees joined with micronutrients at 150 ppm induced the highest values in this concern in both seasons.

Furthermore, all studied rates of amino acids and micronutrients as well as their interactions decreased total acidity %, but it failed to induce a significant difference between them in the two seasons.

The obtained results concerning the positive effect of amino acids on enhancing fruit physical and chemical properties of Canino apricot trees go in line with earlier studies of Fayek *et al.,* (2011) on pear, Khattab *et al.,* (2012) on pomegranate, Hanafy *et al.,* (2012) and El-Shazly and Mustafa (2013) on orange, Belal *et al.,* (2016) on grapevines and Arabloo *et al.,* (2017) on apples. They revealed that sprayed amino acids improved fruit juice %, total soluble solids (TSS), total sugars and V.C. contents as compared with control. The recorded results of micronutrients mixture (Fe, Zn and Mn) dealing with their prospective affect on enhancing physical and chemical properties of Canino apricot fruits are in harmony with earlier studies of El-Seginy *et al.,* (2003) on apple, Tariq *et al.*, (2007) on orange, Wassel *et al.,* (2007) on grapevines, El-Sheikh *et al.,* (2007) on peach, Khorsandi *et al.,* (2009) on pomegranate, Hassan *et al.,* (2010) on plum, Anees *et al.,* (2011) and El-Kosary *et al.,* (2011) on mango, Kazi *et al.,* (2012) on orange, Razzaq *et al.,* (2013) and Nirmaljit *et al.,* (2015) on Kinnow mandarin, Ali *et al.,* (2014) on peach, Saadati *et al.,* (2016) on olive and Zagade *et al.,* (2017) on guava.

Table 4. Effect of spraying some amino acids and micronutrients treatments on fruit weight and fruit firmness of Canino apricot trees during 2016 and 2017 seasons.

		First season					Second season				
		Micronutrients					Micronutrients				
		0.0 ppm	50 ppm	100 ppm	150 ppm	Mean*	0.0 ppm	50 ppm	100 ppm	150 ppm	Mean*
Amino acids		Fruit weight (g)									
0.0 ml/L		28.1	28.1	28.4	28.5	28.3	27.6	28.1	28.7	28.9	28.3
1 ml/L		29.3	29.5	29.9	30.0	29.7	30.1	30.2	30.5	30.6	30.4
2 ml/L		31.4	31.7	31.9	32.1	31.8	31.7	31.9	32.4	32.5	32.1
3 ml/L		32.4	32.8	34.2	34.5	33.5	32.9	33.6	33.9	34.10	33.6
Mean**		30.3	30.5	31.1	31.3		30.6	31.0	31.4	31.5	
L.S.D at 0.05 for	Micronutrients			1.039					2.285		
	Amino acids			1.039					2.285		
	Interaction			2.079					4.570		
		Fruit firmness (lb/inch^2)									
0.0 ml/L		7.12	7.19	7.24	7.29	7.21	7.19	7.26	7.31	7.36	7.28
1 ml/L		7.34	7.38	7.46	7.49	7.42	7.38	7.42	7.56	7.62	7.50
2 ml/L		7.82	7.93	8.12	8.18	8.01	7.86	7.91	8.13	8.19	8.02
3 ml/L		8.20	8.27	8.50	8.50	8.37	8.24	8.31	8.46	8.52	8.38
Mean**		7.62.	7.69	7.83	7.87		7.67	7.73	7.87	7.92	
L.S.D at 0.05 for	Micronutrients			0.1647					0.1647		
	Amino acids			0.1647					0.1647		
	Interaction			0.3293					0.3293		

Table 5. Effect of spraying some amino acids and micronutrients treatments on fruit T.S.S % and fruit total sugars % of Canino apricot trees during 2016 and 2017 seasons.

