Response of Superior Grapevines to Foliar Application of Some Micronutrients in Lignosulfonate Form As Well As Humic Acid and Em

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Abstract: This study was carried out during 2016 and 2017 seasons to examine the effect of spraying Superior grapevines three times with Mn, Zn and Fe in lingosulfonate form each at 0.05 % as well as humic acid and EM each at 50 ml/vine/year either alone or in combinations on growth, vine nutritional status, yield and berries quality. All growth aspects, leaf chemical components, berry setting %, yield, cluster traits and quality of the berries were remarkably improved in response to treating the vines singly or in combinations with Mn, Zn and Fe applied via lignosulfonate at 0.05 % relative to the control. Using all materials together gave the best results. The best results with regard to yield and berries quality of Superior grapevines were obtained due to treating the vines three times with Mn, Zn and Fe in lignosulfonate form at 0.05 % plus humic acid and EM each at 50 ml/vine/year.
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1. Introduction

For enhancing the uptake of different micronutrients it is necessary to select the best form or source of use. Micronutrients are responsible for building photosynthetic pigments, organic foods, enzymes, hormones and vitamins. They are also beneficial for stimulating cell division (**Nijjar, 1985).**

Organic and biofertilization had an announced promotions on organic matter, the availability of most nutrients, fixation of N and reducing soil pH (**Cabrera *et al*., 2003 and Mohd-Yunus *et al*., 2013**).

Application of micronutrients (**Abada, 2002, Sayed-Heba, 2010, Abd El-Wahab, 2010 and Abdelaal *et al*., 2013);** humic acid (**Abd El-Aziz, 2011, Mekawy, 2012, Uwakiem, 2015 and Motawea, 2016**) and EM (**Abada *et al*., 2010, Abdelaal *et al.*, 2013, El-Wany, 2015, Motawea, 2016 and El-Kady-Hanaa, 2017**) had an obvious promotion on growth, yield and berries quality in different grapevine cvs.

The targetof this study was examining the effect of spraying some micronutrients applied via lignosulfonate form as well as humic acid and EM on growth, vine nutritional status, yield and berries quality of Superior grapevines grown under Minia region conditions.

2. Materials and Methods

This study was carried out during the two consecutive seasons of 2016 and 2017 on 24 uniform in vigour own-rooted 10-years old Superior grapevines grown in a private vineyard located at El-Hawarta village, eastern side of Minia city, Minia Governorate. where the soil texture is silty clay and well drained water since water table depth is not less than two meters. The chosen vines are planted at 2 x 3 meters apart. Cane pruning system was followed at the first week of Jan. during both seasons leaving 24 eyes per vine (on the basis of 6 fruiting spurs x 12 eyes plus six renewal spurs x two eyes). The vines were irrigated through surface irrigation system.

Except those dealing with the present treatments (application of micronutrients, humic acid and EM) all the selected vines (24 vines) received the usual horticultural practices that are commonly applied in the vineyard.

1- Soil analysis:

Soil is classified as silty clay in texure with water table depth not less than two meters deep. The results of orchard soil analysis according to **Wilde *et al.,* (1985)** are given in **Table (1)**.

This experiment included the following eight treatments.

1- Control.

2- Spraying Mn in lignosulfonate form at 0.05 %.

3- Spraying Zn in lignosulfonate form at 0.05 %.

4- Spraying Fe in lignosulfonate form at 0.05 %.

5- Soil addition of humic acid at 50 ml/vine/year.

6- Soil addition of EM at 50 ml/vine/year.

7- Spraying all nutrients in lingsulfonate form at 0.05 %.

8- Spraying all nutrients in lingsulfonate plus humic acid and EM each at 50 ml/vine/year.

Table (1): Mechanical, physical and chemical analysis of the tested orchard soil:

Characters	Values
Particle size distribution	
Sand %	:10.60
Slit %	:58.00
Clay %	:31.40
Texture grade	Silty clay
pH (1:2.5 extract)	:8.00
E.C. (1: 2.5 extract) (mmhos/ 1cm/ 25°C)	:0.91
O.M. %	:2.09
$CaCO_3$ %	:1.22
Macronutrients values	
Total N%	:0.11
P (Olsen method, ppm)	:20.00
K (ammonium acetate, ppm)	:419.00
Mg (ppm)	:79.00
S (ppm)	:6.90
B (hot water extractable)	:0.27
EDTA extractable micronutrients (ppm):	
Zn	:1.31
Fe	:11.00
Mn	:10.18
Cu	:1.60

