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EFFECT OF MINERAL OR CHELATED CALCIUM AND MAGNESIUM ON GROWTH AND BUNCH AND BERRY CHARACTERISTICS OF FLAME SEEDLESS GRAPEVINES GROWN IN SANDY SOILS

II- EFFECT ON BUNCH AND BERRY CHARACTERISTICS

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ABSTRACT

This study was conducted during 1997 and 1998 seasons on Flame seedless grapevines grown in a sandy soil to examine the effect of mineral or chelated calcium and magnesium on bunch and berry characteristics. The effect of spraying Ca-EDTA and Mg-EDTA each at 0.15 and 0.30% as well as calcium chloride and magnesium sulphate each at 0.5 and 1.0% was investigated.

Results showed that foliar application of calcium and magnesium either chelated or mineral forms was very effective in increasing bunch and berry weight, dimensions of berry and bunch, number of berries/bunch, berry weight and firmness and skin anthocyanin content as compared to unspraying. Calcium and magnesium treatments had a slight effect on berry shape, total soluble solids and total acidity. In most cases, the application of chelated form of each macronutrient was preferable than application of mineral form in improving most of the studied characters. Foliar application of Mg-EDTA at 0.30% surpassed that of Ca-EDTA in increasing bunch weight, number of berries per bunch, berry weight and dimensions and skin anthocyanins content. However, spraying Ca-EDTA at 0.30% was the more effective in increasing bunch dimensions and berry firmness, than that of Mg-EDTA at the same concentration.

The best results with regard to bunch and berry characteristics of Flame seedless grapevines were obtained due to spraying Mg-EDTA at 0.30% or Ca-EDTA at 0.30% three times on March 15th, May 1st and June 15th.

INTRODUCTION

Flame Seedless as a newly and an early ripening cultivar, still needs an additional information concerning some appropriate practices which if applied could affect possitivily bunch and berry characteristics for enhancing the productivity of the vines. Nutrition particularly with calcium and magnesium seemed to be the main factor greatly influencing the production of fruit trees (Devlin, 1972) through its effect on stimulating growth and vine nutritional status as mentioned in the first part of the present study. So, the second part of the whole study was focused on testing the effects of using Ca and Mg on bunch and berry characteristics.

A great promotion on quality of Thompson seedless grapes in response to foliar application of Ca was observed by Poovaiah (1979), (1985) and (1986) and Rizk and Rizk (1994b).

Foliar application of Mg substantially improved quality of Thompson seedless grapes (Kilany, 1992 and Rizk and Rizk, 1994b). Hagler (1957) on

Muscadine grapes, Larsen (1963) on Concord grapes, Ruhl *et al.* (1992) on Riesling, Chardonney and Cabernet grapes and Spiers and Braswell (1994) on Muscadine grapevines.

The merit of the second part of this study was extended to test the positive action of spraying chelated or mineral form of Ca and Mg on bunch and berry characteristics of flame Seedless cultivar.

MATERIALS AND METHODS

The present study was carried out during 1997 and 1998 seasons on 8 years-old Flame seedless grapevines, grown in a private vineyard located at 63 Kilometers from Cairo on Cairo-Alexandria desert road. The double-cordon system was used in training the vines. Vines were pruned during the last week of December 1996 and 1997, to leave about 60-65 buds per vine. Vines were planted in a sandy soil at 2x3 meters under the drip irrigation system.

One hundred and eight uniform Flame seedless grapevines were chosen and devoted for carrying out this experiment.

