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Effect of spraying certain organic acids and micronutrients on growth and vine nutritional status of Early Sweet grapevines under Upper Egypt conditions.

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Abstract

This study was conducted during three seasons 2021, 2022 and 2023 on Early Sweet grapevines grown in Upper Egypt to investigate the effect of spraying certain micronutrients (Fe + Zn + Mn+ Cu) at 0.025 to 0.1% and /or any one of three organic acids (citric acid at 500 ppm or ascorbic acid at 500 ppm or salicylic acid at 50 ppm) on growth and vine nutritional status of Early Sweet grapevines grown under sandy soil. Spraying the vines three times with Micromix (containing 6.0% Fe+ 3.0% Mn + 3.0% Zn + 1.5% Cu in chelated from) at 0.025 to 0.1% and /or any one of three organic acids (citric or ascorbic acids each at 500 ppm or salicylic acid at 50ppm) was very effective in stimulating shoot length , leaf area, wood ripening coefficient, pruning wood weight/ vine, chlorophyll a, chlorophyll b , total chlorophylls, total carotenoids, N, P, K (as%) , Fe, Zn, and Mn (as ppm) of Early Sweet grapevines over the control. Carrying out three sprays of mixture of Micromix at 0.1% and salicylic acid at 50 ppm gave the best results with regard to vegetative growth characteristics and vine nutritional status of Early Sweet grapevines grown under sandy soil

Keywords: Micromix; citric acid; ascorbic acid; salicylic acid; nutritional status-growth; Early Sweet grapevines.

Introduction

The yield decline and berries quality of shot berries are considered the serious problems facing marketing of Early Sweet grapevines cv to both foreign and local markets. Many trials were carried out for solving such drawbacks by using some organic acids and micronutrients at balanced rate **[1& 2]** disclosed that using some micronutrients had announced promotion on the biosynthesis of some organic foods, natural hormones and some plant pigments. The promoting effect of some organic acids on protecting plant cells from oxidation and plant growth and development. The main role of salicylic acid is it effects on inducing the plant defense against different biotic and abiotic stresses **[3]**. Salicylic acid been reported to induce various positive changes in treated grapevines cv. some vegetative growth, yield and berries quality as well as resistance to various stress conditions**. [3] .**

In addition, the positive action of organic acids in catching or chelating the free radicals with could results in extending the shelf life of the plant cells and stimulating vegetative growth aspects is reported by **[4].** In the meantime, citric acid plays an essential role in signal transduction system, membrane stability and functions activating transporter enzymes, metabolism and translocation of carbohydrates. Also, ascorbic acid is considered a regular of plant growth **[5]**.

The objective of this study was to examine the beneficial effects of certain organic acids and micronutrients on growth and vine nutritional status of Early Sweet grapevines**.**

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Materials and methods

This study was carried out during three seasons 2021, 2022 and 2023 seasons on ninety-six uniforms in vigor 14-years old Early Sweet grapevines grown in a private vineyard located at El-Tode village- Luxor district, Luxor Governorate, Egypt. Vines were spaces at 3.0x 2.0m. (700 vines/fed.) and grown in sandy soil (table 1).

The chosen vines were pruned during the third week of October in three seasons, spur pruning system using Gable shape supporting system was adopted to give 72 eyes per vine (72 eyes /vine load) (30 fruiting spurs x 2 eyes + 6 replacement spurs X 2 eyes). Drip Irrigation system was followed using well water.

Table (1): some mechanical physical and chemical properties of the soil of the experiment site [6].

Constituents	Values	Constituents	Values
Sand %	80.6	Total N %	0.92
Silt %	10.7	Av. P (Olsen method , ppm)	2.0
Clay %	8.7	Av. K (ammonium acetate ppm)	43.0
Texture	Sandy	Zn (ppm)	1.1
pH (1:2.5 extract)	7.98	Fe (ppm)	1.3
EC (1: 2.5 extract) (mmhos/ cm 25°C	1.72	Mn (ppm)	0.91
Organic matter %	0.18		
$CaCO_3$%	2.3		

Common horticultural practices such as fertilization, irrigation, pinching, hoeing and pest management were carried out as usual.

