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RELATION OF GROWTH AND FRUITING IN RED ROOMY GRAPEVINES TO SPRAYING OF ASCORBIC AND CITRIC ACIDS

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ABSTRACT

Two antioxidants namely citric and ascorbic acids were sprayed four times at 0.0, 250, 500, 1000 and 2000 ppm. during 2006 and 2007 seasons, The study focused on testing the effect of antioxidants on growth, yield, physical and chemical characters of Red Roomy grapevines.

Results showed that application of citric acid considerably surpassed ascorbic acid in enhancing growth, yield and quality of the berries. A gradual promotion was observed on leaf area, main shoots length, berry setting yield as well as physical and chemical characters of the berries with increasing the concentrations of the two antioxidants from 0.0 to 2000 ppm. Meaningless stimulation was detected among the two higher concentrations namely 1000 and 2000 ppm.

The best results with regard to yield and fruit quality of Red Roomy grapevines were obtained when the vines were treated four times with citric acid at 1000 ppm.

INTRODUCTION

Minia is the leading governorate in plantation and production of Red Roomy grape *cv*,. It is dominant and popular grape *cv*, planted in this region. Fruiting area and total production of this cv reached 16200 feddans and 11500 ton fruits, respectively (2008 Agricultural Statistics). The phenomenon of cluster looseness is suggested to be one of the main and major problem that facing the production and marketing of this *cv*. Many attempt were mad to solve low berry setting in this grapevine *cv* and out of those was the application of citric and ascorbic acids as antioxidants.

Antioxidants namely vitamins, organic acids and amino acids may play a definite role in enhancing growth and nutritional status of the trees through protecting the plant cells from senescence and death, preventing the free radicals (active oxygen species, singlet oxygen, superoxide anion, hydrogen peroxide, hydroxyl radicals and ozone) from the oxidation of lipids, the components of plasma membrane which is accompanied with the loss of permeability as well as their effect in enhancing cell division and building of organic acids and controlling the incidence of fungi (Prusky, 1980 ; Raskin, 1992 and Elade, 1992).

Previous studies emphasized the beneficial effect of antioxidants on improving growth, vine nutritional status, yield as well as physical and chemical characters of the berries in various grapevine *cvs* (Ahmed *et al*., 1997; Khiamy, 1999; Ali, 2000; El-Sayed *et al.,* 2000; Mansour *et al.,* 2000; Numair-Safaa 2001; Ahmed *et al.,*, 2002; Shoeib and El-Sayed, 2003; Ahmed and Abd El-Hameed, 2004; Mohran, 2005; Nashed, 2006; Ibrahim-Asmaa, 2006; Ahmed and Seleem-Basma, 2008; Abd El-Kariem, 2008 and El-Sawy, 2009).

The objective of this study was to elucidate the effects of citric and ascorbic acids at different concentrations on some growth aspects i.e., yield and quality of Red Roomy grapes. Selecting the best antioxidant and concentration that will be effective in producing an economical yield is another target.

MATERIALS AND METHODS

This investigation was carried out during 2005/2006 and 2006/2007 seasons on thirty uniform in vigour 10 years old and head trained Red Roomy grapevines. The selected vines were grown in a private vineyard located at Samalout district, Minia Governorate where the soil is clay. Planting space was 2 x 2 m. The selected vines were pruned at the middle of January in both seasons to leave vine bud load reached 72 eyes per vine (on the basis of 20 fruiting spurs X three eyes plus six replacement spurs X two eyes). Surface irrigation system was followed.

The experiment included ten treatments from two factors. The first factor (A) consisted from two antioxidants namely citric and ascorbic acids. The five concentrations of each antioxidant namely 0.0, 250, 500, 1000 and 2000 ppm, ranked the second factor (B). The two antioxidants were sprayed four times during each season on the growth starting on the 1^{st} week of April, just before bloom on the 1^{st} week of May, just after berry setting on the 2^{nd} week of June and at one month later (2^{nd} week of July). Triton B as a wetting agent was mixed with all antioxidant solutions before application at 0.05% and spraying was carried out till runoff. Control vines (0.0 ppm) were sprayed with water containing Triton B.

Complete randomized block design, in split-plot arrangement was followed. The two antioxidants and five concentrations of each occupied the main and sub-plots, respectively.

