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Impact of Spraying Some Organic Acids on Growth and Fruiting of Early Sweet Grapevines

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Abstract: This experiment was done in 2021 and 2022 seasons. In order to estimate the results of applying three organic acids (salicylic, ascorbic, and citric) singly and in combination at varying concentrations (250, 500, and 1000 ppm) on the growth, berry quality, and yield of Early Sweet grapevines In comparison to the control, it was discovered that both single and combination administrations of all evaluated organic acids had a beneficial impact on characteristics of growth, vine's nutritional condition, berry quality and yield. It was also observed that the combined applications were superior to those of the single application in all tested traits, and the improvement was compatible with an increased concentration of250 to 1000 ppm. The conclusion is that to raise both yield and berry quality under sandy soil, it might be worth spraying Early Sweet grapes at three different times (beginning of growth, following the berry setting, and after three weeks) with combination of organic acids (citric, ascorbic, and salicylic) with concentrations of 500 ppm from each of them.

Key words: Foliar applications, Citric acid, Ascorbic acid, Salicylic acid, Early Sweet grapevines.

INTRODUCTION

Early Sweet grapes are regarded as a prime and superior cultivar that thrives in Egyptian climates. It can be easily exported to most foreign countries because it matures early, mostly when treated with a dormancy breaking agent. Many attempts were made to improve the physical and chemical attributes of this cultivar, like using natural antioxidants (organic acids) instead of synthetic hormones to overcome their potential hazard to the environment. Antioxidants have protective qualities; they are important to plants' defense against oxidative stress. Additionally, it aids in the majority of organic foods' biosynthesis and the process of cell division **(Oretili, 1987)**. Using organic acids has recently been advised by environmental safety and public health to improve crop productivity, growth, and nutritional situation of different crops because it leads to increase nutrients, phytohormones, vitamins and total carbohydrates while, lowering total phenols **(Kobta *et al*., 1999 and Kobta *et al*., 2000)**.

Making use of different antioxidants (organic acids) to improve yield, and quality of Early Sweet grapes were reported in many works. (**Mahran, 2005; Ibrahiem- Asmaa, 2006; Ahmed, *et al.*, 2010; Abada and Abd El- Hameed, 2010; Bondok- Sawsan*et al.*, 2011; Ahmed *et al.*, 2011; Ahmed *et al.*, 2012; Abada 2014; Abd El-Galil 2015; Ebrahiem,2015; Ali *et al.*, 2016; Sayed, 2017; Gamea-Marwa,2018** and **El- Salhy *et al.*, 2021**). Thus, the purpose of this research is to evaluate how some organic acids (citric, ascorbic, and salicylic) the characteristics of growth, vines' nutritional condition, berry quality and yield of Early Sweet grapevines.

MATERIALS AND METHODS

This experiment was done on 78 early sweet grapevines, 12 years old, in a vine yard placed in west Matay, Minia Governorate, Egypt, during 2021 and 2022 seasons. Vines were planted at 2.0×3.0 apart (700 vine/ fed.) and utilized a gable trellising system. For both seasons, winter pruning was done during the 1stweek of January by leaving72 eyes per vine (20 fruiting spurs, each with three eyes, plus six replacement spurs, each with two eyes). The vineyard's soil type was sandy and well-drained. **(Table 1)**, and drip irrigation system. Some traits of soil were identified, as stated by **(Black *et al*., 1965).**

Table 1: Examination of experiment soil

Constituents	Values	Constituents	Values
Sand %	73.2	Total N%	0.02
Silt %	17.5	Available P (ppm)	1.3
Clay %	9.3	Available K (ppm)	20.4
Texture	Sandy	Fe (ppm)	0.8
pH (1: 2.5 extract)	7.92	Zn (ppm)	0.6
EC (1:2.5 extract) mmhos/ cm)	1.31	Mn (ppm)	2.1
O.M. %	0.22		
$CaCO_3$%	1.98		

This study comprised thirteen treatments from organic acids concentrations.

1- Control (spraying water).
2- Applying spray citric acid at 250 ppm.
3- Applying spray citric acid at 500 ppm.
4- Applying spray citric acid at 1000 ppm.
5- Applying spray ascorbic acid at 250 ppm.
6- Applying spray ascorbic acid at 500 ppm.
7- Applying spray ascorbic acid at 1000 ppm.
8- Applying spray salicylic acid at 250 ppm.
9- Applying spray salicylic acid at 500 ppm.
10- Applying spray salicylic acid at 1000 ppm.

