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Effect of Foliar Applications of Iron, Zinc and Manganese on Yield, Berry Quality and Leaf Mineral Composition of Thompson Seedless and Roumy Red Grape Cultivars

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Abstract. This investigation was carried out during 1992 and 1993 growing seasons to study the effect of foliar application of chelated - iron, zinc and manganese on yield, berry quality and leaf mineral composition of Thompson seedless and Roumy red grape cultivars grown on a calcareous soil in Riyadh region. The results revealed that, in general, spraying vines of both grape cultivars with Fe, Zn and Mn before bloom, after fruit set, and/or during berry development, produced a slight increase in the yield of Thompson seedless cultivar and a significant increase in Roumy red cultivar as compared with the control. The foliar application of Fe, Zn and Mn on the yield and the berry quality was more effective and pronounced in the second season. Furthermore, spraying both grape cultivars with Fe, Zn, and Mn gave an obvious increase in the weight, size, length and diameter of the berries as compared with the control. In addition, the percentage of total soluble solids was increased in both grape cultivars, while the percentage of acidity was decreased only in Roumy red cultivar by the different foliar spray treatments. Regarding leaf analysis, data showed that spraying vines of Thompson seedless and Roumy red grape cultivars with Fe, Zn and Mn two or thee times per year caused major changes in leaf macro- and micronutrient concentrations as compared with the control. No obvious trend was found among the leaf macronutrients composition as affected by spraying vines of both cultivars with the different treatments. Whereas, leaf Fe, Zn and Mn contents were markedly increased with increasing the number of foliar applications of these elements from one up to three times per year for both grape cultivars.

Introduction

Grapes are grown successfully at different districts of Saudi Arabia. Their total production amounted to about 105,000 tons in 1992. In addition, soils of the central reg-

ion of Saudi Arabia being a part of arid and semi-arid regions, are coarse-textured, high in $CaCO_3$ content, and low in organic matter, native available Zn and Fe [1]. Likewise, Al-Mustafa [2] reported that the extractable-Mn was the lowest in Riyadh and Qassim areas as the soils were low in organic matter and high in $CaCO_3$ content. Furthermore, nutritional problems arose seriously in such soils due to high content of $CaCO_3$ and their properties which affect the fertility of these soils [3].

Although, micronutrient elements are needed in relatively very small quantities for adequate plant growth and production, their deficiencies cause a great disturbance in the physiological and metabolic processes involved in the plant [4]. Moreover, the insufficient supply of these elements to grape vines under different soil and environmental conditions is considered to be one of the most important nutritional problems [5]. Previously, Bacha and Abo Hassan [6] studied the effect of soil application of Fe-EDDHA on yield, berry quality and mineral composition of the leaves of Taefi and Des El-Anz grape cultivars grown in Riyadh.

Thus, the purpose of the present investigation was to study the effect of foliar application of chelated-iron, zinc and manganese on the yield, berry quality and leaf mineral composition of Thompson seedless and Roumy red grapes grown in Riyadh.

Materials and Methods

The present study was carried out during 1992 and 1993 growing seasons on 14-year-old vines of both Thompson seedless and Roumy red grape cultivars grown at Dirab Experimental and Research Station, College of Agriculture, King Saud University. The soil of the experimental orchard classified as sandy loam saline calcareous. Data presented in Table 1 show some properties of the soil of the experimental orchard.

Table 1. Physical and chemical properties of soil of the experimental orchard

Texture[1]	pH[2]	E.C.[3] dS/m	$CaCO_3$[4] %	Organic matter %	DTPA-extractable, ppm		
					Fe	Zn	Mn
Sandy-loam	7.5	7.15	33.80	0.25	0.38	0.29	1.37

[1]Sand: 63%, Silt: 21%, and Clay: 16%; [2]pH, 1:1 soil water ratio; [3]E.C., dS/m = dece simens/meter is equal to mmohs/cm; [4]$CaCO_3$ content was measured by the standerd HCl neutralization test.

