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TRIALS FOR IMPROVING YIELD AND QUALITY OF THOMPSON SEEDLESS GRAPES BY USING SOME ANTIOXIDANTS

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ABSTRACT

This study was conducted during 2005 and 2006 seasons to examine the effect of using four antioxidants namely Benzoic acid at 50, 100 or 200 ppm, vitamin B complex at 25, 50 or 100 ppm as well as ascorbic and citric acids each at 250, 500 or 1000 ppm, (control treatment was sprayed with water) on leaf area, percentages of N, P and K in the leaves, berry setting %, yield and fruit quality of Thompson seedless grapevines. Vines were sprayed four times during each growing season at the start of growth, just after berry setting and at 21 days intervals.

Results showed that all antioxidants at all concentrations had measurable influence on the leaf area, percentages of N, P and K in the leaves, yield, berry setting % as well as physical and chemical characters of the berries compared to the control treatment. Spraying citric acid, ascorbic acid, vitamin B complex and Benzoic acid at all concentrations, in descending order proved to be very effective for enhancing growth, yield and fruit quality.

The best results with regard to yield and quality of Thompson seedless grapes were obtained due to spaying the vines four times with citric acid at 500 ppm.

INTRODUCTION

Many trials were conducted for improving physical (especially berry weight) and chemical characters of Thompson seedless grapes by using antioxidants instead of using synthetic auxins for protecting environment from pollution.

Antioxidant compounds have auxinic action, since they have synergistic effect on growth and productivity of most fruit trees. Their practical use in fruit trees under field conditions are favourablly possible. Further and additional studies are needed to elucidate their mode of action on fruit trees and to find cheap antioxidants that are beneficial for enhancing growth and productivity. and safe to human, animal and environment. They are very beneficial for avoiding free oxygen, reducing cell senescence, protecting the cells from senescences, enhancing the cell division and the biosynthesis of organic foods and controlling the incidence of fungal attack.

It is well known that during photosynthesis and respiration processes within plant tissues, many free radicals or active oxygen species namely singlet oxygen, superoxide anion, hydrogen peroxide, hydroxyle radicals and ozone are produced. Production of these unfavourable radicals leads to oxidation of lipids and death of cells. They are beneficial through catching or chelating these radicals (Elade, 1992 and Lee *et al.,* 1995) . They are used instead of auxins and chemicals for producing organic fruits and lowering pollution of environment.

During extensive studies carried out by many workers in different grapevines cvs, application of antioxidants are responsible for stimulating growth characters of the vines and improving nutritional status of the vines, yield and quality of the berries. The effect was depended on concentrations, dates and number of sprays and the grape variety (Khiamy, 1999; Ali, 2000; El- Sayed *et al.,* 2000; Mansour *et al.,* 2000; Abd El-Hady and Ebrahiem- Alia, 2001; Numier – Safaa, 2001 ; Attia, 2002 , Ahmed *et al.,* 2002; Shoeib and El- Sayed , 2003 ; Khiamy, 2003 ; Madian, 2004; Mahran, 2005 and Ibrahim- Asmaa, 2006).

The merit of this study was examining the effect of concentrations of four antioxidants (benzoic acid, vitamin B complex, ascorbic acid and citric acid) on leaf area, percentages of N, P and K in the leaves, berry setting %, yield as well as physical and chemical properties of Thompsom seedless grapes.

MATERIALS AND METHODS

The present study was carried out over two consecutive seasons of 2005 and 2006 on 39 vines 12 years old and head trained Thompson seedless cv. grown in a private vineyard located at Matay district, Minia Governorate where the soil is silty clay. The uniform in vigour vines were planted at 2 x 2 meters apart and pruned at the first week of January in both seasons to leave 72 eyes (8 fruiting spurs x 7 eyes plus 8 renewal spurs x 2 eyes). Surface irrigation system was followed in the vineyard.

The experiment included the following thirteen treatments:

1-Control treatment (sprayed with water only)
2-Spraying Benzoic acid at 50 ppm (1 cm / 20 L)
3- Spraying Benzoic acid at 100 ppm (2 cm / 20 L)
4- Spraying Benzoic acid at 200 ppm (4 cm / 20 L)
5- Spraying Vitamin B complex (B1+ B2+ B3) at 25 ppm (0.5 cm/ 20L.)
6- Spraying Vitamin B complex (B1+ B2+ B3) at 50 ppm (1.0 cm/ 20L.)
7- Spraying Vitamin B complex (B1+ B2+ B3) at 100 ppm (2.0 cm/ 20L.)
8-Spraying Ascorbic acid at 250 ppm (5 cm/ 20 L)
9- Spraying Ascorbic acid at 500 ppm (10 cm/ 20 L)
10- Spraying Ascorbic acid at 1000 ppm (20 cm/ 20 L)
11- Spraying Citric acid at 250 ppm (5 cm/ 20 L)
12- Spraying Citric acid at 500 ppm (10 cm/ 20 L)
13- Spraying Citric acid at 1000 ppm (20 cm/ 20 L)

Each treatment was replicated three times, one vine/ each. Each antioxidant was sprayed four times at growth start (1st week of Mar.) , just after berry setting (1st week of May) and at 21 days intervals (last week of May and third week of June). Triton B as a wetting agent at 0.05 % was added to all antioxidant solutions.