This study consisted from the following sixteen treatments:

1- Control (sprayed with water vines).
2- Spraying some micronutrients (Micromix) at 0.025%.
3- Spraying some micronutrients (Micromix) at 0.05%.
4- Spraying some micronutrients (Micromix) at 0.1%.
5- Spraying salicylic acid at 50 ppm.
6- Spraying ascorbic acid at 500 ppm
7- Spraying citric acid at 500 ppm
8- Spraying some micronutrients (Micromix) at 0.025% plus salicylic acid at 50 ppm.
9- Spraying some micronutrients (Micromix) at 0.025% plus ascorbic acid at 500 ppm.
10- Spraying some micronutrients (Micromix) at 0.025% plus citric acid at 500 ppm.
11- Spraying some micronutrients (Micromix) at 0.05% plus salicylic acid at 50 ppm.
12- Spraying some micronutrients (Micromix) at 0.05% plus ascorbic acid at 500 ppm.
13- Spraying some micronutrients (Micromix) at 0.05% plus citric acid at 500 ppm.
14- Spraying some micronutrients (Micromix) at 0.1% plus salicylic acid at 50 ppm.
15- Spraying some micronutrients (Micromix) at 0.1 % plus ascorbic acid at 500 ppm.
16- Spraying some micronutrients (Micromix) at 0.1 % plus citric acid at 500 ppm.

Each treatment has three replicates, two vines per each. Therefore, 96 uniforms in vigor Early Sweet grapevines. Organic acids namely (salicylic, ascorbic and citric acids) and Micromix compound (micronutrient fertilizer containing 6.0 % Fe, 3.0 % Zn, 3.0 % Mn and 1.5 % Cu in chelated form) were sprayed three times at growth start (second week of February), just after berry setting (last week of March) and at one month later (last week of April). The harvest time starting at third week of May.

Flam organic as a wetting agent was used at 0.5 ml/.L. for all solutions of organic aids , Micromix and water and the spray was done till run off.

Randomized complete block design (RCBD) was adopted for carrying out statistical analysis of this study.

During three seasons 2021, 2022 and 2023 seasons, the following measurements were recorded:

1- Vegetative growth characteristics:

- Main shoot length (cm.)
- leaf area $(cm)^2$ **[7]**
- Wood ripening coefficient **[8]**
- Pruning wood weight per vine(kg.)

2 -leaf chemical components:

- chlorophyll a, b, total chlorophylls and total carotenoids (mg/ g F.W.) **[9]**.
- N, P, and K (as%) , Fe, Zn, and Mn, (as ppm) in the leaves **[10& 11].**

Statistical analysis was done using New L.S. D. at 5% for made all comparisons among sixteen treatment means according to **[12].**

RESULTS AND DISCUSSION

1-Vegetative growth characteristics:

It is clear from the obtained data in Table (2) that single and combined application of Micromix at 0.025 to 0.1% and any one of three organic acids (citric acid at 500 ppm or ascorbic acid at 500 ppm or salicylic acid at 50 ppm) significantly were accompanied with stimulating four growth characteristics namely shoot length, leaf area, wood ripening coefficient and pruning wood weight per vine relative to the check treatment. The promotion on these growth traits was associated with increasing concentrations of Micromix at 0.025 to 0.1%.

Using the three organic acids namely citric acid at 500 ppm, ascorbic acid at 500 ppm or salicylic acid at 50 ppm in ascending order was very effective in stimulating these growth aspects. Using Micromix at 0.025 to 0.1% plus any one of three organic acids (citric, ascorbic and salicylic acids) was significantly superior to using Micromix alone at 0.025 to 0.1% in enhancing these growths attributes.