Table (2): Analysis of Humita 25:

Parameters	Values
Humic acid	25.0
N %	1.0
P_2O_5%	4.0
K_2O%	6.0
Chelated Fe (ppm)	2400.0
Chelated Zn (ppm)	1200.0
Chelated Cu (ppm)	200.0
Chelated B (ppm)	150.0
Chelated Mo (ppm)	15.0
Fulvic acid %	4.0
Humic acids %	10.0
Amino acids %	10.0
pH (1: 2.5 extract)	7.0

Each treatment was replicated three times, one vine per each. The three micronutrients namely Mn, Zn and Fe were applied three times at growth start (2nd week of Mar.), just after berry setting (2nd week of Apr.) and three weeks later (1st week of May). Triton B as a wetting agent was added to all spraying solutions and spray was done till runoff. Both humic acid (Humita 25) and EM applied at 50 ml/vine/year were added once at growth start (2nd week of Mar.) 25 cm apart from vine trunk. Randomized complete block design was followed. Triton B as a wetting agent at 0.05% was added to all nutrient solutions.

A randomized complete block design was followed where this experiment included nineteen treatments each replicated three times, one vine per each.

1. Various measurements:

1.1. Measurements of vegetative growth characters:

At the first week of May during both seasons, twenty mature leaves from the opposite side to the basal clusters on the shoots were picked for calculating the leaf area using the following equation outlined by **Ahmed and Morsy (1999)**.

Leaf area ($cm^{2)}$ = 0.45 (0.79 x diameter 2) + 17.77.

The average leaf area was recorded. Average main shoot length (cm) was recorded as a result of measuring the length of ten shoots per vine (cm) and the average shoot length was recorded. Number of leaves per shoot was also recorded. Dynamic of wood ripening coefficient was calculated by dividing the length of the ripened part of shoot that had brownished colour by the total length of the shoots (green colour) in the ten shoots/ vine (middle of Oct.) according to **Bouard (1966)**. Weight of prunings (kg.)/ vine was recorded just after carrying out pruning by weighing the removal one year old wood (1st week of Jan.). Average cane thickness (cm) was estimated in the five basal internodes of ten canes per vine by using a Vernier caliper.

1.2. Measurements of leaf pigments:

Fresh leaves of each vine were cut into small pieces and a known sample (0.5g) from each sample was taken, homogenized and extracted using 25% acetone with the assistance of little amounts of Na_2CO_3 and clean sand. Filtration was washed several times with acetone till the filtrate was colorless. Acetone was used as a blank. In the filtrates, the optical density was determined using spectrophotometer at the weave length of 662 and 644 nm to determine chlorophylls a and b, respectively. The following equations were used for determination of these plant pigments according to **Von- Wettstein (1957) and Fadl and Seri-El-Deen (1978)**.

Chl.a= (9.784 – E622) – 0.99 – E644)= mg/I

Chl.b= (21.426 – E644) – (4.65 – E662) + mg/I

Total chl. = chl.A + chl.B

Total carotenoids = (4.965 × E 440 – 0.268 (chlorophyll a + chlorophyll b).

Were E = optical density at a given wave length. Calculations were estimated as mg/100 g F.W.

1.3. Measurements of leaf content of N, P, K and Mg:

Petioles of the same leaves that were taken for measuring the leaf area according to **Balo *et al.*, (1988)** were washed several times with water and distilled water and then oven dried at 70°C and grounded, then 0.5 g weight of each sample was digested using H_2SO_4 and H_2O_2 until clear solution (**Chapman and Pratt, 1965**). In the digested solutions, the following nutrients were determined:

1-N % by the modified micro Kejldahl method as described by **Chapman and Pratt (1965)**.

2- P % by using Olsen method as reported by **Wilde *et al.,* (1985).**

3- K % by using flame photometer as outlined by (**Chapman and Pratt (1965)**.

4- Mg and Ca by titration against EDTA (Versene method).

1- Micronutrients namely Zn, Fe and Mn (as ppm) by using atomic absorption spectrophotometer according to **Jones *et al.,* (1991)**.

1.4. Measurements of berry setting %:

It was calculated by caging five clusters / vine in perforated paper bags before blooming stage. The bages were removed at the end of berry setting stage. The number of attached and dropped berries as well as total number of flowers per vine were recorded (dropped + attached berries). Percentage of berry setting was estimated by dividing number of attached berries by total number of flowers per cluster and multiplying the product by 100.