Twenty-four grape vines, at approximately the same vigor and planted at 2.5 × 2.5 meters apart, were selected from each cultivar. All vines were cane trained, and winter pruning was done to leave the same number of buds (60 buds) on each vine. Each vine was fertilized by adding 15 kg of organic manure in January and 1 kg fertilizer mixture (18- 18- 5), 1kg potassium sulfate (48-52% K_2O) and 1kg super phosphate (18-26% P_2O_5) divided in two doses and were added in mid-March and in mid-May. Foliar spray treatments using chelated-iron [sodium ethylene diamine di-(O-hydroxy phenyl acetate), Fe- EDDHA, containing 6% Fe] at the rate of 500 ppm; zinc [disodium ethylene diamine tetra acetate dihydrate, Zn-EDTA, containing 14.2% Zn] at the rate 250 ppm, and manganese [disodium manganous ethylene, Mn-EDTA, containing 12% Mn] at the rate of 250 ppm. Tween-20 was added to the solutions as a surfactant.

A complete randomized block design with six replicates of one-vine-plot for the two cultivars were used. Each experimental vine was surrounded by guard vines on all sides. The treatments were as follows:

(1) Control (vine sprayed with water)
(2) Vines sprayed with a solution containing a combination of chelated-iron, zinc and manganese one time before blooming at mid-March.
(3) Vines sprayed with chelated-iron, zinc and manganese two times, before blooming at mid-March and after fruit set at mid-May.
(4) Vines sprayed with chelated-iron, zinc and manganese three times at mid-March, mid-May and during berry development at mid-June.

Yield was determined (as number and weight of clusters per vine) at harvest time (the first week of July) for Thompson seedless cultivar and (the last week of July) for Roumy red cultivar in both seasons. Five clusters were colleocted at random from each vine to determine the berry quality. One hundred berries were taken from each sample to determine the weight, size, length, diameter of the berry and the volume of juice. Total soluble solids were determined using a hand refractometer and the percentage of acidity (as tartaric acid) by titration with 0.1 N sodium hydroxide according to AOAC [7].

In order to determine the leaf mineral composition, leaf samples were collected from the first fully expanded mature leaves from the tip of the growing shoots, according to Childers [8]. A sample of 30 leaves was taken from each vine in the last week of June during both seasons. Leaf samples were washed several times with tap water and distilled water. Samples were air dried and then oven dried at 70°C. The dried leaves were ground and digested with hydrogen peroxide and sulfuric acid,

according to Evanhuis and DeWaard [9]. Total nitrogen was determined colorimetrically according to Evanhuis [10] and phosphorus was also determined colorimetrically by the ascorbic acid method [11]. Potassium was measured against a standard using air propane flame photometer [12]. Calcium, magnesium, iron, zinc, and manganese were measured using Perkin-Elmer atomic absorption spectrophotometer Model 2380.

Statistical analysis were performed using SAS computer package [13] with Duncan's multiple range test for means comparison [14].

Results and Discussion

Response of Thompson seedless and Roumy red grape cultivars to foliar applications of chelated-iron, zinc and manganese

1. Yield

To achieve high yield of grapes there are many factors beside nutrition that should be controlled. Thus, one must keep in mind that although mineral nutrition is a major factor, it is certainly not the only factor to be considered in good viticulture and high vine productivity.

Data of the first season presented in Table 2 show that the foliar application of Fe, Zn, and Mn did not affect the number, weight of clusters or the yield per vine for the two grape cultivars. Whereas, in the second season, spraying Thompson seedless grape vine with the experimental solution before bloom, significantly increased the number of clusters per vine as compared with the control. Also, spraying Thompson seedless vines three times a year caused a significant increase in the weight of clusters as compared with the control. However, the yield of Thompson seedless grape vines was slightly affected by the different treatments. Concerning Roumy red cultivar, data of the second season listed in Table 2 revealed that spraying vines with all treatments significantly increased the number of clusters and the yield per vine as compared with the control. Whereas, spraying vines three times a year caused a significant increase in the weight of clusters as compared with the control.