The following nine treatments were applied:-

1- Control (water spraying)
2- Calcium chloride ($CaCl_2$) at 0.5 %
3- Calcium chloride at 1.0 %
4- Calcium-EDTA at 0.15 %
5- Calcium-EDTA at 0.30 %
6- Magnesium Sulphate ($MgSO_4$) at 0.5 %
7- Magnesium Sulphate at 1.0 %
8- Magnesium-EDTA at 0.15 %
9- Magnesium-EDTA at 0.30 %

Magnesium sulphate ($MgSO_4 .7H_2O$, 9.8% Mg), Calcium chloride ($CaCl_2$ 8% Ca), Calcium-EDTA (12% Ca in the form of calcium ethylen diamine tetra acetate) and Magnesium-EDTA(12% Mg in the form of magnesium ethylen diamine tetra acetate) were applied. Sprays of both calcium and magnesium compounds were done three times in each seasons, i.e., on March 15th, May 1st and June 15th. Triton B as a wetting agent was added to all sprayed solution and the vines were sprayed till runoff.

The experiment was set in a randomized complete block design (Snedecor and Cochran, 1972) with three replicates per each treatment, each replicate consisted of four vines.

All vines received the regular horticultural practices already applied in the vineyards except those included in the experimental work.

During the two seasons, the following parameters were determined:-

- Bunch and berry characteristics.

Samples of 12 bunches per each treatment (4 bunches for each replicate) were picked at the harvesting time (middle of June in both seasons) and transferred to the laboratory for determining the following parameters:-

1- Average weight of bunch (g.).
2- Dimensions of bunch (length and width of bunch, cm.).

3- Average number of berries/bunch.
4- Berry weight (g.) (an average of 50 berries /replicate).
5- Berry dimensions (length and diameter, cm), then berry shape index was calculated by dividing berry length by berry diameter.
6- Berry firmness (g/cm^2) by using Shatilons instrument
7- Total anthocyanin content in the berry skin were determined according to the method described by Yildiz and Dikmen (1990).
8- Total soluble solids % by using a hand refractometer.
9- Total acidity % (as g tartaric acid /100g juice) according to the A.O.A.C (1975).

The new L.S.D test was used to differentiate the significant differences between various treatment means, according to Waller and Duncan (1969).

RESULTS AND DISCUSSION

1- Bunch weight :

It is evident from the data in Table (1) that spraying Mg-EDTA at 0.30% gave significantly the heaviest bunches in both seasons. Spraying $MgSO_4$ at 1% in 1998 also had the same effect. The other treatments of Ca and Mg in both seasons generally increased the bunch weight compared to the control. The minimum bunch weight was detected in untreated vines in both seasons.

Table (1): Yield /vine and cluster characteristics of Flame Seedless grapevines as affected by mineral or chelated calcium and magnesium sprays (1997 and 1998 seasons).

Treatments	1997					1998				
	Yield /vine (kg)	Cluster weight (g)	Cluster length (g)	Cluster width (cm)	Number of berries /cluster	Yield /vine (kg)	Cluster weight (g)	Cluster length (g)	Cluster width (cm)	Number of berries /cluster
1- Control	8.4 b	451.8 g	20.6 g	15.5 f	254.6 g	10.8 f	533.4 h	22.9 e	16.6 e	265.3 l
2- $CaCl_2$ 0.5 %	9.0 ab	461.2 f	23.4 f	17.7 de	258.5 g	11.7 e	554.5 g	24.1 d	19.8 cd	277.9 f
3- $CaCl_2$ 1.0 %	10.0 ab	492.8 e	24.5 e	18.3 cd	297.9 e	13.0 d	590.3 e	27.2 c	19.7 cd	298.1 e
4-Ca-EDTA 0.15 %	11.2 ab	574.2 c	27.8 b	19.4 b	312.9d	13.8 c	625.0 d	28.8 b	20.1 c	338.6 c
5-Ca-EDTA 0.3 %	14.3 ab	603.0 b	28.9 a	20.2 a	383.2 b	15.6 b	651.6 c	29.0 b	20.3 bc	347.3 b
6-$MgSO_4$ 0.5 %	9.6 ab	462.4 f	26.3 a	17.0 e	255.8 g	13.4 cd	566.1 f	28.9 b	19.4 d	268.1 h
7-Mg SO_4 1.0 %	12.4 ab	496.1 e	26.9 cd	18.6 c	281.5 f	16.8 a	671.4 a	29.1 b	20.0 cd	275.3 g
8-Mg-EDTA 0.15%	11.8 ab	557.3 d	26.6 a	17.5 e	366.1 c	13.4 cd	588.3 e	30.0 a	20.8 ab	304.4 d
9- Mg-EDTA 0.3%	16.1 a	633.6 a	27.5 bc	19.6 ab	411.4 a	16.1 b	662.7 b	29.9 a	21.1 a	375.3 a

