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Effect of spraying certain organic acids and micronutrients on yield and berries quality of Early Sweet grapevines under Upper Egypt conditions

Ahmed H.M. Abdelaal[1], Mohamed A.M. Abada[2], Hussein H.M. Saeed [3], and Sarah M.A. Ahmed[3]

[1] Hort. Dept., Fac. of Agric., Al-Azhar Univ. (Assiut branch), Egypt.

[2] Hort. Res. Instit., ARC, Giza, Egypt.

[3] Hort. Dept., Fac. of Agric. Nat. Res., Aswan Univ., Egypt.

Abstract

This study was carried out during 2021, 2022 and 2023 seasons, on 14 years old Early Sweet grapevines grown on sandy soil of Luxor governorate to examine the effect of spraying some micronutrients form of Micromix (containing 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 or ascorbic acid each at 500 ppm or salicylic acid at 50 ppm) on yield and berries quality of Early Sweet grapevines. Yield and some physical and chemical parameters of quality were remarkably improved due to spraying Micromix at 0025 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) compared to the control. Using any one of three organic acids was effective in enhancing yield and quality of berries more than Micromix. However, combined application of two compounds surpassed the application one mational alone. The best results with regard to yield and berries quality of Early Sweet grapevines grown under sandy soil conditions were observed due to spraying the vines three times with a mixture of Micromix at 0.1% and salicylic acid at 50 ppm.

Keywords: Micromix; citric acid; ascorbic acid; salicylic acid; yield; berries quality; Early Sweet grapevines.

Introduction

Early Sweet grapes cv, is a popular and well - know grapevine cultivar that has thrived in the Upper Egypt conditions, this cultivar ripens early, perhaps in the middle of May. Furthermore, because of its early ripening, character, which reduces completeness, it has a better potential for export to foreign markets. Despite, the introduction of various grapevines cultivars to Egypt recently, this grapevine cv. is still considered one of the most important popular and profitable grapevine cultivars. Micronutrients deficiency of as Fe, Zn and Mn in Egypt soils became a wide spread problem in the last years, their deficiencies cause a great disturbance in the physiological activities of plants which is reflected on reducing the yield and lowering quality of fruits **[1].** The beneficial effects of some micronutrients on growth and fruiting of grapevines cultivars was supported on Red Roomy grapevines by **[2, 3, 4],** on Early Superior grapevines **[5],** on Ruby Seedless grapevines **[6],** on Superior grapevines **[7],** and on Thompson Seedless grapevines **[8]**.

Some organic acids (antioxidants) play an important role in plant defense against oxidative stress and the biosynthesis of most organic foods and activation of cell division process. Organic acids compounds have auxinic action, since they have synergistic effects on growth and fruiting of fruit trees their practical use in fruit trees under field condition is favorably possible.

*Corresponding author E-mail: sarah6956957@gmail.com

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Organic acids are very beneficial for avoiding free oxygen and reducing cell senescence, as well as protect the cells from senescence, enhancing the cell division and the biosynthesis of organic foods and controlling the incidence of fugal attack. **[9 & 10].**

The merit of this study was examining the effect of some organic acids and micronutrients on yield and berries quality of Early Sweet grapevines under Upper Egypt conditions.

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 [11].

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 were 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- The yield per vine

- number of cluster
- weight (g.), length and width of clusters (cm.)

2- percentage of shot berry.

3- physical and chemical characteristics: -

- 100 berry weight (g.)
- longitudinal and equatorial (cm.)
- TSS%
- Reducing sugar% **[12]**
- Total acidity % (as g. tartaric acid / 100 ml juice) **[13]**.

Statistical analysis was done treatment means were compared using New L.S.D. at 5% **[14].**

RESULTS AND DISCUSSION

1-Yield and cluster aspects:

It is evident from the obtained data in Tables (2 and 3) that treating Early sweet grapevines three times with some Micromix and / or any one of three organic acids (citric, ascorbic and salicylic acids) Significantly improved the yield expressed in weight and number of cluster per vine as well as weight, length and width of cluster relative to the check treatment.

There was a gradual and significant promotion on yield per vine and cluster aspects with increasing in concentrations of Micromix from 0.025 to 0.1%. The best organic acids in improving the yield and cluster aspects were citric at 500 ppm, ascorbic acid at 500ppm and salicylic acid at 50ppm, in ascending order. Using any organic acids with Micromix at 0.025 to 0.1% significantly improved the yield per vine and cluster weight than using Micromix or organic acids alone. The maximum values yield per vine (18.76, 24.48 and 24.66 kg.) was recorded on the vines that treated with Micromix at 0.1% and salicylic acid at 50ppm during three seasons respectively. The untreated vines produced yield reached (13.92, 13.72 and 13.72 kg.) during three seasons, respectively. The percentage of increment of yield /vine in the promised treatment over the control treatment reached 34.8, 78.4 and 79.7% during three seasons, respectively. Number of cluster per vine in the

first seasons (2021) was unaffected by the present treatments. Similar trend was noticed during three seasons.