All the selected vines received the common horticultural practices which are usually used in the vineyard except antioxidant treatments.

The following measurements were made during both seasons:

1- Vegetative growth parameters namely main shoot length (cm) and leaf area (cm^2) were measured at the last week of July. Leaf area for the leaves opposite to the basal clusters was calculated according to the equation reported by Ahmed and Morsy (1999).
2- Berry set % was estimated by dividing number of berries/cluster by the total number of flowers/cluster (attached berries + dropped berries + dropped flowers) and multiplying the product by 100.
3- Yield per vine expressed as weight (kg) and number of clusters per vine was recorded at harvesting date (middle of September) then the average cluster weight (g) and dimensions (length and shoulder in cm) were recorded.
4- Five clusters were taken at random from the yield of each vine for the determination of berry weight (g), berry shape (longitudinal/equatorial), total soluble solids %, total sugars % and total acidity % (as g of tartaric acid/100 ml juice), according to A.O.A.C. (1985), TSS/acidity was also estimated.

Statistical analysis was according to Snedecor and Cochran (1972) using new L.S.D parameter at 5%.

RESULTS AND DISCUSSIONS

Leaf area and main shoot length:

It is clear from the data in Table 1 that application of citric acid was superior to ascorbic acid in stimulating growth characters namely leaf area and main shoot length in both growing seasons.

Foliar application of antioxidants at 250 to 2000 ppm significantly stimulated the two growth characters compared with the control. The promotion was in proportional to the increase in concentrations. Increasing concentrations from 1000 to 2000 ppm had no significant stimulation on such two traits. The maximum and minimum values were detected on the vines sprayed with 2000 and 0.0 ppm antioxidants, respectively, in both seasons.

Table 1: Effect of different concentrations of ascorbic and citric acids on leaf area (cm^2) and main shoot length (cm) of Red Roomy grapevines during 2006 and 2007 seasons

Concentrations (B) ppm	Leaf area (cm^2)					
	2006			2007		
	The two antioxidants (A)					
	a_1 Ascorbic	a_2 Citric	Mean (B)	a_1 Ascorbic	a_2 Citric	Mean (B)
b_1 0.0	120.0	120.5	120.25	119.0	119.5	119.25
b_2 250	124.0	129.0	126.5	125.3	134.2	129.75
b_3 500	128.2	134.0	131.1	130.7	138.5	134.6
b_4 1000	131.0	140.0	135.5	141.6	144.6	143.10
b_5 2000	131.5	140.6	136.05	142.0	144.97	143.48
Mean (A)	126.94	132.82		131.72	136.35	
New L.S.D. 5%	*A* *1.54*	*B* *1.69*	*AB* *2.39*	*A* *0.70*	*B* *0.91*	*AB* *1.29*
	Shoot length (cm)					
b_1 0.0 ppm	55.0	55.3	55.2	57.5	58.0	57.8
b_2 250 ppm	64.3	79.0	71.7	66.0	79.0	72.5
b_3 500 ppm	74.0	89.0	81.5	77.0	89.0	83.0
b_4 1000 ppm	82.0	95.0	88.5	84.0	97.5	90.8
b_5 2000 ppm	83.0	95.5	89.3	85.0	98.0	91.5
Mean (A)	71.7	82.8		73.9	84.3	
New L.S.D. 5%	*A* *0.3*	*B* *0.2*	*AB* *0.3*	*A* *1.0*	*B* *0.5*	*AB* *0.7*

The studied interaction (types and concentrations of antioxidants) had significant effect on such growth traits. The maximum values were recorded on vines sprayed four times with citric acid at 2000 ppm. The untreated vines gave the minimum values. This was observed during both experimental seasons.

The stimulating effect of antioxidant on growth characters could be attributed to their positive effects on cell divisions and the biosyntheses of natural hormones and organic foods (Raskin, 1992).

The present results are in harmony with those obtained by Ahmed *et al.,* (1997), Khiamy (1999) and Ibrahim-Asmaa (2006) on Red Roomy grapevines.

Berry setting percentage, Yield and cluster characters:

Data in Table 2 reveal that, berry setting %, yield expressed in weight and number of clusters/vine as well as cluster weight and dimensions (length and shoulder) improved significantly to the application of citric acid compared to ascorbic acid. However, the type of antioxidants had no significant effect on number of clusters in the first season of study. These results were true in both seasons.