Values with the same letter (s) in common do not differ significantly at 5% level

The improving effect of Ca on bunch weight was previously by the results of Rizk and Rizk (1994b) on Thompson Seedless grapes and Spiers and Braswell (1994) on Muscadine grapevines.

The results concerning Mg are in harmony with the findings of Kilany (1992) and Rizk and Rizk(1994a) on Thompson Seedless grapevines.

2- Bunch dimensions:-

It can be shown from the data in Table (1) that all Ca and Mg treatments succeeded in increasing length and width of the bunch compared to control treatment. Spraying Ca-EDTA at 0.30% in 1997 and Mg-EDTA in

1998 increases significantly bunch dimensions compared to the other treatments. The maximum values were obtained from Ca-EDTA treatment in the first season and Mg-EDTA in the second one. The minimum values were detected in the untreated vines.

However, these results are in disagreement with those obtained by Rizk and Rizk(1994b) who found that using Ca-EDTA failed to affect the bunch dimensions of Thompson Seedless grapevines.

3- Number of berries /bunch

Number of berries per bunch as presented in Table (1) was positively affected by the foliar application of all forms of Ca and Mg as compared to the control treatment. The maximum value was observed in vines received Mg-EDTA at 0.30% followed by Ca-EDTA at 0.30%. Lower values of this parameter were due to spraying mineral Ca and Mg as compared to spraying chelated Ca and Mg. The untreated vines had the lowest number of berries /bunch in both seasons.

Similar conclusion regarding the effect of Mg was reported by Kilany (1992) on Thompson Seedless grapevines.

Generally, spraying Mg-EDTA at 0.30 % followed by Ca-EDTA at 0.30% achieved the best results with regard to bunch and berry characteristics of Flame Seedless cultivar.

4- Berry weight

It is evident from the data in Table (2) that spraying Mg-EDTA at 0.30 % followed by Ca-EDTA at the same concentration had a detectable tendency to produce the heaviest berries. Spraying mineral Ca or Mg slightly increased this parameter as compared to the control treatment.

Table (2): Physical characteristics of berries of Flame Seedless grapevines as affected by mineral or chelated calcium and magnesium sprays (1997 and 1998 seasons).

Treatments	1997					1998				
	Berry weight (g)	Berry length (cm)	Berry diameter (cm)	Berry shape	Berries firmness (g/cm^2)	Berry weight (g)	Berry length (cm)	Berry diameter (cm)	Berry shape	Berries firmness (g/cm^2)
1- Control	2.48 e	1.48 c	1.47 c	1.02 a	126.6 e	2.34 f	1.50 c	1.48 b	1.01 a	126.6 h
2- $CaCl_2$ 0.5 %	2.65 d	1.53 c	1.56 c	0.98 a	203.3 c	2.52 e	1.50 c	1.55 a	0.97 a	205.0 e
3- $CaCl_2$ 1.0 %	2.87 c	1.66 a	1.59 b	1.04 a	215.0 c	2.65 d	1.63 a	1.59 a	1.03 a	241.6 c
4-Ca-EDTA 0.15 %	2.88 c	1.60 ab	1.58 b	1.01 a	276.6 b	2.77 c	1.62 a	1.56 a	1.01 a	270.0 a
5-Ca-EDTA 0.3 %	3.05 b	1.58 abc	1.58 b	1.00 a	316.6 a	2.94 a	1.64 a	1.60 a	1.03 a	300.0 g
6-$MgSO_4$ 0.5 %	2.63 d	1.53 bc	1.48 c	1.03 a	175.0 d	2.56 e	1.56 b	1.53 a	1.02 a	165.0 g
7-Mg SO_4 1.0 %	2.93 c	1.54 bc	1.48 c	1.04 a	176.6 d	2.69 d	1.60 b	1.57 a	1.02 a	188.3 f
8-Mg-EDTA 0.15%	2.90 c	1.60 ab	1.58 b	1.01 a	176.6 d	2.84 b	1.59 b	1.56 a	1.02 a	198.3 ef
9- Mg-EDTA 0.3%	3.14 a	1.68 a	1.67 a	1.00 a	186.6 d	2.90 a	1.64 a	1.61 a	1.02 a	215.0 d