11- Applying spray (citric, ascorbic and salicylic acids) at 250 ppm.

12- Applying spray (citric, ascorbic and salicylic acids) at 500 ppm.

13- Applying spray (citric, ascorbic and salicylic acids) at 1000 ppm.

Three replicates of each treatment were made, with two vines per replicate. During each season, these organic acids were sprayed at three different times (beginning of growth, following the berry setting and after three weeks). Each organic acid was dissolved using ten milliliters of ethyl alcohol and wetting agent (tritonB) was added at a rate of 0.05% to each treatment. As usual, other horticultural practices were followed through the two seasons.

After that, all of these measurements were noted as follows:

- Main shoot length (cm): average length of ten shoots was recorded.

- Number of leaves / shoot.

- Leaf area (cm^2) during-1st of May, twenty leaves from main shoot basal clusters were chosen to calculate the average leaf area using the equation presented by **Ahmed and Morsy (1999)**.

- Pigments of Leaves (chlorophylls a, b and total carotenoids (mg/1.0 g F.W.) as mentioned by **Lichtenthaler and Wellburn (1985)**.

-Some nutrients of (N%, P%, and K%): Utilizing techniques described by **Wilde *et al*. (1985)**

- The percentages of berry setting.

- Shoot berry%, berry weight(g.) and berry (equatorial and longitudinal, in cm.).

- Chemical properties of berries (specifically their TSS%, reducing sugar%, and total acidity) were calculated according to **A.O.A.C.** (**2000**), and TSS/acid was calculated.

- Wood ripening coefficient: calculated in accordance with **Bouard 1966.**

- Cane thickness (cm) was measured by using an avernier caliper just before winter pruning.

-Wood pruning weight (kg.): calculated in January during winter pruning.

All collected data were tabulated, and a statistical analysis was done in accordance with **Mead *et al.* (1993)**. The differences between treatments were compared using Duncan's test at 5% level.

RESULTS AND DISCUSSION

1. Vegetative growth characteristics.

The impact of applying various concentrations of organic acids (citric, ascorbic, and salicylic) on certain traits of vegetative growth of Early Sweet grapes over the course of two consecutive growing seasons (2021 and 2022) is shown in (Table 2). Results obtained suggested that, when compared to control treatment, all tested applications significantly stimulated leaf area, shoot length and number of leaves/shoot. Use of organic acids (citric, ascorbic, and salicylic) in ascending order was found to greatly increase these growth characteristics. Increasing each organic acid's concentration from 500 to 1000 ppm did not significantly promote these growth-related aspects. It was found that using combined application was more advantageous than single treatments to improve all tested vegetative growth traits during two seasons. The vine treated with a mixture of the three organic acids at 1000 ppm showed the highest values of shoot length (124.0 and 125.0 cm), number of leaves/shoot (22.0 and 22.5), and leaf area (126.0 and 126.9 cm2). In contrast, the lowest values were found on control treatments.

Table (2). Effect of spraying some organic acids on some vegetative growth characteristics of Early Sweet grapevines during 2021 and 2022 seasons.

Treatments	Main Shoot length (cm)				No. of leaves/ shoot				Leaf area (cm)^2			
	2021		2022		2021		2022		2021		2022	
Control	99.00	k	100.00	h	16.00	f	16.50	g	102.00	i	103.00	i
Salicylic acid at 250 ppm	111.00	g	112.50	d	18.00	d	18.00	ef	115.00	d	116.00	e
Salicylic acid at 500 ppm	114.00	e	116.00	c	18.50	d	19.00	d	119.00	c	120.00	d
Salicylic acid at 1000 ppm	118.00	c	119.50	b	19.50	c	20.00	c	121.00	b	121.80	c
Ascorbic acid at 250 ppm	107.00	i	108.00	f	17.00	e	17.50	f	110.00	f	110.70	g
Ascorbic acid at 500 ppm	112.00	f	113.50	d	18.00	d	18.50	de	113.00	e	113.90	f
Ascorbic acid at 1000 ppm	115.00	d	116.50	c	18.50	d	19.00	d	116.00	d	117.00	e
Citric acid at 250 ppm	104.50	j	106.00	g	16.50	e	17.00	fg	105.50	h	116.30	e
Citric acid at 500 ppm	108.00	h	109.50	e	17.00	e	17.50	f	108.00	g	108.80	h
Citric acid at 1000 ppm	112.00	f	113.50	d	18.00	d	18.50	de	109.80	f	110.40	g
Three organic acids in low conc.	118.50	c	120.00	b	20.00	c	20.50	c	121.50	b	121.80	c
Three organic acids in mid. conc.	122.50	b	124.00	a	21.00	b	21.50	b	124.80	a	125.20	b
Three organic acids in high conc.	124.00	a	125.00	a	22.00	a	22.50	a	126.00	a	126.90	a