		First season					Second season				
		Micronutrients					Micronutrients				
		0.0 ppm	50 ppm	100 ppm	150 ppm	Mean*	0.0 ppm	50 ppm	100 ppm	150 ppm	Mean*
Amino acids		Fruit T.S.S. %									
0.0 ml/L		11.19	11.26	11.31	11.31	11.27	11.08	11.17	11.28	11.27	11.20
1 ml/L		11.34	11.34	11.39	11.38	11.36	11.21	11.28	11.36	11.41	11.32
2 ml/L		11.46	11.49	11.58	11.63	11.54	11.49	11.57	11.62	11.73	11.60
3 ml/L		11.92	12.14	12.21	12.28	12.14	12.11	12.26	12.37	12.42	12.29
Mean**		11.48	11.56	11.62	11.65		11.47	11.57	11.66	11.71	
L.S.D at 0.05 for	Micronutrients			0.2059					0.2025		
	Amino acids			0.2059					0.2025		
	Interaction			0.4118					0.4050		
		Fruit total sugars %									
0.0 ml/L		7.29	7.34	7.48	7.51	7.41	7.21	7.29	7.41	7.48	7.35
1 ml/L		7.68	7.72	7.83	7.82	7.76	7.74	7.86	7.96	7.94	7.88
2 ml/L		7.94	8.06	8.19	8.21	8.10	8.13	8.19	8.28	8.34	8.24
3 ml/L		8.36	8.41	8.54	8.59	8.48	8.39	8.46	8.57	8.62	8.51
Mean**		7.82	7.88	8.01	8.03		7.87	7.95	9.06	8.10	
L.S.D at 0.05 for	Micronutrients			0.1619					0.4459		
	Amino acids			0.1619					0.4459		
	Interaction			0.3238					0.8918		

Table 6. Effect of spraying some amino acids and micronutrients treatments on fruit total acidity and fruit V.C of Canino apricot trees during 2016 and 2017 seasons.

		First season					Second season				
		Micronutrients					Micronutrients				
		0.0 ppm	50 ppm	100 ppm	150 ppm	Mean*	0.0 ppm	50 ppm	100 ppm	150 ppm	Mean*
Amino acids		Fruit total acidity %									
0.0 ml/L		1.48	1.41	1.43	1.40	1.43	1.43	1.41	1.42	1.42	1.42
1 ml/L		1.43	1.46	1.41	1.43	1.43	1.41	1.39	1.40	1.40	1.40
2 ml/L		1.46	1.42	1.40	1.40	1.42	1.38	1.38	1.41	1.42	1.40
3 ml/L		1.42	1.40	1.39	1.39	1.40	1.39	1.39	1.38	1.38	1.39
Mean**		1.45	1.42	1.41	1.41		1.40	1.39	1.40	1.41	
L.S.D at 0.05 for	Micronutrients			0.04567					0.03729		
	Amino acids			0.04567					0.3729		
	Interaction			0.09133					0.07457		
		Fruit V.C (mg/100 ml juice)									
0.0 ml/L		14.26	14.31	14.39	14.42	14.35	14.37	14.46	14.58	14.64	14.51
1 ml/L		14.48	14.56	14.68	14.74	14.61	15.08	15.19	15.32	15.39	15.24
2 ml/L		14.87	14.96	15.13	15.22	15.05	15.86	15.97	16.13	16.21	16.04
3 ml/L		15.34	15.45	15.62	15.69	15.52	16.34	16.41	16.56	16.72	16.51
Mean**		14.47	14.82	14.65	115.02		15.41	15.51	15.65	15.74	
L.S.D at 0.05 for	Micronutrients			1.054					0.7187		
	Amino acids			1.054					0.7187		
	Interaction			2.108					1.437		

4- Leaf mineral content

Leaf mineral content determinations in Tables (7 and 8) revealed that the values of leaf N, P, K, Fe, Zn and Mn contents are linearly increased with increasing the rates of amino acids or micronutrients, hence the high rate of amino acids (3 ml/L) or micronutrients (150 ppm) showed to be the most effective ones for inducing the highest values in this respect in both seasons. Regarding the interaction effect between amino acids and micronutrients, data in Tables (7 and 8) indicate that all resulted combinations succeeded in increasing the values of these parameters, with superior for the combination of amino acids at the high rate with significant differences in most cases during the two seasons of study. However, the highest values of leaf N, P, K, Fe, Zn and Mn contents were obtained by using the doubled treatment between amino acids at 3 ml/L and micronutrients at 150 ppm in the two seasons.

Table 7. Effect of spraying some amino acids and micronutrients treatments on leaf N, P and K percentages of Canino apricot trees during 2016 and 2017 seasons.