2-Percentage of shot berries:

It is revealed from the obtained data in Table (2) that single and combined application of Micromix and any one of the three organic acids (citric, ascorbic and salicylic acids) significantly reduced shot berries% relative to the control treatment. There was a gradual and very significant reduction on shot berries% with increasing concentration of Micromix from 0.025 to 0.1% the best organic acids in controlling shot berries % in the cluster were citric acid at 500ppm, ascorbic acid at 500 ppm and salicylic acid at 50ppm in ascending order. A significant reduction on the percentage of shot berries was observed when the vines received Micromix at 0.025 to 0.1% plus any one of the three organic acids compared to using Micromix at 0.025 to 0.1% alone. The lowest values of shot berries % (6.0, 5.5 and 5.2%) during three seasons, respectively, were recorded on the vines that sprayed with Micromix at 0.1% plus salicylic acid at 50ppm. While the highest values of shot berries % (12.2, 12.0 and 12.0%) during 2021, 2022 and 2023 seasons, respectively, were recorded on the untreated vines, these results were similar in three seasons.

Table (2): Effect of certain organic acids and micronutrients on number of clusters/vine, yield, cluster weight and the percentage of shot berries of Early Sweet grapevines during 2021, 2022 and 2023 seasons.

Treatments	No. of clusters per vine			Yield/vine (k g.)			Av. Cluster weight (g.)			Shot berries%		
	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
T1	29.0	28.0	28.0	13.92	13.72	13.72	480.0	490.0	490.0	12.2	12.0	12.0
T2	28.0	29.0	30.0	14.14	14.79	15.45	505.0	510.0	515.0	11.5	11.3	11.1
T3	28.0	29.0	30.0	14.42	15.08	15.75	515.0	520.0	525.0	11.3	11.0	10.8
T4	28.0	30.0	31.0	14.56	15.75	16.43	520.0	525.0	530.0	11.0	10.8	10.6
T5	28.0	33.0	34.0	15.40	18.32	19.21	550.0	550.0	565.0	10.0	9.7	9.5
T6	27.0	32.0	33.0	14.58	17.60	18.48	540.0	550.0	560.0	10.3	10.0	9.8
T7	29.0	31.0	32.0	15.08	16.43	17.12	520.0	530.0	535.0	11.0	10.5	10.3
T8	28.0	34.0	35.0	16.52	20.23	21.00	590.0	595.0	600.0	9.5	9.2	9.0
T9	28.0	33.0	34.0	16.24	19.31	20.23	580.0	585.0	595.0	9.7	9.4	9.2
T10	29.0	32.0	33.0	16.10	18.24	19.14	555.0	570.0	580.0	10.0	9.5	9.3
T11	28.0	35.0	36.0	18.20	22.93	23.76	650.0	655.0	660.0	8.2	8.0	7.5
T12	28.0	34.0	35.0	17.50	21.42	22.40	625.0	630.0	640.0	9.0	8.6	8.2
T13	28.0	33.0	34.0	17.08	20.46	21.42	610.0	620.0	630.0	9.6	9.1	8.8
T14	28.0	36.0	36.0	18.76	24.48	24.66	670.0	680.0	685.0	6.0	5.5	5.2
T15	28.0	35.0	36.0	18.48	23.45	24.48	660.0	670.0	680.0	7.0	6.8	6.6
T16	28.0	34.0	35.0	17.92	22.10	23.10	640.0	650.0	660.0	8.0	7.7	7.5
L.S.D. at 5%	NS	1.1	1.2	0.65	0.71	0.77	7.1	7.3	7.5	0.4	0.4	0.3

3- Physical and chemical characteristics of the berries

Data in Table (3 and 4) clearly show that supplying the vines with Micromix and / or any one of three organic acids (citric, ascorbic and salicylic acids) significantly was responsible for improving quality of the berries in terms of increasing 100 berry weight, length and diameter of berry, TSS%, TSS/acid ratio and reducing sugars% and reducing total acidity % relative to the control treatment. The promotion on some physical and chemical characteristics was related to the increase in concentrations of Micromix from 0.025 to 0.1% using any one of three organic acids namely (citric acid at 500 ppm, ascorbic acids at 500 ppm and salicylic acid at 50 ppm) in ascending order was very effective in enhancing berry quality. Using Micromix at 0.025 to 0.1% and any one of the three

organic acids was significantly favorable in improving quality of the berries than using Micromix at 0.025 to 0.1% alone. Spraying a mixture of Micromix at 0.1% and salicylic acid at 50ppm three times gave the best results with regard to quality of the berries. While unfavorable effects on the berry quality were observed on untreated vines. These results were true during three seasons 2021, 2022 and 2023 seasons.