In general, the foliar application of chelated- Fe, Zn, and Mn to Thompson seedless and Roumy red cultivars was more effective and pronounced on the yield only in the second season. In addition, spraying vines of both cultivars with all treatments gave a slight increase in Thompson seedless yield, but significantly increased the Roumy red yield as compared with the control. The present results might support

Table 2. Effect of foliar application of Chelated-iron, zinc and manganese on the yield of Thompson seedless and Roumy red grape cultivars in 1992 and 1993 seasons

Treatments	Thompson seedless			Roumy red		
	Number of clusters per vine	Cluster weight (g)	Yield per vine (kg)	Number of clusters per vine	Cluster weight (g)	Yield per vine (kg)
			1992			
Control	23.00 a	175.72 a	3.890 a	19.17 a	167.17 a	3.260 a
Foliar spray (one time)	23.27 a	204.47 a	4.758 a	20.33 a	194.33 a	3.975 a
Foliar spray (two times)	23.50 a	181.77 a	4.257 a	17.83 a	189.50 a	3.400 a
Foliar spray (three times)	22.83 a	223.92 a	4.943 a	19.83 a	186.17a	3.655 a
			1993			
Control	11.00 b	210.67 b	2.245 a	9.83 b	182.83 b	1.822 b
Foliar spray (one time)	16.17 a	232.17 ab	3.755 a	17.00 a	229.00 ab	3.852 a
Foliar spray (two times)	13.00 ab	241.50 ab	3.257 a	17.33 a	225.33 ab	3.857 a
Foliar spray (three times)	13.67 ab	277.50 a	3.835 a	16.50 a	244.50a	4.005 a

Means not sharing the same letter within columns are significantly different ($P < 0.05$), Duncan's multiple range test.

the notion that chelating agents can often increase the yield independently of supplying deficient micronutrients. A more favorable micronutrient balance is one possible explanation.

These findings are partially in agreement with those obtained by El-Gazzar *et al*, [5], Mitovic [15], Kesheva [16] Valenzuela and Reyes [17] and Christensen [18]. Although these investigators worked under different soils and climate conditions, they found that spraying grape vines with Fe, Zn, and Mn, individually or in different combinations, markedly increased the grape yield.

2. Berry quality

a) Physical properties of the berry

Data listed in Table 3 showed that, in the first season, spraying Thompson seedless grape vines with the different treatments did not affect weight, size, or juice volume of berries as compared with the control. Meanwhile, spraying grape vines with chelated- Fe, Zn, and Mn two or three times per year, significantly increased berry diameter as compared with the control. Whereas, in the second season, spraying

Table 3. Effect of foliar application of chelated-iron, zinc and manganese on the physical properties of the berries of Thompson seedless and Roumy red grape cultivars in 1992 and 1993 seasons

Treatments	Thompson seedless					Roumy red				
	Weight of 100 berries (g)	Size of 100 berries (ml)	Juice volume of 100 berries (ml)	Berry length (cm)	Berry diameter (cm)	Weight of 100 berries (g)	Size of 100 berries (ml)	Juice vol. of 100 berries (ml)	Berry length (cm)	Berry diameter (cm)
1992										
Control	131.5 a	123.7 a	66.3 a	1.50 b	1.13 b	376.0 a	354.2 a	127.7 b	1.92 c	1.67 b
Foliar spray (one time)	139.2 a	129.8 a	73.8 a	1.60 ab	1.17 a	390.5 a	373.3 a	140.3 ab	2.10 b	1.72 b
Foliar spray (two times)	139.0 a	129.2 a	68.8 a	1.66 a	1.16 ab	383.3 a	385.0 a	148.0 a	2.07 b	1.70 b
Foliar spray (three times)	140.5 a	130.3 a	71.5 a	1.68 a	1.17 a	383.7 a	367.5 a	143.7 ab	2.30 a	1.88 a
1993										
Control	150.5 b	145.0 b	59.3 a	1.48 b	1.22 b	367.5 b	365.0 b	130.0 b	2.107 b	1.77 b
Foliar spray (one time)	157.0 b	153.3 b	59.8 a	1.69 a	1.35 a	438.3 ab	440.0 ab	150.8 a	2.25 ab	1.90 ab
Foliar spray (two times)	172.7 a	166.7 a	60.8 a	1.79 a	1.39 a	492.5 a	493.3 a	148.3 ab	2.37 a	1.93 ab
Foliar spray (three times)	171.0 a	165.8 a	62.0 a	1.79 a	1.39 a	459.2 a	456.7 a	153.3 a	2.35 a	2.08 a

Means not sharing the same letter within columns are significantly different ($P < 0.05$), Duncan's multiple range test.

grape vines two or three times per year, significantly increased weight and size of berries as compared with the control. Also, spraying vines with all treatments produced significant increase in berry length and diameter as compared with the control. However, juice volume of berries was unaffected by the different treatments.