In column means followed by the same letters are not statistically different at 0.05 level according to Duncan's multiple range test.

2. Chemical composition of leaves

Data acquired in Tables (3 and 4) showed that spraying vines three times with single or combined organic acids enhanced significantly the photosynthesis pigments (chlorophylls a, b and carotenoids) in leaves and leaf chemical components (N%, P%, and K%) as compared to control treatments. These pigments and certain nutrients in the leaves were greatly enhanced by applying citric, ascorbic, and salicylic acids in ascending order, resulting in a step-by-step increase in concentration from 250 to 1000 parts per million. regular promotion with concentrations rising from 250 to 1000 parts per million. Creating the total organic acid concentration from 500 to 1000 ppm didn't significantly enhance any of the pigments that were tested or some of the leaves' nutrients. The maximum values of chlorophyll a (2.06 and 2.10 mg/1.0 g F.W.), chlorophyll b (1.38 and 1.40mg/ 1.0 g F.W.), carotenoids (1.45 and 1.47 mg/ 1.0 g F.W.), N (1.94 and 1.96 %), P (0.41 and 0.43 %) and K (1.44 and 1.46 %) were noted on vines that received the three organic acids at 1000 ppm through both seasons.

3-berry setting % and yield measurements.

Data acquired in Table 5 show that berry setting %, yield measurements (cluster weight (g.) and number of clusters / vine) were all considerably increased when compared to untreated vines by practically all single and combined applications of the tested organic acids at all tested concentrations (250 to 1000 ppm). Increases in the dosages of organic acids (citric, ascorbic and salicylic) were significantly connected with the promotion. The combined application of these three organic acids was greatly superior to single treatments in raising the percentage of berry setting and yield during the two tested seasons. Gradual promotion was observed at all tested parameters when concentrations were increased from 250 to 1000 ppm. The best results in terms of total yield were found in vines treated with a mixture of the three organic acids (citric, ascorbic and salicylic) each at 1000 ppm. In both seasons, yield per vine under the indicated treatments was 13.6 and 18.0 kg, respectively, higher than yield of control treatment, which were 10.6 and 11.2 kg. When treated with a mixture of organic acids at 1000 ppm each, the percentage increase in yield over the control treatment was 28.3 and 60.7%, respectively. In the first season, number of clusters per vine was unaffected by the treatments. Both seasons provided the same results.

Table (3). Effect of spraying some organic acids on leaf pigment of Early Sweet grapevines during 2021 and 2022 seasons

Treatments	Chlorophyll a (mg/ 1.0 g F.W.)		Chlorophyll b (mg/ 1.0 g F.W.)		Total carotenoids (mg/ 1.0 g F.W.)	
	2021	2022	2021	2022	2021	2022
Control	1.65 i	1.68 f	1.05 h	1.06 f	1.12 i	1.15 j
Salicylic acid at 250 ppm	1.85 def	1.88 cd	1.22 cde	1.24 cde	1.29 cdef	1.31 defg
Salicylic acid at 500 ppm	1.91 cd	1.93 c	1.26 bcd	1.30 bcd	1.33 cd	1.35 cde
Salicylic acid at 1000 ppm	1.94 bc	1.96 bc	1.28 bc	1.31 bc	1.35 bc	1.38 bc
Ascorbic acid at 250 ppm	1.78 fgh	1.81 de	1.16 efg	1.19 e	1.23 fgh	1.26 ghi
Ascorbic acid at 500 ppm	1.81 efg	1.83 de	1.20 def	1.24 cde	1.27 defg	1.30 efg
Ascorbic acid at 1000 ppm	1.87 cde	1.89 cd	1.23 cde	1.28 bcd	1.30 cde	1.33 cdef
Citric acid at 250 ppm	1.72 hi	1.75 ef	1.10 gh	1.16 e	1.17 hi	1.20 ij
Citric acid at 500 ppm	1.76 gh	1.79 e	1.14 fg	1.19 e	1.21 gh	1.23 hi
Citric acid at 1000 ppm	1.79 efgh	1.81 de	1.18 ef	1.22 de	1.25 efgh	1.28 fgh
Three organic acids in low conc.	1.93 bcd	1.94 c	1.28 bc	1.32 ab	1.35 bc	1.37 bcd
Three organic acids in mid. conc.	2.00 ab	2.03 ab	1.33 ab	1.36 ab	1.40 ab	1.42 ab
Three organic acids in high conc.	2.06 a	2.10 a	1.38 a	1.40 a	1.45 a	1.47 a