1.5. Measurements of yield as well as physical and chemical characteristics of the berries:

When T.S.S./ acid in the control treatment reached 25:1, clusters were harvest (**Weaver, 1976**). The yield of each vine was recorded in terms of weight (kg) and number of clusters/vine. Five clusters per each vines were taken for determination of the following physical and chemical characteristics of the berries:

1- Cluster dimensions (length and shoulder in cm).

2- Percentage of shot berries by dividing number of small berries by total number of berries sand multiplying the product by 100.

3- Average berry weight (g.) and dimensions (longitudinal and equatorial (in cm).

4- Percentage of total soluble solids in the juice by using handy refractometer.

5- Percentage of total acidity in the juice (as g tartaric acid/100 ml juice) by titration against 0.1 N NaOH using phenolphthalein indicator (**A.O.A.C., 2000**).

6- The ratio between T.S.S. and acid.

7- The percentage of reducing sugars in the juice (**Lane and Eynon, 1965**) as described by **A.O.A.C. (2000)**.

Statistical analysis:

Statistical analysis was done and the different treatment means were compared using new L.S.D. at 5% (R**angaswamy, 1995 and Rao, 2007**)).

3. Results and Discussion

1- Effect of some micronutrients, humic acid and EM on some vegetative growth aspects:

It is clear from the data in Table (3) that single and combined applications of Mn, Zn and Fe applied in lignosulfonate each at 0.05 % as well as humic acid and EM each at 50 m/vine/year significantly stimulated the six growth aspects namely main shoot length, number of leaves/shoot, leaf area, wood ripening coefficient, cane thickness and pruning wood weight relative to the control. Using humic acid or EM each at 50 ml/vine was significantly superior than using any micronutrients alone in stimulating these growth aspects. Using EM was significantly superior than using humic acid in enhancing these growth aspects. Significant differences on these growth aspects were observed among the eight treatments. Combined applications of these materials were significantly favourable than using each material alone in this connection. Using all micronutrients each at 0.05 % as well as humic acid and EM each at 50 ml/vine/year gave the maximum values. The untreated vines produced the lowest values. These results were true during both seasons.

2- Effect of some micronutrients, humic acid and EM on the leaf chEMical components:

It is quite clear from the obtained data in Tables (4 & 5) that single and combined applications of Mn, Zn and Fe in lignosulfonate form at 0.05 % as well as humic acid and EM each at 50 ml/vine/year caused a significant promotion on chlorophylls a & b, total chlorophylls, total carotenoids, N, P, K, Mg, Ca, Zn, Fe, Mn and Cu in the leaves over the control treatment. Using Fe, Zn and Mn, in descending order significantly enhanced all leaf chEMical components. Using humic acid or EM each at 50 ml/vine significantly surpassed the application of single application of micronutrients in stimulating theses chEMical components. Combined applications of these materials were significantly favourable than using each material alone in this respect. The maximum values were recorded on the vines that received all micronutrients, humic acid and EM together. The untreated vines produced the lowest values. The present treatments had no significant effect on the leaf content of Cu in the leaves. These results were true during both seasons.

3- Effect of some micronutrients, humic acid and EM on the percentage of berry setting:

Data in Table (6) show the percentages of berry setting was significantly improved in response to single and combined applications of the three micronutrients namely Mn, Zn and Fe in lignosulfonate form each at 0.05 % as well as humic acid and EM each at 50 ml/vine/year relative to the control. Using Fe, Zn and Mn, in descending order was significantly very effective in improving the percentage of berry setting. Using humic acid or EM each at 50 ml/vine/year was significantly favourable than using any micronutrients in this respect. Combined applications were significantly favourable than using each material alone in this respect. Significant differences on berry setting % were observed among the eight treatments. Percentage of berry setting reached the maximum values namely 13.1 & 13.3 % in the vines treated with all materials together while the minimum values (8.1 & 8.8 %) were recorded on the untreated vines, during both seasons, respectively. Similar trend was noticed during both seasons.