		First season					Second season				
		Micronutrients					Micronutrients				
		0.0	50 ppm	100 ppm	150 ppm	Mean*	0.0	50 ppm	100 ppm	150 ppm	Mean*
Amino acids						N %					
0.0		1.86	1.92	2.01	2.04	1.96	1.74	1.87	1.98	1.97	1.89
1 cm^3/L		2.08	2.19	2.17	2.24	2.17	2.03	2.14	2.19	2.21	2.14
2 cm^3/L		2.43	2.41	2.46	2.48	2.42	2.28	2.36	2.41	2.43	2.37
3 cm^3/L		2.46	2.56	2.63	2.68	2.58	2.41	2.51	2.59	2.62	2.53
Mean**		2.19	2.27	2.32	2.36		2.12	2.22	2.29	2.31	
L.S.D at 0.05 for	Micronutrients			0.08744					0.1021		
	Amino acids			0.08744					0.1021		
	Interaction			0.1749					0.2042		
						P %					
0.0		0.127	0.131	0.136	0.134	0.132	0.132	0.141	0.139	0.142	0.139
1 cm^3/L		0.135	0.139	0.138	0.140	0.138	0.140	0.143	0.149	0.152	0.146
2 cm^3/L		0.141	0.143	0.148	0.149	0.145	0.151	0.159	0.158	0.163	0.158
3 cm^3/L		0.147	0.151	0.157	0.159	0.154	0.159	0.164	0.166	0.169	0.165
Mean**		0.138	0.141	0.145	0.146		0.146	0.152	0.153	0.157	
L.S.D at 0.05 for	Micronutrients			0.0083					0.008338		
	Amino acids			0.0083					0.008338		
	Interaction			0.0167					0.01668		
						K %					
0.0		1.29	1.34	1.41	1.43	1.37	1.36	1.42	1.40	1.45	1.41
1 cm^3/L		1.42	1.49	1.48	1.52	1.48	1.48	1.53	1.69	1.67	1.59
2 cm^3/L		1.51	1.56	1.63	1.68	1.60	1.68	1.73	1.81	1.84	1.77
3 cm^3/L		1.62	1.68	1.79	1.83	1.73	1.78	1.83	1.89	1.92	1.86
Mean**		1.46	1.52	1.58	1.62		1.58	1.63	1.70	1.72	
L.S.D at 0.05 for	Micronutrients			0.09865					0.1395		
	Amino acids			0.09865					0.1395		
	Interaction			0.1973					0.279		

Table 8. Effect of spraying some amino acids and micronutrients treatments on leaf Fe, Zn and Mn contents of Canino apricot trees during 2016 and 2017 seasons.

		First season					Second season				
		Micronutrients					Micronutrients				
		0.0	50 ppm	100 ppm	150 ppm	Mean*	0.0	50 ppm	100 ppm	150 ppm	Mean*
Amino acids						Fe ppm					
0.0		86.9	92.7	106.9	111.3	99.45	92.8	102.4	114.3	116.0	106.4
1 cm^3/L		93.4	112.4	128.6	131.4	116.4	98.2	106.1	116.6	119.3	110.1
2 cm^3/L		96.1	121.7	132.7	136.9	121.8	102.6	108.2	121.0	121.8	113.5
3 cm^3/L		98.4	129.1	135.4	138.1	125.3	104.1	112.6	121.1	129.3	116.8
Mean**		93.7	114.0	125.9	129.4		99.4	107.3	118.3	121.6	
L.S.D at 0.05 for	Micronutrients			13.84					5.043		
	Amino acids			13.84					5.043		
	Interaction			27.68					10.09		
						Zn ppm					
0.0		21.6	21.9	23.6	23.4	22.6	22.8	23.8	24.1	24.7	23.9
1 cm^3/L		21.8	22.4	24.3	24.9	23.4	23.1	24.3	25.6	25.4	24.6
2 cm^3/L		22.6	23.6	24.8	25.3	24.1	23.7	26.1	25.9	26.3	25.5
3 cm^3/L		23.2	24.2	25.1	25.8	24.6	24.1	26.0	26.2	26.7	25.8
Mean**		22.3	23.0	24.5	24.9		23.4	25.1	25.5	25.8	
L.S.D at 0.05 for	Micronutrients			1.066					1.488		
	Amino acids			1.066					1.488		
	Interaction			2.133					2.976		
						Mn ppm					
0.0		27.3	28.7	29.8	30.1	29.0	26.4	29.1	31.2	31.8	29.6
1 cm^3/L		28.1	29.1	30.7	31.0	29.7	27.8	30.2	31.9	32.2	30.5
2 cm^3/L		29.4	31.2	32.6	33.2	31.6	28.1	31.4	32.8	32.9	31.3
3 cm^3/L		29.8	32.1	32.9	33.6	32.1	28.4	32.0	32.7	33.2	31.6
Mean**		28.7	30.3	31.5	32.0		27.7	30.7	32.2	32.5	
L.S.D at 0.05 for	Micronutrients			2.727					1.706		
	Amino acids			2.727					1.706		
	Interaction			5.453					3.412		

The obtained results of amino acids in terms of leaf mineral content of Canino apricot trees go in line with earlier studies of Fayek *et al.,* (2011) on pear. They reported that amino acid treatments improved the nutritional status of the trees. Also, El-Shazly and Mustafa (2013) on Washington Navel orange revealed that foliar sprays with amino acids improved leaf chlorophyll content and leaf mineral contents (N, P, K, Ca and Mg).