The maximum values of shoot length (127.0, 129.0 and 131.0 cm), leaf area (123.0, 124.0 and 125.0 cm^2), wood ripening coefficient (0.95, 0.96 and 0.97) and pruning wood weight (2.10, 2.15 and 2.20 kg.) during 2021, 2022 and 2023 seasons, respectively were observed on the vines that received three sprays of Micromix at 0.1% and salicylic acid at 50ppm. The lowest values were recorded on untreated vines. These results were true during three seasons.

Table (2): Effect of certain organic acids and micronutrients on vegetative growth aspects of Early Sweet grapevines during 2021, 2022 and 2023 seasons.

Treatments	Main shoot length (cm.)			Leaf area $(cm)^2$			Wood ripening coefficient			Pruning wood weight / vine (kg.)		
	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
T1	105.0	108.0	111.0	98.5	99.0	99.0	0.71	0.71	0.72	1.75	1.76	1.77
T2	109.0	110.0	111.5	101.0	102.0	102.5	0.73	0.74	0.74	1.77	1.78	1.80
T3	112.0	112.5	113.0	103.5	104.5	105.0	0.75	0.76	0.77	1.79	1.81	1.82
T4	114.0	115.0	115.5	105.0	106.0	106.5	0.76	0.77	0.78	1.82	1.83	1.84
T5	119.5	120.5	121.0	109.0	110.0	111.0	0.80	0.81	0.82	1.88	1.90	1.91
T6	117.0	118.0	119.0	107.0	107.5	108.0	0.77	0.78	0.79	1.84	1.85	1.86
T7	113.0	113.5	116.0	105.0	106.0	107.0	0.75	0.76	0.77	1.81	1.82	1.83
T8	123.0	124.0	125.5	114.0	115.0	115.5	0.84	0.85	0.86	1.93	1.95	1.96
T9	121.0	122.5	123.0	112.5	113.0	113.5	0.81	0.82	0.83	1.90	1.91	1.93
T10	119.5	120.5	122.0	111.0	112.0	112.5	0.79	0.81	0.82	1.86	1.88	1.89
T11	125.5	126.0	126.5	118.0	119.0	120.0	0.90	0.91	0.92	1.99	2.00	2.05
T12	123.5	125.0	125.0	115.5	116.5	117.5	0.86	0.88	0.88	1.95	1.98	1.99
T13	121.5	122.0	123.0	113.5	114.0	115.0	0.84	0.86	0.87	1.90	1.93	1.95
T14	127.0	129.0	131.0	123.0	124.0	125.0	0.95	0.96	0.97	2.10	2.15	2.20
T15	126.0	128.0	129.0	121.0	121.5	122.5	0.93	0.94	0.95	2.05	2.10	2.15
T16	124.0	125.0	125.0	119.5	121.0	122.0	0.90	0.91	0.92	1.98	2.05	2.10
L.S.D. at 5%	**0.9**	**1.1**	**1.2**	**0.8**	**0.9**	**0.9**	**0.05**	**0.06**	**0.07**	**0.22**	**0.24**	**0.25**

2- Leaf chemical composition:

It becomes clear to us from the obtained data in Tables (3 to 5) that ten leaf chemical components namely chlorophyll a, chlorophyll b, total chlorophylls, total carotenoids, N, P, K, Fe, Zn. and Mn in the leaves were significantly varied among the fifteen Micromix and some organic acids treatments. They were significantly enhanced with using Micromix (6.0% Fe+ 3.0% Mn + 3.0% Zn + 1.5% Cu in chelated form) at 0.025 to 0.1% and / or any one of three organic acids (citric acid at 500 ppm or ascorbic acid at 500 ppm or Salicylic acid at 50 ppm) relative to the control treatment.

The increase in these plant pigments and N, P, K, Fe, Zn and Mn in the leaves was significantly correlated with increasing concentrations of Micromix.