4- Effect of some micronutrients, humic acid and EM on the yield cluster parameters:

It is noticed from the obtained data in Table (6) that treating Superior grapevines with any micronutrients and/or humic acid and EM significantly was followed by improving the yield expressed in weight and number of clusters/vine as well as cluster weight and dimensions relative to the control. The promotion was significantly associated with using Mn, Zn and Fe, in ascending order. Using humic acid and EM each at 50 ml/vine/year was significantly superior than using micronutrient each singly in enhancing these parameters. Combined applications of these materials were significantly favourable than using each material alone in this respect. Significant differences on these parameters were observed among the eight treatment. The maximum yield (10.7 & 15.7 kg/vine) were recorded on the vines that treated with all materials together during both seasons, respectively. The untreated vines produced the lowest values of yield (8.3 & 7.7 kg) during both seasons, respectively. These results were true during both seasons. Number of clusters/vine in the first season of study was significantly unaffected by the present treatments.

5- Effect of some micronutrients, humic acid and EM on the percentage of shot berries:

Data in Table (7) show the percentage of shot berries was significantly reduced due to using any micronutrients and/or humic acid and EM relative to the control. Using Fe, Zn and Mn, in descending order was very effective in reducing shot berries. Using humic acid or EM each at 50 ml/vine/year was significantly favourable in reducing shot berries than using any micronutrients singly. Combined applications were significantly superior than single one in reducing shot berries %. The lowest values of shot berries (5.3 & 5.0 %) were recorded on the vines that received all materials together during both seasons, respectively. The untreated vines produced the highest values (11.5 & 12.0 %) during both seasons, respectively. These results were true during both seasons.

6- Effect of some micronutrients, humic acid and EM on some physical and chEMical characteristics of the berries:

Table (3): Effect of some micronutrients in lignosulfonate form as well as humic acid and EM on some vegetative growth characteristics of Superior grapevines during 2016 and 2017 seasons

Treatments	Main shoot length (cm)		No. of leaves/shoot		Leaf area $(cm)^2$		Wood ripening coefficient		Cane thickness (cm)		Pruning wood weight (kg)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	110	113.3	15.0	17.0	108	107.4	0.66	0.61	1.12	1.11	1.49	1.51
LignosulfonateMn at 0.05 %	111.9	115.0	17.0	18.0	110.0	108.8	0.69	0.63	1.14	1.16	1.54	1.58
Lignosulfonate Zn at 0.05 %	115.8	117.0	19.0	20.0	114	111	0.75	0.74	1.16	1.19	1.64	1.68
Lignosulfonate Fe at 0.05 %	117.8	121.0	20.0	22.0	116.7	113.1	0.80	0.80	1.25	1.24	1.69	1.70
Humic acid at 50 ml/vine/year	121.0	122.6	24.0	25.0	118.8	115.3	0.83	0.84	1.28	1.32	1.80	1.82
EM at 50 ml/vine/year	123.6	126.4	26.0	26.0	121.1	118.0	0.88	0.89	1.31	1.36	1.84	1.86
All micronutrients	131.0	134.1	29.0	29.0	123.4	120.0	0.90	0.93	1.35	1.40	1.93	1.97
All micronutrients + Humic acid + EM	132.0	135.6	31.0	31.0	128.0	124.8	0.96	0.96	1.42	1.44	1.99	2.07
New L.S.D. at 5%	**0.8**	**0.7**	**1.0**	**1.0**	**1.1**	**1.1**	**0.03**	**0.02**	**0.02**	**0.02**	**0.04**	**0.03**

It is clear from the obtained data in Tables (8 & 9) that single and combined applications of Mn, Zn and Fe in lignosulfonate form each at 0.05 % as well as humic acid and EM each at 50 ml/vine/year was significantly very effective in improving quality of the berries in terms of increasing berry weight and dimensions (longitudinal and equatorial), T.S.S. %, reducing sugars % and T.S.S./acid and decreasing total acidity % relative to the control. The promotion on quality of the berries was significantly associated with using Fe, Zn and Mn, in descending order. Using humic acid or EM each at 50 ml/vien/year was significantly superior than using any micronutrients alone in enhancing quality of the berries. Combined applications were significantly favourable than using each material alone in this respect. Significant differences on these quality parameters were detected among the eight treatments. Using all micronutrients together significantly surpassed the application of each micronutrient alone as well as application of humic acid and EM. The best results with regard to quality parameters were obtained due to treating the vines with all materials together. Unfavourable effects on quality parameters were detected on untreated vines. These results were true during both seasons.