The obtained results of micronutrients mixture (Fe, Zn and Mn) on leaf mineral content of Canino apricot trees are in accordance with those reported by El-Seginy *et al.,* (2003) on apple, El-Sheikh *et al.,* (2007) on peach, Hassan *et al.,* (2010) on plum, Abd-Elmegeed *et al.,* (2013) on pear and Tariq *et al.,* (2007) on orange and Razzaq *et al.,* (2013) and Nirmaljit*et al.,* (2015) on Kinnow mandarin. They mentioned that foliar sprays with some micronutrients alone or in combinations improved leaf chemical constituents in most cases.

Conclusively, in order to produce good quality Canino apricot fruits with more yield, it is preferable to spray the trees with amino acids at 3 ml/L supplemented with micronutrients at 150 ppm foliar spray three times a year**.**

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تأثير رش الأحماض الأمينية والعناصر الصغرى وتفاعلاتهم على النمو والمحصول وجودة الثمرة والمحتوى المعدنى لأشجار المشمش كانينو

حامد الزعبلاوي محمود البدوي
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أجريت هذه التجربة خلال موسمى ٢٠١٦ و٢٠١٧ بمزرعة خاصة بمنطقة الخطاطبة – محافظة المنوفية – مصر. لدراسة تأثير الرش الورقى بالأحماض الأمينية بتركيزات صفر ، ١، ٢، ٣ مل/ لتر والرش بمخلوط عناصر صغرى مكون من الحديد + الزنك + المنجنيز بتركيز صفر ، ٥٠، ١٠٠، ١٥٠ جزء فى المليون لكل منهم والتفاعلات المتداخلة بين الأحماض الأمينية ومخلوط العناصر الصغرى على نمو ومحصول وجودة الثمار والمحتوى المعدنى لأشجار المشمش صنف كانينو عمر ثمانية أعوام والمنزرعة على مسافات ٤×٥م فى تربة رملية تحت ظروف الرى بالتنقيط. وكانت الأشجار المختارة للدراسة متماثلة فى النمو والقوة والانتاجية. وقد أوضحت النتائج المتحصل عليها أن أكبر طول نمو خضرى وأكبر عدد للأوراق/ نمو وأكبر مساحة ورقية تم الحصول عليهم عند إستخدام تفاعلات التركيز المرتفع للأحماض الأمينية (٣ مل/ لتر) خاصة عند رشها بمخلوط العناصر الضغرى بالتركيز المرتفع (١٥٠ جزء فى المليون) فى كلا الموسمين. أكبر نسبة عقد للأزهار تم الحصول عليها بإستخدام تفاعلات الأحماض الأمينية بالتركيز المرتفع ورشها بمخلوط العناصر الصغرى بتركيز ١٥٠ جزء فى المليون فى كلا الموسمين. أكبر وزن للثمرة وأعلى محصول ثمار/ فدان تم الحصول عليه بإستخدام المعاملة المختلطة بين الأحماض الأمينية بتركيز ٣ مل/ لتر ومخلوط العناصر الصغرى بتركيز ١٥٠ جزء فى المليون. كما تم الحصول على أعلى صلابة للثمار عند أستخدام تفاعلات التركيز المرتفع من مخلوط العناصر الصغرى وخاصة عند رشها بالتركيز المرتفع من الأحماض الأمينية فى كلا الموسمين. أدى رش الأشجار بالأحماض الأمينية بتركيز ٣مل/ لتر بالإضافة لرشها بمخلوط العناصر الصغرى بتركيز ١٥٠ جزء فى المليون أكبر محتوى من المواد الصلبة الذائبة الكلية والسكريات وفيتامن C. وأن أكبر محتوى للأوراق من النتروجين، الفوسفور، البوتاسيوم، الحديد، الزنك والمنجنيز تم الحصول عليها عند أستخدام المعاملة المزدوجة بين الرش بالأحماض الأمينية بيركيز ٣مل/ لتر ومخلوط العناصر الصغرى بتركيز ١٥٠ جزء فى المليون فى كلا الموسمين. وعموماً فإن رش أشجار المشمش صنف كانيينو بالأحماض الأمينية بتركيز ٣ مل/ لتر بالإضافة لرشها بمخلوط العناصر الصغرى بتركيز ١٥٠ جزء فى المليون أعطى تأثيرات جيدة على النمو والمحصول وجودة الثمار.