The maximum values chlorophyll a (3.15, 3.20 and 3.25 mg/g F.W.) chlorophyll b (1.55, 1.61 and 1.70 mg/g F.W.) total chlorophylls (4.70, 4.81 and 4.95 mg/g F.W.) total carotenoids (1.75, 1.80 and 1.85 mg/g F.W.)N(2.03, 2.11 and 2.16%) , P (0.38, 0.39 and 0.39%) , K(1.50, 1.55 and 1.58%), Fe (65.0, 65.4 and 66.0 ppm), Zn(59.0, 59.7 and 60.2 ppm) and Mn (61.0, 61.3, 61.7 ppm) during three seasons, respectively were observed on the vines that received a mixture of Micromix (some micronutrients) at 0.1% and salicylic acid at 50 ppm. The untreated vines produced the minimum values. These results were true during 2021, 2022 and 2023 seasons.

DISCUSSION:

Organic acids (antioxidants) play an important role in plant defense against oxidative stress and biosynthesis of most organic foods and activation of cell division process. Ascorbic acid is known as a growth regulating factor which influences many biological processes. It acted as co-enzymes in the enzymatic reactions by which proteins are carbohydrates and metabolizes and involved in photosynthesis and respiration **[13].**

Table (3): Effect of certain organic acids and micronutrients on leaf pigments (mg/1g F.W.) of Early Sweet grapevines during 2021, 2022 and 2023 seasons.

Treatments	Chlorophyll a (mg/g F.W.)			Chlorophyll b (mg/g F.W.)			Total chlorophylls (mg/g F.W.)			Total carotenoids (mg/g F.W.)		
	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
T1	2.33	2.35	2.38	1.11	1.11	1.13	3.44	3.46	3.51	1.33	1.36	1.38
T2	2.38	2.40	2.45	1.14	1.17	1.19	3.52	3.57	3.64	1.38	1.41	1.43
T3	2.41	2.46	2.51	1.16	1.20	1.22	3.57	3.66	3.73	1.41	1.43	1.46
T4	2.44	2.50	2.55	1.17	1.22	1.24	3.61	3.72	3.79	1.44	1.47	1.50
T5	2.51	2.56	2.61	1.22	1.27	1.29	3.73	3.83	3.89	1.51	1.54	1.56
T6	2.48	2.54	2.58	1.20	1.26	1.28	3.68	3.80	3.86	1.47	1.50	1.52
T7	2.43	2.50	2.54	1.17	1.22	1.24	3.60	3.72	3.78	1.42	1.48	1.51
T8	2.61	2.66	2.71	1.31	1.38	1.41	3.92	4.04	4.12	1.61	1.66	1.69
T9	2.55	2.61	2.66	1.25	1.31	1.34	3.80	3.92	4.00	1.55	1.60	1.63
T10	2.50	2.58	2.62	1.21	1.27	1.29	3.71	3.85	3.91	1.50	1.54	1.59
T11	2.72	2.80	2.83	1.42	1.46	1.48	4.14	4.26	4.31	1.69	1.73	1.75
T12	2.66	2.75	2.80	1.36	1.41	1.43	4.02	4.16	4.23	1.66	1.70	1.72
T13	2.60	2.68	2.72	1.30	1.36	1.39	3.90	4.04	4.11	1.59	1.63	1.65
T14	3.15	3.20	3.25	1.55	1.61	1.70	4.70	4.81	4.95	1.75	1.80	1.85
T15	2.95	3.05	3.15	1.47	1.51	1.56	4.42	4.56	4.71	1.72	1.77	1.80
T16	2.80	2.90	2.98	1.41	1.46	1.49	4.21	4.36	4.47	1.68	1.71	1.73
L.S.D. at 5%	0.11	0.13	0.14	0.07	0.07	0.08	0.15	0.17	0.18	0.8	0.8	0.9

Table (4): Effect of certain organic acids and micronutrients on percentages of N, P and K in the leaves of Early Sweet grapevines during 2021, 2022 and 2023 seasons.