A gradual promotion was observed in berry setting %, yield and cluster weight and dimensions with increasing concentrations of antioxidants from 0.0 to 2000 ppm. Significant differences were observed on these parameters with varying concentrations except among the two higher concentrations namely 1000 and 2000 ppm. Therefore, the recommended concentration was 1000 ppm from the economical point of view.

The maximum and economical yield was obtained on vines that received four sprays of citric acid at 1000 ppm. Under this promising treatment, yield per vine reached 8.8 and 13.4 kg compared with 5.9 and 5.9 kg produced by the untreated vines in both seasons, respectively. This means that the percentage of increase due application of the previous promised treatment over the check treatment reached 49.2 and 127.1% in both seasons, respectively.

These results might be attributed to the promotive effects of antioxidants on growth, vine nutritional status and berry setting. Similar results were reported by Numair-Safaa (2001), Ahmed and Abd El-Hameed (2004), Shoeib and El-Sayed (2003) and Mahran (2005).

Physical and chemical characters of the berries:

Application of citric acid was significantly preferable than ascorbic acid in improving physical and chemical characters of the berries in terms of increasing berry weight, total soluble solids total sugars and T.S.S/acid and in reducing total acidity (Table 4). However, total acidity was unsignificantly varied among the two antioxidants. These results were true in the two investigated seasons.

The same table show a gradual promotion on quality of berries with the increase in concentrations of both antioxidants without significant stimulation among higher concentrations namely 1000 and 2000 ppm. This demonstrates the essential of using 1000 ppm concentration instead of 2000 ppm from each compound.

The best results were obtained on the vines that received four sprays of citric acid at 1000 ppm. It is worth to mention that application of citric and ascorbic acids at 250 to 2000 ppm produced roundish berries as compared with non-application. Citric acid was superior to ascorbic acid in this connection.

The more roundish berries were produced with increasing concentrations. Similar trend was observed in 2006 and 2007 seasons. These results might be attributed to the positive action of antioxidants on translocation and biosynthesis of sugars which was reflected on advancing maturity stage.

These results are in accordance with those obtained by Ahmed and Seleem-Basma (2008), Abd El-Kariem (2008) and El-Sawy (2009).

Table 2: Effect of different concentrations of ascorbic and citric acids on berries set %, number of clusters/vine, cluster weight (gm) and yield/vine (kg) of Red Roomy grapevines during 2006 and 2007 seasons.

Concentrations (B) ppm	Berry set %					
	2006			2007		
	The two antioxidants (A)					
	a_1 Ascorbic	a_2 Citric	Mean (B)	a_1 Ascorbic	a_2 Citric	Mean (B)
b_1 0.0	6.60	6.70	6.65	6.90	7.00	6.95
b_2 250	7.50	9.00	8.25	7.60	8.60	8.10
b_3 500	9.97	11.50	9.73	9.00	9.97	9.48
b_4 1000	9.50	11.60	10.55	9.93	10.97	10.45
b_5 2000	9.70	11.70	10.70	10.00	11.00	10.50
Mean (A)	8.45	9.90		8.69	9.51	
New L.S.D. 5%	*A 0.69*	*B 0.295*	*AB 0.417*	*A 0.520*	*B 0.743*	*AB NS*
Number of clusters/vine						
b_1 0.0 ppm	19.00	19.00	19.00	19.00	20.00	19.50
b_2 250 ppm	20.00	21.00	20.50	24.33	25.00	24.67
b_3 500 ppm	20.93	21.00	20.97	27.00	28.00	27.50
b_4 1000 ppm	20.00	21.00	20.5	29.00	31.00	30.00
b_5 2000 ppm	20.00	21.00	20.5	29.00	31.00	30.00
Mean (A)	19.99	20.60		25.67	27.00	
New L.S.D. 5%	*A 0.424*	*B 1.071*	*AB NS*	*A NS*	*B 0.914*	*AB NS*
Yield/vine (kg)						
b_1 0.0 ppm	5.92	5.94	5.93	5.93	5.93	5.93
b_2 250 ppm	7.00	7.80	7.40	8.91	9.54	9.23
b_3 500 ppm	7.95	8.79	8.37	10.46	11.88	11.17
b_4 1000 ppm	8.21	8.80	8.51	12.77	13.35	13.06
b_5 2000 ppm	8.30	8.82	8.56	9.05	13.27	11.16
Mean (A)	7.48	8.03		9.42	10.80	
New L.S.D. 5%	*A 0.21*	*B 0.51*	*AB NS*	*A 0.398*	*B 0.466*	*AB 0.659*
Cluster weight(g)						
b_1 0.0 ppm	311.50	312.70	312.10	312.00	312.00	312.00
b_2 250 ppm	350.0	390.00	370.00	366.00	392.00	379.00
b_3 500 ppm	380.00	420.00	400.00	387.30	440.00	413.70
b_4 1000 ppm	410.00	440.00	425.00	440.00	460.00	450.00
b_5 2000 ppm	415.00	441.00	428.00	441.00	461.00	451.00
Mean (A)	373.30	400.7		389.30	413.00	
New L.S.D. 5%	*A 11.35*	*B 7.00*	*AB 9.91*	*A 10.94*	*B 7.57*	*AB 10.70*