In column means followed by the same letters are not statistically different at 0.05 level according to Duncan's multiple range test.

4. Physical characteristics of the berries

Data in Table 6 make it clear that shoot berry% was greatly lower when three organic acids (citric, ascorbic, and salicylic) were applied singly or in combination, each at a concentration of 250 to 1000 ppm, in comparison to the untreated treatment. The combined treatments were significantly superior to single treatments in improving shoot berry percentage. During both seasons, clusters harvested from vines treated with three organic acids at 1000 ppm each showed the lowest values. According to the data in Table 6 spraying vines three times with various levels of organic acids (250–1000 ppm) either singly or in combination greatly enhanced the quality of berry characteristics, such as rising weight and dimensions of berries. Treatment of vines with the three organic acids at 1000 ppm provided the best values. of berry weight (5.70 and 5.75 g), berry longitudinal length (2.50 and 2.55 cm), and berry equatorial length (2.19 and 2.21 cm) at both seasons, respectively.

Table (4). Effect of spraying some organic acids on percentages of N, P and K in the leaves of Early Sweet grapevines during 2021 and 2022 seasons

Treatments	Leaf N %		Leaf P %		Leaf K %	
	2021	2022	2021	2022	2021	2022
Control	1.60 H	1.62 H	0.18 j	0.19 h	1.15 h	1.16 h
Salicylic acid at 250 ppm	1.80 Cde	1.82 cdef	0.29 e	0.31 de	1.28 d	1.30 cd
Salicylic acid at 500 ppm	1.84 Cd	1.86 Bcd	0.33 d	0.35 bc	1.31 cd	1.33 c
Salicylic acid at 1000 ppm	1.86 Bc	1.88 Bc	0.36 bc	0.34 bcd	1.35 b	1.38 b
Ascorbic acid at 250 ppm	1.75 Ef	1.77 Efg	0.25 gh	0.28 ef	1.22 f	1.25 f
Ascorbic acid at 500 ppm	1.79 Def	1.81 cdef	0.28 ef	0.31 de	1.26 de	1.29 de
Ascorbic acid at 1000 ppm	1.81 Cde	1.83 Cde	0.29 e	0.32 cd	1.29 d	1.31 cd
Citric acid at 250 ppm	1.68 G	1.71 G	0.21 i	0.22 gh	1.18 gh	1.21 g
Citric acid at 500 ppm	1.73 Fg	1.75 Fg	0.23 hi	0.25 fg	1.21 fg	1.23 fg
Citric acid at 1000 ppm	1.77 Ef	1.79 Def	0.26 fg	0.28 ef	1.23 ef	1.26 ef
Three organic acids in low conc.	1.85 Bcd	1.87 Bc	0.35 cd	0.37 ab	1.34 bc	1.38 b
Three organic acids in mid. conc.	1.91 Ab	1.93 Ab	0.38 b	0.39 a	1.41 a	1.43 a
Three organic acids in high conc.	1.94 A	1.96 A	0.41 a	0.40 a	1.44 a	1.46 a

In column means followed by the same letters are not statistically different at 0.05 level according to Duncan's multiple range test.