Treatments	Leaf N %			Leaf P%			Leaf K%		
	2021	2022	2023	2021	2022	2023	2021	2022	2023
T1	1.61	1.63	1.65	0.09	0.11	0.11	1.13	1.15	1.15
T2	1.64	1.66	1.68	0.13	015	0.16	1.17	1.19	1.20
T3	1.69	1.71	1.73	0.15	0.17	0.18	1.19	1.21	1.22
T4	1.71	1.73	1.75	0.18	0.20	0.21	1.21	1.23	1.24
T5	1.79	1.81	1.82	0.24	0.26	0.27	1.29	1.31	1.32
T6	1.76	1.79	1.80	0.22	0.24	0.25	1.25	1.27	1.28
T7	1.70	1.73	1.74	0.19	0.20	0.22	1.20	1.22	1.23
T8	1.84	1.85	1.87	0.28	0.29	0.31	1.36	1.38	1.39
T9	1.81	1.83	1.84	0.25	0.28	0.29	1.33	1.35	1.36
T10	1.78	1.80	1.81	0.23	0.25	0.27	1.28	1.31	1.33
T11	1.91	1.93	1.94	0.33	0.35	0.37	1.41	1.42	1.43
T12	1.89	1.91	1.92	0.31	0.33	0.35	1.36	1.38	1.39
T13	1.82	1.83	1.85	0.26	0.29	0.30	1.32	1.34	1.37
T14	2.03	2.11	2.16	0.38	0.39	0.39	1.50	1.55	1.58
T15	1.96	2.00	2.08	0.36	0.37	0.38	1.44	1.48	1.50
T16	1.90	1.98	2.02	0.32	0.33	0.35	1.40	1.44	1.47
L.S.D. at 5%	0.07	0.08	0.09	0.03	0.04	0.05	0.06	0.07	0.07

Table (5): Effect of certain organic acids and micronutrients on content of Zn, Fe and Mn (as ppm) in the leaves of Early Sweet grapevines during 2021, 2022 and 2023 seasons.

Treatments	Leaf Zn (ppm)			Leaf Fe (ppm)			Leaf Mn (ppm)		
	2021	2022	2023	2021	2022	2023	2021	2022	2023
T1	44.2	44.5	44.8	52.3	52.5	52.9	46.5	46.5	47.0
T2	45.8	46.2	46.9	53.5	54.0	54.3	48.0	48.6	49.1
T3	47.0	47.4	47.8	54.2	54.8	55.3	49.0	49.5	49.9
T4	48.4	48.9	49.4	55.0	55.4	55.9	49.5	50.0	50.4
T5	50.5	51.0	51.3	58.0	58.3	58.9	52.5	52.9	53..1
T6	49.9	50.2	50.8	56.9	57.2	57.8	51.0	51.6	51.9
T7	48.0	48.6	49.0	55.2	55.7	56.1	49.5	50.1	50.7
T8	53.4	54.0	54.2	60.0	60.4	60.8	55.0	55.4	55.8
T9	52.0	52.6	53.0	59.2	60.0	60.3	53.5	53.9	54.2
T10	50.0	51.2	52.0	57.6	58.1	58.8	52.0	52.6	53.0
T11	57.2	57.9	58.4	62.0	62.4	62.8	58.0	58.8	59.2
T12	55.0	55.6	55.9	61.0	61.3	61.7	56.5	56.9	57.2
T13	53.0	53.5	53.8	59.5	60.0	60.4	54.0	54.4	54.8
T14	59.0	59.7	60.2	65.0	65.4	66.0	61.0	61.3	61.7
T15	58.0	59.0	59.5	63.7	64.1	64.8	59.0	59.5	59.9
T16	57.0	57.8	58.4	62.0	62.5	62.9	57.0	57.8	58.2
L.S.D. at 5%	**0.8**	**0.9**	**0.9**	**1.0**	**1.1**	**1.1**	**0.9**	**0.9**	**1.0**

Ascorbic acid in currently considered to be a regular on the plant growth and development owing to their effect on cell division and differentiation, it is involved in wide range of important function as organic acids defense, growth and photo protection**.[14]** .