Table 3: Effect of different concentrations of ascorbic and citric acids on cluster length and shoulder (cm), berry weight (gm) and berry shape of Red Roomy grapevines during 2006 and 2007 seasons.

Concentrations (B) ppm	Cluster length (cm)					
	2006			2007		
	The two antioxidants (A)					
	a_1 Ascorbic	a_2 Citric	Mean (B)	a_1 Ascorbic	a_2 Citric	Mean (B)
b_1 0.0	14.0	14.2	14.1	14.5	14.6	14.6
b_2 250	16.5	18.97	17.7	18.6	20.5	19.6
b_3 500	18.6	20.0	19.3	20.0	24.0	22.0
b_4 1000	20.0	21.97	21.0	22.2	26.0	24.1
b_5 2000	20.3	22.0	21.2	22.5	26.3	24.4
Mean (A)	17.88	19.43		19.56	22.3	
New L.S.D. 5%	*A 0.643*	*B 0.222*	*AB 0.314*	*A 0.07*	*B 0.314*	*AB 0.445*
Cluster shoulder (cm)						
b_1 0.0 ppm	10.0	10.0	10.0	10.1	10.2	10.2
b_2 250 ppm	12.0	14.0	13.0	12.2	14.5	13.4
b_3 500 ppm	14.0	16.0	14.9	14.0	17.0	15.5
b_4 1000 ppm	14.5	18.9	16.7	14.7	19.2	16.9
b_5 2000 ppm	14.6	19.2	16.9	14.8	19.5	17.2
Mean (A)	13.01	15.63		13.16	16.08	
New L.S.D. 5%	*A 0.569*	*B 0.371*	*AB 0.525*	*A 0.130*	*B 0.222*	*AB 0.314*
Berry weight (gm)						
b_1 0.0 ppm	4.90	4.92	4.91	5.00	5.00	5.00
b_2 250 ppm	5.41	5.71	5.56	5.44	5.82	5.63
b_3 500 ppm	5.80	5.90	5.85	5.84	6.00	5.92
b_4 1000 ppm	6.00	6.11	6.06	6.11	6.22	6.17
b_5 2000 ppm	6.03	6.12	6.08	6.12	6.24	6.18
Mean (A)	5.63	5.75		5.70	5.86	
New L.S.D. 5%	*A 0.085*	*B 0.055*	*AB 0.077*	*A 0.049*	*B 0.039*	*AB 0.055*
Berry shape						
b_1 0.0 ppm	1.19	1.20	1.195	1.22	1.23	1.23
b_2 250 ppm	1.15	1.10	1.125	1.15	1.10	1.13
b_3 500 ppm	1.11	1.08	1.095	1.11	1.07	1.09
b_4 1000 ppm	1.09	1.06	1.075	1.08	1.05	1.07
b_5 2000 ppm	1.08	1.05	1.065	1.07	1.05	1.06
Mean (A)	1.12	1.10		1.13	1.10	
New L.S.D. 5%	*A 0.02*	*B 0.02*	*AB 0.03*	*A 0.03*	*B 0.02*	*AB 0.03*

Table 4: Effect of different concentrations of ascorbic and citric acids on percentage of TSS, total acidity and TSS/acidity of Red Roomy grapevines during 2006 and 2007 seasons.