Table (5). Effect of spraying some organic acids in berry setting %, yield per vine and number and weight cluster of Early Sweet grapevines during 2021 and 2022 seasons

Treatments	Berry setting %		No. of clusters / vine		Average cluster / weight (g.)		Yield/ vine (kg.)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	9.20 i	9.40 h	27.00 f	29.0 g	380.00 j	385.00 j	10.60 i	11.20 i
Salicylic acid at 250 ppm	10.70 de	10.80 de	32.00 d	34.0 de	435.00 ef	440.00 ed	12.20 ef	14.90 ef
Salicylic acid at 500 ppm	10.90 cde	11.00 cd	35.00 bc	36.0 bc	445.00 cd	450.00 cd	12.90 c	16.20 cd
Salicylic acid at 1000 ppm	11.10 bc	11.30 bc	35.00 bc	37.0 ab	450.00 c	455.00 bc	13.10 bc	16.80 bc
Ascorbic acid at 250 ppm	10.20 g	10.50 ef	31.00 de	33.0 ef	440.00 de	415.00 g	11.50 gh	13.60 gh
Ascorbic acid at 500 ppm	10.60 ef	10.80 de	32.00 d	34.0 de	430.00 f	435.00 f	12.00 f	14.80 f
Ascorbic acid at 1000 ppm	10.80 cde	11.00 cd	34.00 c	35.0 cd	440.00 de	445.00 de	12.30 e	15.60 de
Citric acid at 250 ppm	9.70 h	9.90 g	30.00 e	30.0 g	390.00 i	395.00 i	11.30 h	11.90 i
Citric acid at 500 ppm	10.10 g	10.30 fg	30.00 e	32.0 f	400.00 h	405.00 h	11.60 g	12.90 h
Citric acid at 1000 ppm	10.30 fg	10.50 ef	32.00 d	33.0 ef	415.00 g	420.00 g	12.00 f	13.90 g
Three organic acids in low conc.	11.00 cd	11.20 bcd	34.00 c	36.0 bc	450.00 c	460.00 b	12.60 d	16.60 bc
Three organic acids in mid. conc.	11.40 ab	11.60 ab	36.00 b	37.0 ab	460.00 b	470.00 a	13.30 b	17.30 ab
Three organic acids in high conc.	11.60 a	11.80 a	38.00 a	38.0 a	470.00 a	475.00 a	13.60 a	18.00 a

In column means followed by the same letters are not statistically different at 0.05 level according to Duncan's multiple range test.

Table (6). Effect of spraying some organic acids on the percentage of shot berry as well as some physical characteristics of Early Sweet grapevines during 2021 and 2022 seasons

Treatments	Shot berries %		Berry weight (g)		Berry longitudinal (cm)		Berry equatorial (cm)	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	8.50 a	8.40 a	4.50 j	4.50 j	2.18 j	2.19 g	1.88 h	1.89 j
Salicylic acid at 250 ppm	7.15 cde	7.10 cd	5.15 e	5.20 e	2.29 ef	2.31 d	1.98 de	1.99 fg
Salicylic acid at 500 ppm	6.80 ef	6.70 ef	5.30 d	5.35 d	2.33 cd	2.35 c	2.01 c	2.03 de
Salicylic acid at 1000 ppm	6.60 f	6.50 fg	5.40 c	5.45 c	2.35 c	2.37 c	2.04 b	2.06 cd
Ascorbic acid at 250 ppm	7.50 cd	7.40 c	4.90 gh	4.95 gh	2.25 gh	2.27 e	1.95 f	1.97 gh
Ascorbic acid at 500 ppm	7.20 cde	7.10 cd	5.05 f	5.10 f	2.28 efg	2.30 de	1.99 cd	1.99 fg
Ascorbic acid at 1000 ppm	7.10 de	7.00 de	5.20 e	5.25 e	2.30 de	2.31 d	2.00 cd	2.01 ef
Citric acid at 250 ppm	8.00 b	7.90 b	4.70 i	4.74 i	2.21 ij	2.22 fg	1.91 g	1.92 ij
Citric acid at 500 ppm	7.60 bc	7.40 c	4.85 h	4.90 h	2.24 hi	2.26 e	1.94 f	1.95 hi
Citric acid at 1000 ppm	7.40 cd	7.20 cd	4.95 g	5.00 g	2.26 fgh	2.28 de	1.96 ef	1.97 gh
Three organic acids in low conc.	6.60 f	6.30 g	5.40 c	5.50 c	2.35 c	2.37 c	2.06 b	2.07 c
Three organic acids in mid. conc.	5.50 g	4.90 h	5.60 b	5.65 b	2.42 b	2.45 b	2.11 a	2.14 b
Three organic acids in high conc.	4.60 h	4.10 i	5.70 a	5.75 a	2.50 a	2.55 a	2.11 a	2.21 a

In column means followed by the same letters are not statistically different at 0.05 level according to Duncan's multiple range test.