The positive action of salicylic acid is plant hormone that play an essential role in varies plant development and the growth, the main role of Salicylic acid is it effect on inducing the plant defense against different biotic and abiotic stresses **[3].**

Organic acids namely citric, ascorbic and salicylic acids has been reported to induce various positive changes in treated grapevine cultivars some vegetative growth characteristics and vine nutritional status and resistance to various stress conditions, these results of the present investigation agree with those of **[15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 3, 25, 26, 27& 28].**

The important regulatory effects of Fe in building some plant pigments like chlorophylls and regulating reduction and oxidants reactions **[29]**. Zn in activating metabolism enzymes, cell division and enlargement, IAA, biosynthesis of organic foods, water absorption and nutrients transport **[1& 30]** Mn in enhancing co-enzymes that are responsible for enhancing the activity of oxidation and respiration enzymes and the biosynthesis of some organic acid, nitrogen metabolism, nitrate reduction and biosynthesis of IAA **[31& 32].**

Most micronutrients in plant are that enzyme activity and hormone synthesis. It investigators suggested that micronutrients namely (Fe, Zn, Mn and Cu) application to grapevines cv. increased growth and fruiting **[33, 34, 35& 36].**

CONCLUSION

Carrying out three sprays of a mixture of Micromix at 0.1% and salicylic acid at 50 ppm gave the best results with regard to vegetative growth characters and vine nutritional status of Early Sweet grapevines under Upper Egypt conditions.

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تأثير رش بعض الأحماض العضوية والعناصر الصغرى على النمو الخضرى والحالة الغذائية للكرمات فى كرمات العنب الإيرلى سويت تحت ظروف صعيد مصر

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الملخص:

أجريت هذه الدراسة خلال ثلاثة مواسم متتالية هى 2021، 2022، 2023 على كرمات عنب أيرلى سويت نامية فى صعيد مصر وكان هدف الدراسة اختبار تأثير رش بعض العناصر الصغرى (الحديد والزنك والمنجنيز والنحاس) بتركيز من 0.025 الى 0.1% مع أو بدون أى من الأحماض العضوية الثلاثة (حامض الستريك بتركيز 500 جزء فى المليون أو حامض الاسكوربيك بتركيز 500 جزء فى المليون أو حامض السلسليك بتركيز 50 جزء فى المليون) على النمو والحالة الغذائية للكرمات فى العنب الإيرلى سويت النامية فى التربة الرملية.

أدى رش الكرمات ثلاثة مرات بمركب الميكرومكس (يحتوى على 6% حديد + 3% زنك + 3% منجنيز + 1.5% نحاس فى الصورة المخلبية) بتركيز من 0.025 الى 0.1% مع أو بدون أى من الثلاثة أحماض العضوية التالية (حامض الستريك بتركيز 500 جزء فى المليون أو حامض الاسكوربيك بتركيز 500 جزء فى المليون أو حامض السلسليك بتركيز 50 جزء فى المليون) الى حدوث تحسن واضح فى طول الفرخ ومساحة الورقة ومعامل نضج الخشب ووزن خشب التقليم وكلوروفيل أ وكلوروفيل ب والكلوروفيل الكلى والكاروتينات الكلية ومحتوى الاوراق من عناصر النتروجين والفوسفور والبوتاسيوم والحديد والزنك والمنجنيز وذلك مقارنة بمعاملة الكونترول.

أمكن الحصول على أفضل النتائج بخصوص بعض صفات النمو الخضرى والحالة الغذائية للكرمات فى العنب الايرلى سويت النامية فى التربة الرملية عند رش الكرمات ثلاثة مرات بمخلوط يتكون من مركب الميكروميكس بمعدل 0.1% مع حامض السلسليك بتركيز 50 جزء فى المليون.

الكلمات الدالة: ميكرومكس- حامض الستريك- حامض الاسكوربيك- حامض السلسليك- النمو الخضرى- الحالة الغذائية للكرمات- كرمات العنب الايرلى سويت.