Table (4): Effect of some micronutrients in lignosulfonate form as well as humic acid and EM on some photosynthetic pigments and percentages of N and P in the leaves of Superior grapevines during 2016 and 2017 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)		Leaf N %		Leaf P %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	4.94	4.81	1.11	1.12	6.05	5.93	1.11	1.06	1.59	1.61	0.119	0.120
Lignosulfonate Mn at 0.05 %	5.00	4.90	1.22	1.22	6.22	6.12	1.18	1.20	1.66	1.69	0.130	0.129
Lignosulfonate Zn at 0.05 %	5.25	5.11	1.31	1.32	6.56	6.43	1.26	1.27	1.78	1.79	0.141	0.139
Lignosulfonate Fe at 0.05 %	5.42	5.20	1.45	1.39	6.87	6.59	1.40	1.38	1.80	1.86	0.151	0.150
Humic acid at 50 ml/vine/year	5.60	5.41	1.55	1.53	7.15	6.94	1.51	1.49	1.92	1.95	0.161	0.160
EM at 50 ml/vine/year	5.71	5.68	1.62	1.65	7.33	7.33	1.61	1.61	2.01	2.05	0.171	0.171
All micronutrients	6.01	5.94	1.74	1.69	7.75	7.67	1.72	1.74	2.10	2.14	0.182	0.182
All micronutrients + Humic acid + EM	6.15	6.16	1.80	1.88	7.98	8.04	1.81	1.80	2.17	2.21	0.199	0.194
New L.S.D. at 5%	**0.04**	**0.05**	**0.06**	**0.04**	**0.06**	**0.05**	**0.07**	**0.05**	**0.06**	**0.07**	**0.08**	**0.06**

Table (5): Effect of some micronutrients in lignosulfonate form as well as humic acid and EM on the leaf content of K, Mg and Ca (as %) and Zn, Fe, Mn and Cu (as ppm) in the leaves of Superior grapevines during 2016 and 2017 seasons

Treatments	**Leaf K %**		**Leaf Mg %**		**Leaf Ca %**		**Leaf Zn (ppm)**		**Leaf Mn (ppm)**		**Leaf Fe (ppm)**		**Leaf Cu (ppm)**	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	1.11	1.06	0.50	0.49	1.95	1.96	50.1	49.9	53.9	54.3	47.3	48.0	0.91	0.90
LignosulfonateMn at 0.05 %	1.18	1.18	0.55	0.54	2.11	2.06	52.3	52.5	57.0	56.8	49.0	49.2	0.92	0.90
Lignosulfonate Zn at 0.05 %	1.33	1.32	0.62	0.64	2.23	2.31	57.1	56.5	60.3	60.0	53.3	53.5	0.92	0.90
Lignosulfonate Fe at 0.05 %	1.40	1.39	0.67	0.69	2.36	2.42	59.1	60.9	64.0	62.4	55.6	55.0	0.92	0.90
Humic acid at 50 ml/vine/year	1.52	1.51	0.75	0.74	2.55	2.61	63.9	62.9	68.0	66.4	60.0	56.6	0.92	0.91
EM at 50 ml/vine/year	1.60	1.58	0.80	0.78	2.77	2.80	66.5	66.6	70.0	69.4	61.6	60.1	0.92	0.91
All micronutrients	1.71	1.68	0.86	0.83	2.89	2.88	71.9	68.1	74.3	72.5	65.0	64.0	0.92	0.91
All micronutrients + Humic acid + EM	1.84	1.76	0.92	0.87	2.99	2.97	75.0	71.1	76.8	75.9	67.0	65.0	0.92	0.91
New L.S.D. at 5%	**0.05**	**0.06**	**0.04**	**0.03**	**0.07**	**0.08**	**1.9**	**1.8**	**1.9**	**1.7**	**1.4**	**1.0**	**NS**	**NS**

Table (6): Effect of some micronutrients in lignosulfonate form as well as humic acid and EM on the percentage of berry setting, yield as well as cluster weight and dimension of Superior grapevines during 2016 and 2017 seasons

Treatments	Berry setting %		No. of clusters/vine		Yield/vine (kg.)		Av. Cluster weight (g.)		Av. Cluster length (cm)		Av. Cluster shoulder (cm)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	8.1	8.8	23.0	21.0	8.3	7.7	361	365	15.7	15.5	11.4	11.5
Lignosulfonate Mn at 0.05 %	8.7	9.4	23.0	23.0	8.6	8.7	373	378	16.2	16.0	11.7	11.9
Lignosulfonate Zn at 0.05 %	9.4	10.3	24.0	25.0	9.2	9.8	385	390	16.7	16.6	12.0	12.4
Lignosulfonate Fe at 0.05 %	10.0	11.0	24.0	27.0	9.6	10.9	400	405	17.1	17.2	12.3	12.8
Humic acid at 50 ml/vine/year	11.0	11.7	24.0	29.0	9.9	12.2	411	421	17.7	18.1	12.6	13.2
EM at 50 ml/vine/year	11.6	12.1	24.0	31.0	10.2	13.5	425	435	18.2	18.6	13.0	13.5
All micronutrients	12.6	12.7	24.0	32.0	10.4	14.4	435	450	19.0	19.3	13.2	13.7
All micronutrients + Humic acid + EM	13.1	13.3	24.0	34.0	10.7	15.7	446	463	19.5	20.0	13.5	14.0
New L.S.D. at 5%	**0.5**	**0.4**	**NS**	**2.0**	**0.3**	**0.6**	**9.9**	**10.0**	**0.4**	**0.4**	**0.3**	**0.3**