5. Berries quality parameters

Data obtained in Table7 show that spraying vines three times with each of the three organic acids, ranging in concentration from 250 to 1000 ppm, either singly or in combination, significantly improved the berry quality characteristics (TSS %, TSS/acid ratio, and of reducing sugars %), while also reducing total acidity% when compared to control treatment. Using all organic acids in the same order was significantly associated with an improvement in the quality of berries. Expanding concentrations of three organic acids from 250 to 1000 ppm were linked to improved berry quality. When compared to single applications, the combined application of the three organic acids under study proved to be significantly more effective in enhancing the quality of berries. Vines treated with the three organic acids at 1000 ppm each during both seasons produced the highest TSS% (20.9, 21.2%) and reducing sugars (17.7, 17.8%), while control treatment recorded lowest value. On the other hand, treating Early Sweet grapevines with three organic acids each at 1000 ppm resulted in the lowest total acidity% (0.450 and 0.530%) However, in both seasons the berries from thecontrol treatment had the highest total acidity %(0.712 and 0.707%).

6. Wood ripening coefficient, cane thickness and wood pruning weight/vine

Table 8 describes the effects of applying three organic acids (citric, ascorbic, and salicylic) on wood ripening coefficient, cane thickness and wood pruning weight /vine. During two seasons, it was found that almost all combined and single treatments of the three organic acids significantly increased (wood ripening coefficient, cane thickness and wood pruning weight /vine) traits as compared to control treatment. The highest values of wood ripening coefficient (0.92 and 0.93), cane thickness (1.21 and 1.22 cm) and wood pruning weight per vine (2.30 and 2.35 kg) were noted on vines sprayed with a mix of three tested acids at 1000 ppm, while the lowest values were shown in control treatment during two seasons.

Table (7). Effect of spraying some organic acids on some chemical characteristics of Early Sweet grapevines during 2021 and 2022 seasons

Treatments	TSS %		Total acidity %		TSS/ acid		Reducing sugars %	
	2021	2022	2021	2022	2021	2022	2021	2022
Control	17.50 i	17.60 k	0.712 a	0.707 a	24.60 i	24.90 j	14.50 h	14.60 i
Salicylic acid at 250 ppm	18.60 ef	18.80 fg	0.635 de	0.630 ef	29.30 e	29.80 e	15.60 e	15.70 ef
Salicylic acid at 500 ppm	19.00 d	19.20 de	0.610 f	0.600 gh	31.10 d	32.00 d	16.00 d	16.20 d
Salicylic acid at 1000 ppm	19.40 c	19.60 cd	0.600 fg	0.590 h	32.30 c	33.20 c	16.40 c	16.60 c
Ascorbic acid at 250 ppm	18.20 fg	18.40 hi	0.675 c	0.670 bc	26.90 g	27.50 gh	15.10 fg	15.30 gh
Ascorbic acid at 500 ppm	18.40 ef	18.60 fgh	0.650 d	0.645 de	28.30 f	28.80 f	15.30 f	15.50 fg
Ascorbic acid at 1000 ppm	18.70 de	18.90 ef	0.630 e	0.620 fg	29.70 e	30.40 e	15.60 e	15.80 e
Citric acid at 250 ppm	17.80 hi	18.00 j	0.695 ab	0.690 b	25.60 h	26.00 i	14.90 g	15.10 h
Citric acid at 500 ppm	18.00 gh	18.20 ij	0.680 bc	0.675 bc	26.50 g	26.90 hi	15.10 fg	15.30 gh
Citric acid at 1000 ppm	18.30 fg	18.50 ghi	0.670 c	0.660 cd	27.30 g	28.00 fg	15.30 f	15.50 fg
Three organic acids in low conc.	19.50 c	19.80 c	0.590 g	0.580 h	33.10 c	34.10 c	16.40 c	16.60 c
Three organic acids in mid. conc.	20.20 b	20.40 b	0.560 h	0.550 i	36.10 b	37.10 b	17.00 b	17.10 b
Three organic acids in high conc.	20.90 a	21.20 a	0.540 i	0.530 i	38.70 a	39.90 a	17.70 a	17.80 a

In column means followed by the same letters are not statistically different at 0.05 level according to Duncan's multiple range test.