Regarding Roumy red cultivar, data in Table 3 showed that weight and size of berries were unaffected by the different treatments, in the first season. Whereas, in the second season, spraying vines two or three times per year caused a significant increase in both weight and size of berries comparing to the control. It was also noticed that spraying vines two times per year, in the first season, and one or three times, in the second season, gave significant increase in juice volume of berries comparing to the control. Data also showed that spraying vines with all treatments in the first season, and three times per year, in the second season, gave a significant increase in the berry length and diameter as compared with the control.

Generally, spraying Thompson seedless and Roumy red grape cultivars two and three times per year caused an obvious increase in the weight, size, length and diameter of the berries, especially in the second season as compared with the control. These results were somewhat in agreement with those obtained by Iannini [19] and Rana and Sharma [20].

b) Chemical properties of the berry

No significant differences in T.S.S. were found between the different treatments in the first season among both grape cultivars. Whereas, in the second season spraying Thompson seedless cultivar with all treatments and spraying Roumy red cultivar three times gave a significant increase in T.S.S. comparing to the control (Table 4).

Data showed that spraying Thompson seedless cultivar two or three times per year in the first season, gave a significant increase in the percentage of acidity comparing to the control. However, no significant difference was found between the different treatments in the second season. On the other hand, spraying Roumy red cultivar did not affect the berry acidity in the first season, but in the second season, there was a significant decrease in the berry acidity as compared with those of the control and vines sprayed one time per year (Table 4).

These results were somewhat in line with those obtained by Musamukhamedove [21], Kumar and Bhushan [22], Valenzuela and Reyes [17] and Alekperov [23]. They found that spraying grape vines with Fe, Zn, and Mn either alone or in various combinations enhanced berry T.S.S. content and decreased juice acidity.

Table 4. Effect of foliar application of Chelated-iron, zinc and manganese on the chemical properties of the berries of Thompson seedless and Roumy red grape cultivars in 1992 and 1993 seasons

Treatments	Thompson seedless		Roumy red	
	Total soluble solids %	Acidity solids %	Total soluble %	Acdity %
	1992			
Control	22.0 a	1.107 a	21.5 a	0.408 a
Foliar spray (one time)	23.1 a	1.178 ab	22.4 a	0.395 a
Foliar spray (two times)	22.1 a	1.302 a	22.5 a	0.391 a
Foliar spray (three times)	22.2 a	1.285 a	22.5 a	0.371 a
	1993			
Control	21.8 b	0.950 a	19.3 b	0.445 a
Foliar spray (one time)	23.1 a	0.953 a	20.0 ab	0.449 a
Foliar spray (two times)	23.2 a	0.950 a	20.3 ab	0.449 ab
Foliar spray (three times)	23.2 a	0.973 a	21.2 a	0.365 b

Means not sharing the same letter within columns are significantly different ($P < 0.05$), Duncan's multiple range test.

3. Leaf mineral composition

(a) Macronutrients

Data listed in Table 5 showed that spraying Thompson seedless grape vines with chelated- Fe, Zn, and Mn did not affect leaf nitrogen content, in the first season, but in the second season, all treatments gave a significant increase in leaf nitrogen content than the control. Leaf phosphorus content was decreased in vines sprayed one or three times per year, in the first season, or three times, in the second season. Leaf potassium content was increased, in the first season, in vines sprayed two times per year as compared with the control and that sprayed three times per year. While, in the second season, there were no significant differences between the treatments. Data also showed that leaf calcium and magnesium were unaffected by the different treatments.

Concerning Roumy red cultivar, data presented in Table 6 showed that leaf nitrogen and potassium contents were unaffected by the different treatments, in both seasons. Leaf phosphorus content was markedly increased only in the first season by spraying vines three times per year as compared with the control. Leaf calcium and magnesium contents were significantly decreased, only in the second season, in vines

Table 5. Effect of foliar application of Chelated-iron, zinc and manganese on the leaf mineral composition of Thompson seedless grape vines in 1992 and 1993 seasons