Completely randomized block design was adopted. During both seasons, the following parameters were recorded:

1-Leaf area in the twenty leaves opposite to the basal clusters was measured according to Ahmed and Morsy (1999).

2-Percentages of N, P and K in the same leaves taken for measuring leaf area were determined according to the procedures outlined by **Wilde *et al.*, (1985).**

3-Berry set % was estimated by dividing number of fruitletes by total number of flowers per cluster and multiplying the product by 100.

4-Yield per vine expressed in weight (kg.) and number of clusters per vine was recorded at harvesting date (middle of July) when T.S.S. / acid in the berries of the check treatment reached at least 25 : 1

5-Average cluster weight (g.)

6-Five clusters were taken at random from the yield of each vine for determination of the following physical and chemical characters:

6-1 Average berry weight (g.)

6-2 Percentage of total soluble solids.

6-3 Percentage of total sugars (Lane and Eyngon Procedure, A.O.A.C., 1995)

6-4 Percentage of total acidity (as g tartaric acid / 100 ml juice, A.O.A.C., 1995).

All obtained data were tabulated and statistically analyzed using new L.S.D. test at 5 % according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Effect of antioxidants on the leaf area and N, P and K content.

It is clear from the data in Table 1 that spraying Benzoic acid at 50 to 200 ppm, Vitamin B complex at 25 to 100 ppm , ascorbic acid at 250 to 1000 ppm and Citric acid at 250 to 1000 ppm significantly stimulated the leaf area and its content of N, P and K compared to the control treatment. The promotion was associated with increasing concentrations of each antioxidant. This promotion was with using Benzoic acid, Vitamin B complex, ascorbic acid and Citric acid, in ascending order. Significant differences on these parameters were due to varying the concentrations except among the higher two concentrations from each antioxidant. Spraying citric acid at 1000 ppm four times gave the maximum values, untreated vines gave the minimum values. These results were true in both seasons.

Table 1 : Effect of some antioxidants on leaf area and its content of N, P and K, berry set % and yield /vine (kg.) of Thompson seedless grapevines during 2006 and 2007 seasons.

Treatment	Leaf area $(cm)^2$		Leaf N %		Leaf P %	
	2006	2007	2006	2007	2006	2007
Control	100.0	101.0	1.11	1.05	0.10	0.11
Benzoic acid at 50 ppm	102.2	103.0	1.16	1.10	0.12	0.12
Benzoic acid at 100 ppm	103.5	105.0	1.20	1.15	0.14	0.14
Benzoic acid at 200 ppm	104.0	105.3	1.21	1.17	0.15	0.15
Vitamin B complex at 25 ppm	105.5	107.1	1.25	1.22	0.18	0.17
Vitamin B complex at 50 ppm	107.0	109.0	1.29	1.30	0.21	0.20
Vitamin B complex at 100 ppm	107.3	109.3	1.30	1.31	0.22	0.21
Ascorbic acid at 250 ppm	109.1	111.5	1.34	1.40	0.25	0.23
Ascorbic acid at 500 ppm	111.0	113.0	1.40	1.46	0.28	0.25
Ascorbic acid at 1000 ppm	111.4	113.3	1.41	1.47	0.29	0.26
Citric acid at 250 ppm	113.5	114.9	1.47	1.55	0.33	0.29
Citric acid at 500 ppm	116.0	117.0	1.55	1.59	0.35	0.33
Citric acid at 1000 ppm	116.5	117.2	1.57	1.60	0.36	0.34
New L.S.D. at 5%	1.1	1.3	0.03	0.04	0.02	0.02
Treatment	**Leaf K%**		**Berry set %**		**Yield/ vine (kg.)**	
	2006	2007	2006	2007	2006	2007
Control	0.99	0.95	16.1	15.2	6.0	6.3
Benzoic acid at 50 ppm	1.04	1.00	17.4	16.5	6.7	6.9
Benzoic acid at 100 ppm	1.07	1.05	18.7	17.9	7.0	7.5
Benzoic acid at 200 ppm	1.08	1.06	18.9	18.0	7.0	7.8
Vitamin B complex at 25 ppm	1.15	1.11	20.5	19.4	7.6	8.1
Vitamin B complex at 50 ppm	1.19	1.16	22.0	20.7	7.8	8.8
Vitamin B complex at 100 ppm	1.20	1.17	22.2	20.8	7.9	8.8
Ascorbic acid at 250 ppm	1.25	1.22	23.6	22.0	8.1	9.5
Ascorbic acid at 500 ppm	1.30	1.27	25.0	23.5	8.4	10.2
Ascorbic acid at 1000 ppm	1.31	1.32	25.4	24.0	8.4	10.3
Citric acid at 250 ppm	1.35	1.38	27.0	25.5	9.0	11.0
Citric acid at 500 ppm	1.39	1.43	27.5	27.0	9.3	11.7
Citric acid at 1000 ppm	1.40	1.44	29.0	27.3	9.3	11.7
New L.S.D. at 5%	0.03	0.04	1.1	1.2	0.5	0.5