Table (3): Effect of certain organic acids and micronutrients on cluster dimensions and berry length and diameter of Early Sweet grapevines during 2021, 2022 and 2023 seasons.

Treatments	Cluster length (cm.)			Cluster width (cm.)			Berry length (cm.)			Berry diameter (cm.)		
	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
T1	22.0	22.3	23.0	9.5	9.8	9.8	2.22	2.24	2.24	1.62	1.63	1.64
T2	22.8	23.3	23.8	9.8	9.9	10.0	2.28	2.30	2.32	1.66	1.68	1.69
T3	23.4	23.8	24.1	10.1	10.3	10.5	2.32	2.34	2.35	1.69	1.71	1.72
T4	24.2	24.6	24.8	10.3	10.6	10.8	2.40	2.42	2.42	1.71	1.73	1.74
T5	25.8	26.2	26.6	10.8	11.0	11.2	2.53	2.55	2.56	1.76	1.78	1.80
T6	25.0	25.6	26.0	10.5	10.7	10.9	2.54	2.47	2.49	1.74	1.75	1.77
T7	24.0	24.5	24.7	10.2	10.5	10.8	2.35	2.36	2.37	1.70	1.72	1.75
T8	27.5	27.9	28.1	11.4	11.6	11.8	2.62	2.64	2.65	1.80	1.82	1.85
T9	26.9	27.2	27.8	11.0	11.2	11.4	2.55	2.56	2.58	1.78	1.80	1.82
T10	26.0	26.5	26.9	10.7	10.9	11.1	2.50	2.52	2.54	1.75	1.77	1.78
T11	29.5	29.8	30.0	12.0	12.4	12.7	2.68	2.70	2.72	1.85	1.88	1.88
T12	28.2	28.8	29.1	11.7	11.9	12.2	2.65	2.68	2.70	1.84	1.85	1.87
T13	27.1	27.5	27.8	11.2	11.5	11.8	2.60	2.62	2.64	1.80	1.82	1.84
T14	31.0	31.4	31.8	14.0	14.2	14.6	2.73	2.75	2.77	1.92	1.95	2.00
T15	30.0	30.5	30.9	13.0	13.5	13.8	2.70	2.72	2.74	1.89	1.92	1.95
T16	29.0	29.3	29.8	12.0	12.6	13.0	2.66	2.68	2.70	1.86	1.88	1.90
L.S.D. at 5%	**0.6**	**0.7**	**0.7**	**0.3**	**0.4**	**0.5**	**0.07**	**0.08**	**0.09**	**0.04**	**0.05**	**0.06**

Table (4): Effect of certain organic acids and micronutrients on 100 beery weight and some chemical characteristics of the berries of Early Sweet grapevines during 2021, 2022 and 2023 seasons.

Treatments	100 berry weights (g.)			TSS %			Total acidity %			TSS/acid			Reducing sugars%		
	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
T1	440.5	445.0	446.0	17.8	18.0	18.0	0.715	0.710	0.710	24.9	52.3	25.3	14.9	15.0	15.0
T2	450.0	455.0	460.0	18.2	18.4	18.5	0.680	0.675	0.670	26.7	27.2	27.6	15.3	15.5	15.6
T3	455.5	460.5	464.0	18.5	18.7	18.9	0.670	0.665	0.660	27.6	28.1	28.6	15.5	15.7	15.8
T4	460.0	464.0	470.0	18.8	19.0	19.2	0.655	0.650	0.645	28.7	29.2	29.8	15.8	16.0	16.2
T5	478.5	482.0	488.0	19.2	19.4	19.5	0.630	0.625	0.615	30.4	31.0	31.7	16.5	16.7	16.9
T6	470.0	474.0	480.0	19.0	19.2	19.3	0.645	0.640	0.630	29.4	30.0	30.6	16.2	16.5	16.7
T7	462.0	468.0	472.0	18.7	19.0	19.1	0.660	0.650	0.640	28.3	29.2	29.8	15.8	16.0	16.3
T8	490.5	492.0	495.0	19.9	20.0	20.2	0.610	0.600	0.590	32.6	33.3	34.2	17.2	17.4	17.6
T9	482.5	488.0	491.5	19.4	19.8	20.0	0.620	0.610	0.600	31.2	32.4	33.3	16.8	17.0	17.3
T10	477.0	480.5	482.5	19.1	19.3	19.5	0.635	0.620	0.615	30.1	31.1	31.7	16.4	16.8	17.0
T11	510.5	515.0	518.0	20.6	20.8	21.0	0.570	0.555	0.540	36.1	37.4	38.8	17.9	18.2	18.4
T12	495.0	499.0	505.0	20.2	20.5	20.8	0.590	0.570	0.560	34.2	35.9	37.1	17.5	17.8	18.0
T13	488.0	494.0	500.0	19.8	20.0	20.2	0.615	0.600	0.590	32.2	33.3	34.2	17.0	17.4	17.7
T14	530.0	538.0	540.0	21.6	21.7	21.8	0.510	0.500	0.490	42.3	43.4	44.4	18.5	18.6	18.9
T15	520.0	525.0	528.5	21.0	21.4	21.6	0.540	0.520	0.510	38.8	41.1	42.3	18.1	18.4	18.6
T16	505.0	510.0	513.0	20.5	20.8	21.0	0.570	0.550	0.540	35.9	37.8	38.8	17.8	18.0	18.2
L.S.D. at 5%	**4.7**	**5.1**	**5.3**	**0.3**	**0.4**	**0.4**	**0.016**	**0.18**	**0.019**	**0.8**	**0.9**	**0.9**	**0.2**	**0.3**	**0.3**