Treatments	% on dry weight basis					ppm on dry weight basis		
	N	P	K	Ca	Mg	Fe	Zn	Mn
			1992					
Control	2.52 a	0.23 a	0.89 b	3.61 a	0.57 a	93.83 b	35.67 b	92.67 b
Foliar spray (one time)	2.39 a	0.17 b	0.93 ab	4.06 a	0.58 a	102.17 b	55.83 ab	95.83 b
Foliar spray (two times)	2.41 a	0.19 ab	1.02 a	4.28 a	0.58 a	139.00 a	53.17 ab	125.33 a
Foliar spray (three times)	2.46 a	0.14 b	0.88 b	3.72 a	0.50 a	150.17 a	62.67 a	130.83 a
			1993					
Control	2.27 b	0.21 ab	0.69 a	3.52 a	0.74 a	111.67 b	19.17 c	77.17 c
Foliar spray (one time)	3.09 a	0.24 a	0.74 a	4.54 a	0.79 a	148.67 ab	35.00 b	122.50 b
Foliar spray (two times)	3.34 a	0.23 a	0.77 a	4.72 a	0.76 a	155.50 a	45.67 b	157.83 ab
Foliar spray (three times)	2.84 a	0.19 b	0.65 a	4.36 a	0.82 a	158.17 a	72.67 a	180.50 a

Means not sharing the same letter within columns are significantly different ($P < 0.05$), Duncan's multiple range test.

Table 6. Effect of foliar application of Chelated-iron, zinc and manganese on the leaf mineral composition of Roumy red grape vines in 1992 and 1993 seasons

Treatments	% on dry weight basis					ppm on dry weight basis		
	N	P	K	Ca	Mg	Fe	Zn	Mn
			1992					
Control	2.09 a	0.15 b	0.99 a	4.14 a	0.52 a	128.50 b	10.83 c	92.67 b
Foliar spray (one time)	2.34 a	0.17 ab	0.91 a	4.28 a	0.52 a	136.50 b	12.17 c	96.33 b
Foliar spray (two times)	2.23 a	0.17 ab	0.98 a	4.56 a	0.54 ab	184.83 a	22.83 b	106.67 ab
Foliar spray (three times)	2.14 a	0.18 a	1.00 a	4.31 a	0.53 a	179.67 a	27.67 a	112.00 a
			1993					
Control	2.61 a	0.19 a	0.73 a	5.11 a	0.84 a	117.50 b	25.00 c	92.17 b
Foliar spray (one time)	2.79 a	0.21 a	0.93 a	4.71 ab	0.78 ab	138.67 ab	40.17 b	105.50 ab
Foliar spray (two times)	2.70 a	0.18 a	0.86 a	4.06 b	0.62 b	139.83 ab	40.00 b	116.17 a
Foliar spray (three times)	2.82 a	0.18 a	0.89 a	4.38 ab	0.75 ab	150.33 a	55.00 a	125.83 a

Means not sharing the same letter within columns are significantly different ($P < 0.05$), Duncan's multiple range test.

sprayed two times per year compared to the control. No other significant differences were found between the different treatments.

In general, spraying both grape cultivars with chelated- Fe, Zn and Mn caused major changes in leaf macronutrient contents as compared with the control. However, no obvious trend was found among the leaf macronutrients composition as affected by the different treatments. These results are, partially, in line with those obtained by Movchan and Sobornikova [24] who found that zinc foliar spray in Riesling grape vine increased leaf P and Ca contents and slightly decreased N content.

(b) Micronutrients

Data presented in Table 5 showed that spraying Thompson seedless grape vines with Fe, Zn, and Mn two or three times per year gave a significant increase in leaf iron content as compared with the control, in both seasons. Also leaf zinc content was markedly increased in vines sprayed three times per year, in the first season, and in all treatments, in the second season compared to the control. Whereas, spraying vines two or three times, in the first season and in all treatments in the second season, significantly increased leaf manganese content compared to the control.

Concerning Roumy red grape cultivar, data listed in Table 6 revealed that spraying vines two or three times per year, in the first season, and three times, in the second season, gave a highly significant increase in leaf iron content as compared with the control. Similarly, leaf zinc content increased significantly in vines sprayed two or three times, in the first season, and in all treatments, in the second season compared to the control. Data also showed that spraying vines one time, in the first season, or three times per year, in the second season, produced a significant increase in leaf manganese content as compared with the control.

Generally, leaf Fe, Zn and Mn contents were markedly increased with increasing the number of spraying both grape cultivars with these elements. The results of this investigation are in agreement with those reported by El-Gazzar *et al.* [5], Christensen [18], Aggarwal *et al.* [25] and Fregoni *et al.* [26]. They found that spraying grape vines with Fe, Zn and Mn caused high values for each element when it was applied alone or in different mixtures.