Table (8). Effect of spraying some organic acids on some vegetative growth characteristics of Early Sweet grapevines during 2021 and 2022 seasons

Treatments	Wood ripening coefficient		Cane thickness (cm)		Wood pruning weight (kg/ vine)	
	2021	2022	2021	2022	2021	2022
Control	0.68 c	0.69 d	0.94 g	0.96 i	1.88 g	1.90 h
Salicylic acid at 250 ppm	0.80 b	0.81 bc	1.06 de	1.07 efg	2.05 de	2.08 cde
Salicylic acid at 500 ppm	0.85 ab	0.86 ab	1.09 cd	1.10 cde	2.10 cd	2.13 c
Salicylic acid at 1000 ppm	0.88 a	0.89 a	1.13 bc	1.14 bcd	2.13 c	2.15 c
Ascorbic acid at 250 ppm	0.76 b	0.77 cd	1.01 ef	1.03 fgh	2.00 ef	2.05 def
Ascorbic acid at 500 ppm	0.79 b	0.81 bc	1.05 def	1.08 def	2.04 de	2.10 cde
Ascorbic acid at 1000 ppm	0.81 b	0.82 bc	1.08 cd	1.09 def	2.05 de	2.11 cd
Citric acid at 250 ppm	0.71 c	0.73 d	0.98 fg	1.00 hi	1.95 fg	1.99 f
Citric acid at 500 ppm	0.74 bc	0.75 cd	0.99 fg	1.01 ghi	1.99 ef	2.02 ef
Citric acid at 1000 ppm	0.76 b	0.77 cd	1.03 def	1.05 efg	2.02 ef	2.06 def
Three organic acids in low conc.	0.87 a	0.88 a	1.13 bc	1.16 abc	2.13 c	2.15 c
Three organic acids in mid. conc.	0.89 a	0.91 a	1.18 ab	1.19 ab	2.22 b	2.25 b
Three organic acids in high conc.	0.92 a	0.93 a	1.21 a	1.22 a	2.30 a	2.35 a

In column means followed by the same letters are not statistically different at 0.05 level according to Duncan's multiple range test.

Discussion

Organic acids are essential for the biosynthesis of the majority of organic foods, the activation of cell division, and oxidative stress resistance in plants. The current findings may be explained by salicylic acid's positive effects on cell division, sugar, plant pigment, and amino acid biosynthesis, as well as the increased resistance of different types of fruit crops to biotic stress. Another explanation is that SA reduces the production of reactive oxygen species and prevents cell death **(Taiz and Zeiger, 2002 and Joseph *et al*., 2010)**.

Ascorbic acid regulates growth and has an impact on numerous biological processes. It is a co-enzyme in the enzymatic processes involved in respiration, photosynthesis, and the metabolism of proteins and carbohydrates **(Robinson, 1973)**. It is currently considered a regulator tree growth and development owing to its effect on cell division and differentiation. It is involved in a wide range of important functions, such as antioxidant defense, photo protection and growth **(Blockhina *et al*., 2003)**.

The impact of citric acid on growth, yield, and quality of fruits may be explained by its ability to improve the uptake of magnesium and biosynthesis of sugars and plant pigments, which will enhance and progress fruit quality, **(Oretili, 1987; Singh *et al*., 2001).** The current investigation's results confirm **(Ahmed *et al.*, 2002; Ahmed and Abd El- Hameed, 2004; Farahat, 2008; Abada and Abd El-Hameed, 2010, Abada, 2014, Abd El- Rady, 2015; Sayed, 2017 and El- Salhy*et al.*,2021)**.

Conclusion

According to experimental conditions, it could be recommended to spray Early Sweet grapevines with a combination of three organic acids (salicylic, ascorbic and citric) at three different times (beginning of growth, following the berry setting and after three weeks) each at 500 ppm to improve the characteristics of growth, vines' nutritional condition, berry quality, and yield of Early Sweet grapevines.

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