Values with the same letter (s) in common do not differ significantly at 5% l

The stimulating effect of Mg was supported by the results of Kilany (1992) on Thompson Seedless grapes.

However, the results regarding the effect of Ca are not in agreement with those obtained by Rizk and Rizk(1994b) who found that Ca-EDTA had no effect on berry weight of Thompson Seedless grapes.

5- Berry dimensions and shape

Data in Table (2) clearly show that all Ca or Mg treatments increased length and diameter of the berry as compared to control. The maximum values were detected in Mg-EDTA treatment at 0.30 %, while the minimum values were noticed on the berry of the untreated vines. Berry shape was nearly spherical without any reliable differences between the Ca or Mg treatments.

The results of Kilany (1992) showed the beneficial effect of using Mg on berry dimensions of Thompson seedless grapevines.

6- Berry firmness

Data in Table (2) obviously reveal that all Ca treatments especially in the chelated form significantly increased the firmness of berries. Magnesium treatments came next in this respect. Anyhow, control berries were more soft and had the least values of firmness. Similar results were obtained in both seasons.

The results of Devlin (1972) confirmed the beneficial effect of using Ca in increasing the firmness of fruit crops. Bermer *et al.,* (1986) and Noe *et al.,* (1995) found that foliar spray of Mg improved firmness of apple fruit.

7- Berry skin anthocyanins content

Data in Table (3) clearly show that all Ca and Mg treatments increased berry skin content of anthocyanin compared to the untreated vines. Results further reveal that spraying Mg-EDTA at 0.30% gave significantly the highest anthocyanin content in the berry skin followed by $CaCl_2$ at 1.0 % then Ca-EDTA at 0.30%, respectively. Berries of control treatment were poor in their colour as they had the lowest values of skin anthocyanin content. These results were valid for both seasons.

8- Total soluble solids (TSS)

It could be concluded from the data shown in Table (3) that the highest percentage of total soluble solids was presented in the berries of Ca-EDTA at 0.15% treatment followed by Ca Cl_2 at 1.0 % which had more or less the same percentage of TSS. However, in the second season, no significant differences concerning this parameter were observed between all Ca and Mg treatments and the control.

Table (3): Chemical characteristics of berries of Flame Seedless grapevines as affected by mineral or chelated calcium and magnesium sprays (1997 and 1998 seasons)

Treatments	1997			1998		
	Skin-anthocyanin (mg/100g)	TSS %	Acidity %	Skin-anthocyanin (mg/100g)	TSS %	Acidity %
1- Control	17.14 d	17.06 d	0.69 a	20.96 d	18.30 a	0.60 a
2- $CaCl_2$ 0.5 %	23.39 c	17.40 d	0.70 a	22.38 d	18.00 a	0.60 a
3- $CaCl_2$ 1.0 %	33.92 b	19.50 b	0.72 a	33.38 b	19.06 a	0.60 a
4-Ca-EDTA 0.15%	20.63cd	20.60 a	0.71 a	23.41 d	18.30 a	0.59 a
5-Ca-EDTA 0.3 %	30.49 b	17.60 c	0.71 a	32.20 b	18.80 a	0.61 a
6-$MgSO_4$ 0.5 %	19.22 cd	18.60 d	0.72 a	21.86 d	18.80 a	0.60 a
7-$MgSO_4$ 1.0 %	23.60 c	18.10 d	0.77 a	28.64 c	18.90 a	0.61 a
8-Mg EDTA 0.15%	19.27 cd	17.60 d	0.71 a	22.93 d	18.50 a	0.60 a
9-Mg-EDTA 0.3%	48.20 a	17.47 d	0.78 a	46.71 a	18.40 a	0.63 a