Table (7): Effect of some micronutrients in lignosulfonate form as well as humic acid and EM on shot berries % and berry weight and dimensions of Superior grapevines during 2016 and 2017 seasons

Treatments	Shot berries %		Av. Berry weight (g.)		Av. Berry equatorial (cm)		Av. Berry longitudinal (cm)	
	2016	2017	2016	2017	2016	2017	2016	2017
Control	11.5	12.0	2.91	2.94	2.00	2.00	2.20	2.22
Lignosulfonate Mn at 0.05 %	10.0	11.0	3.00	3.02	2.04	2.04	2.25	2.27
Lignosulfonate Zn at 0.05 %	9.5	10.1	3.11	3.11	2.08	2.11	2.28	2.33
Lignosulfonate Fe at 0.05 %	8.0	9.0	3.23	3.19	2.14	2.17	2.34	2.38
Humic acid at 50 ml/vine/year	7.4	7.9	3.36	3.30	2.18	2.20	2.39	2.42
EM at 50 ml/vine/year	6.8	7.0	3.47	3.41	2.22	2.24	2.42	2.47
All micronutrients	6.0	6.4	3.59	3.52	2.25	2.27	2.45	2.50
All micronutrients + Humic acid + EM	5.3	5.0	3.71	3.64	2.29	2.31	2.50	2.55
New L.S.D. at 5%	**0.4**	**0.5**	**0.08**	**0.07**	**0.03**	**0.02**	**0.4**	**0.4**

Table (8): Effect of some micronutrients in lignosulfonate form as well as humic acid and EM on some chemical characteristics of the berries of Superior grapevines during 2016 and 2017 seasons

Treatments	T.S.S. %		Reducing sugars %		Total acidity %		T.S.S./acid	
	2016	2017	2016	2017	2016	2017	2016	2017
Control	17.5	18.0	15.5	15.1	0.699	0.719	25.0	25.0
Lignosulfonate Mn at 0.05 %	18.0	18.6	16.0	15.6	0.680	0.701	26.5	26.5
Lignosulfonate Zn at 0.05 %	19.0	19.2	16.5	16.3	0.660	0.681	28.8	28.2
Lignosulfonate Fe at 0.05 %	19.5	19.8	17.0	16.9	0.640	0.650	30.5	30.5
Humic acid at 50 ml/vine/year	20.1	20.4	17.6	17.4	0.620	0.630	32.4	32.4
EM at 50 ml/vine/year	20.6	21.0	18.0	18.0	0.600	0.610	34.3	34.4
All micronutrients	21.0	21.5	18.5	18.6	0.581	0.592	36.1	36.3
All micronutrients + Humic acid + EM	21.5	22.1	19.1	19.8	0.561	0.571	38.3	38.7
New L.S.D. at 5%	**0.4**	**0.5**	**0.4**	**0.5**	**0.018**	**0.016**	**1.4**	**1.2**

4. Discussion

Application of micronutrients (**Abada, 2002, Sayed-Heba, 2010, Abd El-Wahab, 2010 and Abdelaal *et al*., 2013);** humic acid (**Abd El-Aziz, 2011, Mekawy, 2012, Uwakiem, 2015 and Motawea, 2016**) and EM (**Abada *et al*., 2010, Abdelaal *et al.*, 2013, El-Wany, 2015, Motawea, 2016 and El-Kady-Hanaa, 2017**) had an obvious promotion on growth, yield and berries quality in different grapevine cvs.

Conclusion

The best results with regard to yield and berries quality of Superior grapevines were obtained due to treating the vines three times with Mn, Zn and Fe in lignosulfonate form at 0.05 % plus humic acid and EM each at 50 ml/vine/year.

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