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 **[15]**.

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 **[16]**.

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 **[17]**.

Organic acids namely citric, ascorbic and salicylic acids have 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 **[18, 19, 20, 21, 22, 23, 24, 3, 25, 26, 27, 28& 29].**

The important regulatory effects of Fe in building some plant pigments like chlorophylls and regulating reduction and oxidants reactions **[30].** Zn in activating metabolism enzymes, cell division and enlargement, IAA, biosynthesis of organic foods, water absorption and nutrients transport **[31 & 32]**, 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 **[33** & **34].**

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 **[35, 36, 37& 38].**

CONCLUSION

Treating Early sweet grapevines three times with Micromix at 0.1% and salicylic acid at 50ppm was responsible for improving yield quantitively and qualitatively.

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تاثير رش بعض الأحماض العضوية والعناصر الصغرى على كمية المحصول وخصائص الجودة للحبات فى كرمات العنب الإيرلى سويت تحت ظروف صعيد مصر .

أحمد حسن عبد العال[1]، محمد مجاور عباده[2]، حسين حمدان محمد سعيد[3]، سارة محمد أمين أحمد[3]

[1] قسم البساتين – كلية الزراعة – جامعة الأزهر (فرع أسيوط) – أسيوط – جمهورية مصر العربية
[2] معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة – جمهورية مصر العربية
[3] قسم البساتين – كلية الزراعة والموارد الطبيعية – جامعة أسوان – أسوان – جمهورية مصر العربية

الملخص:

أجريت هذه التجربة خلال مواسم 2021و 2022و 2023 على كرمات عنب ايرلى سويت عمرها 14 عام ونامية فى تربة رملية بمحافظة الأقصر لدراسة تأثير الرش الورقى ببعض العناصر الصغرى فى صورة مركب الميكروميكس (يحتوى على 6% حديد و 3% زنك و 3% منجنيز و 1.5% نحاس فى الصورة المخلبية) بتركيز من 0.025 الى 0.1% مع أو بدون أى من الأحماض العضوية الثلاثة (حامض الستريك أو حامض الاسكوربيك بتركيز 500 جزء فى المليون أو حامض السلسليك بتركيز 50 جزء فى المليون) على كمية المحصول وخصائص جودة حبات العنب الايرلى سويت.

كان هناك تحسين واضح فى كمية المحصول والخصائص الطبيعية والكيميائية للحبات عند رش مركب الميكروميكس بتركيز من 0.025 الى 0.1% وأى 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 فى الصورة الفردية او المشتركة مقارنة بمعاملة الكونترول.

وكان استخدام أى من الأحماض العضوية الثلاثة مفضلا عن استخدام مركب الميكرومكس فى تحسين كمية المحصول وخصائص الجودة للحبات وكان استخدام مركب الميكروميكس مع أى من حمض الستريك أو حمض الاسكوربيك أو حمض السلسليك مفضلا عن استخدام كل منها مفرده.

أمكن الحصول على أفضل النتائج بخصوص كمية المحصول وخصائص الجودة للحبات فى العنب الايرلى سويت النامى فى التربة الرملية عند رش الكرمات ثلاث مرات بمخلوط يتكون من مركب الميكرومكس بتركيز 0.1% مع حامض السلسليك بتركيز 50 جزء فى المليون .

الكلمات الدالة: ميكرومكس، حامض الستريك – حامض الاسكوربيك – حامض السلسليك – كمية المحصول – خصائص الجودة للحبات – كرمات العنب الايرلى سويت.