Data of the soil analysis listed in Table 1 revealed that the soil of the experimental orchard contained high percentage of $CaCO_3$ and low organic matter. Also, the soil contained low extractable - Fe and Zn, according to the values obtained by Lindsay and Norvell [27]. In addition, analysis of the leaves of both grape cultivars for the two growing seasons listed in Tables 5 and 6 showed that leaf iron, zinc, and

manganese contents in the control vines of Thompson seedless grape ranged from 94 to 112, 19 to 36, and 77 to 93 ppm, respectively. Whereas, these elements in Roumy red cultivar ranged from 118 to 129, 11 to 25 and 92 to 93 ppm, respectively. It seems from the values of these elements obtained by Childers [8] and Bennett [28] on grapes, that the leaf iron and manganese contents were at the optimal levels. Whereas, leaf zinc concentration was at the slight deficiency level. These results showed that since iron, zinc and manganese foliar sprays markedly increased the concentrations of these elements in the leaves of the sprayed vines, it may be suggested that, for correction iron, zinc and/or manganese deficiences, chelated- iron, zinc and manganese either alone or in a mixture, could be applied to the foliage in concentrations similar to these used in the present investigation.

Conclusion

Recommendations for the application of micronutrients are based primarily on the correction of deficiency symptoms and insurance of vigorous growth of the grape vine cultivars. It was found from the present study that spraying Thompson seedless and Roumy red grape vines with chelated- Fe, Zn, and Mn caused a slight increase in Thompson seedless grape yield, but significantly increased the yield in Roumy red cultivar. In addition, the foliar spray treatments had beneficial effects on most of the berry quality of both cultivars. Also, increasing the number of foliar spray applications of Fe, Zn and Mn up to three times, markedly increased the concentrations of these elements in the leaves of both grape cultivars comparing to the control.

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تأثير الرش بالحديد والزنك والمنجنيز على المحصول وجودة الثمار والمحتوى المعدني للأوراق في العنب البناتي والرومي الأحمر النامية في منطقة الرياض

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ملخص البحث. أجرى هذا البحث خلال عامي ١٩٩٢م و ١٩٩٣م بغرض دراسة تأثير الرش بالحديد والزنك والمنجنيز في صورة مخلبية على المحصول وصفات الثمار والمحتوى المعدني للأوراق في صنفي البناتي والرومي الأحمر والنامية في محطة الأبحاث والتجارب الزراعية بمزرعة كلية الزراعة، جامعة الملك سعود بالرياض.

وقد أظهرت النتائج بوجه عام أن رش شجيرات العنب في كلا الصنفين بالحديد والزنك والمنجنيز قبل تفتح البراعم، وبعد عقد الثمار و / أو خلال فترة نمو الحبات قد أدى إلى زياد بسيطة في محصول العنب البناتي وإلى زيادة مؤكدة في محصول العنب الرومي الأحمر وذلك بمقارنتها بالكنترول. وقد كان تأثير الرش على المحصول أوضح خلال الموسم الثاني. وبالإضافة إلى ذلك فإن رش شجيرات كلا الصنفين بالحديد والزنك والمنجنيز قد أعطى زيادة في وزن وحجم وطول وعرض الحبيبات بمقارنتها الكنترول. كما زادت النسبة المئوية للمواد الصلبة الكلية في كلا الصنفين. بينما نقصت النسبة المئوية للحموضة في العنب الرومي الأحمر فقط نتيجة لمعاملات الرش المختلفة.

وفيما يختص بتحليل الأوراق، فقد أظهرت النتائج أن رش شجيرات العنب البناتي والرومي الأحمر بالحديد والزنك والمنجنيز عدة مرات خلال الموسم قد تسبب في تغيرات واضحة في محتوى الأوراق من العناصر المعدنية الصغرى والكبرى. ولم توجد اتجاهات واضحة في محتوى الأوراق من العناصر الكبرى كنتيجة لتأثرها بمعاملات الرش المختلفة. وبالإضافة إلى ذلك، فإن محتوى الأوراق من عناصر الحديد والزنك والمنجنيز قد زادت زيادة واضحة بزيادة عدد مرات الرش بهذه العناصر خلال الموسم في كلا الصنفين.