Concentrations (B) ppm	TSS %					
	2006			2007		
	The two antioxidants (A)					
	a_1 Ascorbic	a_2 Citric	Mean (B)	a_1 Ascorbic	a_2 Citric	Mean (B)
b_1 0.0	17.1	17.2	17.2	17.2	17.2	17.2
b_2 250	17.5	17.8	17.7	17.7	19.5	18.6
b_3 500	18.4	18.6	18.5	18.97	20.0	19.5
b_4 1000	19.2	19.6	19.4	19.5	21.5	20.5
b_5 2000	19.3	19.7	19.5	19.4	21.6	20.5
Mean (A)	18.30	18.58		18.6	19.96	
New L.S.D. 5%	*A* *0.156*	*B* *0.431*	*AB* *NS*	*A* *0.049*	*B* *0.411*	*AB* *0.582*
Total acidity %						
b_1 0.0 ppm	0.682	0.685	0.683	0.682	0.680	0.681
b_2 250 ppm	0.670	0.650	0.660	0.661	0.625	0.643
b_3 500 ppm	0.630	0.636	0.633	0.640	0.604	0.622
b_4 1000 ppm	0.610	0.606	0.608	0.620	0.590	0.605
b_5 2000 ppm	0.603	0.600	0.602	0.618	0.586	0.602
Mean (A)	0.639	0.635		0.644	0.617	
New L.S.D. 5%	*A* *NS*	*B* *0.018*	*AB* *0.026*	*A* *NS*	*B* *0.019*	*AB* *0.027*
TSS/total acidity						
b_1 0.0 ppm	25.08	25.10	25.09	25.22	25.30	25.26
b_2 250 ppm	26.38	27.38	26.88	26.78	31.18	28.98
b_3 500 ppm	29.22	29.25	29.23	29.64	33.16	31.40
b_4 1000 ppm	31.48	32.36	31.92	31.98	36.16	34.07
b_5 2000 ppm	32.13	32.83	32.48	31.45	36.86	34.16
Mean (A)	28.90	29.39		29.02	32.53	
New L.S.D. 5%	*A* *0.473*	*B* *0.784*	*AB* *NS*	*A* *1.061*	*B* *1.019*	*AB* *1.441*

In conclusion, using four sprays of citric acid at 1000 ppm is recommended for obtaining an economical yield and improving quality of Red Roomy grapes.

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علاقة النمو والأثمار في كرمات العنب الرومي الأحمر برش حامض الستريك والأسكوربيك

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خلال موسمي ٢٠٠٥/٢٠٠٦ و ٢٠٠٦/٢٠٠٧ تم رش مادتين من المواد المضادة للأكسدة هما حامض الستريك وحامض الأسكوربيك أربعة مرات بتركيزات صفر، ٢٥٠، ٥٠٠، ١٠٠٠، ٢٠٠٠ جزء في المليون. وقد تركزت الدراسة علي أختبار تأثيرات هاتين المادتين علي النمو وكمية المحصول وكذلك الخصائص الطبيعية والكيميائية لحبات العنب الرومي الأحمر.

أشارت نتائج الدراسة الي تفوق أستخدام حامض الستريك عن أستخدام حامض الأسكوربيك في تحسين النمو وكمية المحصول وخصائص الجودة للحبات. وكان هناك تحسن تدريجي في مساحة الورقة وطول النمو الرئيسي والنسبة المئوية لعقد الحبات وكمية المحصول والخصائص الطبيعية والكيميائية للحبات. نتيجة لزيادة التركيز المستخدم من هاتين المادتين من صفر الي ٢٠٠٠ جزء في المليون ولم يكن هناك فرق ملموس علي هذه الصفات عند رفع التركيز المستخدم من هاتين المادتين من ١٠٠٠ الي ٢٠٠٠ جزء في المليون.

أمكن الحصول علي أفضل النتائج بخصوص كمية المحصول وخصائص الجودة لحبات العنب الرومي الأحمر عند رش الكرمات أربعة مرات بحامض الستريك بتركيز ١٠٠٠ جزء في المليون.