Values with the same letter (s) in common do not differ significantly at 5% level

The improving effect of Mg on the total soluble solids was supported by the results of Kilany (1992) on Thompson seedless grapevines. The slight effect of Mg on the total soluble solids detected in the second season was confirmed by the results of Larsen *et al.* (1963) on Concord grapes. The meaningless influence of Ca on the total soluble solids was also reported by Rizk and Rizk (1994b) on Thompson seedless grapes.

9- Total acidity

In assessing the effect of different treatments of Ca and Mg on the total acidity of juice, it is clear from Table (3) that neither Ca nor Mg treatment caused a significant influence on the total acidity compared to the control treatment. These results were true in both seasons.

According to the results obtained in this investigation, it can be concluded that spraying Flame Seedless grapevines three times (March 15th, May 1st, andJune 15th) with Mg-EDTA at 0.30% or Ca-EDTA at 0.30% was very promising in improving bunch and berry characteristics of this cultivar. The results in this respect acquire an outstanding importance from the economical point of view. Raising, the anthocyanin content of berry skin which by its turn realiges an even and good coloration of the berries will undoubtedily help in achieving higher prices of the product not only in the local but also in the foreign markets.

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تأثير الكالسيوم والماغنسيوم المعدني أو المخلبي على نمو و صفات عناقيد وحبات كرمات العنب الفليم سيدلس النامي في الأراضي الرملية

2- التأثير على صفات العناقيد والحبات

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- أجريت هذه التجربة خلال موسمي 1997 ،1998 على العنب الفليم سيدلس النامي في الأرض الرملية وكان الهدف من الدراسة اختبار تأثير الكالسيوم والماغنسيوم المعدني أو المخلبي على جودة الثمار وتضمنت معاملات التجربة رش الكالسيوم والماغنسيوم المعدني بتركيز 0,15 ، 0,30 % ورش كلوريد الكالسيوم وكبريتات الماغنسيوم بتركيز 5, ، 1 %.

- ولقد أشارت نتائج الدراسة أن رش الكالسيوم والماغنسيوم المعدني أو المخلبي كان فعالا في زيادة متوسط وزن العنقود ، أبعاد العنقود والحبة ، عدد الحبات في العنقود، وزن وصلابة الحبة ، ومحتوى القشرة من الأنثوسيانين وذلك بالمقارنة بعدم الرش. كان لمعاملات الكالسيوم والماغنسيوم تأثير طفيف على شكل الحبة ونسبة المواد الصلبة الذائبة الكلية والحموضة الكلية. وفي معظم الحالات تفوقت الصورة المخلبية للكالسيوم والماغنسيوم على الصورة المعدنية لهما في زيادة معظم الصفات تحت الدراسة.

- وكان رش الصورة المخلبية الماغنسيوم بتركيز 3,. % مفيدا في تعظيم وزن العنقود وعدد الحبات في العنقود ووزن وأبعاد الحبات ومحتوى القشرة من الأنثوسيانين وذلك بالمقارنة باستخدام الصورة المخلبية للكالسيوم. ولقد تفوقت الصورة المخلبية للكالسيوم بتركيز 3,. % عن الصورة المخلبية الماغنسيوم بتركيز 3,. % في زيادة أبعاد العنقود وصلابة الحبة.

- ولقد أمكن الحصول على أفضل النتائج بخصوص الجودة لحبات العنب الفليم سيدلس عند رش الماغنسيوم المخلبي بتركيز 3,. % أو الكالسيوم المخلبي بتركيز 3,. % ثلاث مرات خلال موسم النمو في منتصف مارس ، أول مايو ، ومنتصف يونيو.