The present results are in harmony with those obtained by Khiamy (1999); Abd El- Hady and Ebrahim – Alia (2001); Madian (2004) and Mahran (2005).

Effect of antioxidants on berry set % , yield and cluster weight:

Data in Tables 1 and 2 clearly show that berry set %, yield expressed as number of clusters / vine(in the second season of study) and yield and cluster weight improved significantly in response to the application of the four antioxidants compared to the control treatment. There was a gradual promotion on such parameters with increasing concentrations of these antioxidants. Increasing concentrations of Benzoic acid from 100 to 200 ppm, vitamin B complex from 50 to 100 ppm and ascorbic and citric acids from 500 to 1000 ppm failed to show significant increase in such characters. The best antioxidant in this respect was citric acid followed by ascorbic acid. The maximum and minimum yield were observed in vines treated with citric acid at 500 ppm and untreated vines, respectively. Yield reached 9.3 and 11.7 kg/ vine in vines treated with citric acid at 500 ppm in both seasons, respectively. Untreated vines produced 6.0 and 6.3 kg/ vine in both seasons respectively. This means that percentage of increase due using the promised treatment reached 55.0 and 85.7 % in 2005 and 2006 seasons, respectively. Number of clusters in the first seasons of study did not change with the present treatments.

These results coincided with those obtained by Ali (2000), Mansour *et al.,* (2000), El- Sayed (2003), Khiamy (2003) and Ibrahim-Asmaa (2006).

Effect of antioxidants on physical and chemical characters of the berries.

It is evident from the obtained data in Tables 1 and 2 that spraying Benzoic acid at 50 to 200, vitamin B complex at 25 to 100 ppm and both ascorbic acid and citric acids each at 250 to 1000 ppm significantly improved berries quality in terms of increasing berry weight, total soluble solids % and total sugars % and in decreasing total acidity % compared to the control treatment. The promotion was associated with increasing concentrations as well as application of Benzoic acid, vitamin B complex, ascorbic acid and citric acid, in ascending order. Significant differences on all properties were detected among all concentrations except among the two higher concentrations of each antioxidant.

Table 2 : Effect of antioxidants on yield as well as physical and chemical characters of the berries of Thompson seedless grapevines during 2006 and 2007 seasons.

Treatment	No. of clusters / vine		Av. Cluster weight (g.)		Av. Berry weight (g)	
	2006	2007	2006	2007	2006	2007
Control	20.0	21.0	300.0	301.0	1.63	1.70
Benzoic acid at 50 ppm	21.0	22.0	320.0	314.0	1.70	1.77
Benzoic acid at 100 ppm	21.0	23.0	333.0	325.0	1.78	1.89
Benzoic acid at 200 ppm	21.0	24.0	334.0	326.0	1.80	1.90
Vitamin B complex at 25 ppm	22.0	24.0	345.0	339.0	1.86	1.96
Vitamin B complex at 50 ppm	22.0	25.0	356.0	351.0	1.92	2.03
Vitamin B complex at 100 ppm	22.0	25.0	357.0	352.0	1.93	2.05
Ascorbic acid at 250 ppm	22.0	26.0	369.0	365.0	2.00	2.12
Ascorbic acid at 500 ppm	22.0	27.0	380.0	377.0	2.06	2.20
Ascorbic acid at 1000 ppm	22.0	27.0	381.0	380.0	2.07	2.21
Citric acid at 250 ppm	23.0	28.0	392.0	393.0	2.13	2.30
Citric acid at 500 ppm	23.0	29.0	403.0	405.0	2.22	2.37
Citric acid at 1000 ppm	23.0	29.0	404.0	405.0	2.23	2.38
New L.S.D. at 5%	N.S	1.0	10.1	11.0	0.05	0.06
Treatment	**T.S.S. %**		**Total sugars %**		**Total acidity %**	
	2006	2007	2006	2007	2006	2007
Control	18.0	18.0	16.6	16.3	0.720	0.718
Benzoic acid at 50 ppm	18.6	18.5	17.0	16.8	0.690	0.678
Benzoic acid at 100 ppm	19.6	19.0	17.4	17.1	0.659	0.658
Benzoic acid at 200 ppm	19.8	19.1	17.5	17.2	0.657	0.655
Vitamin B complex at 25 ppm	20.5	19.7	18.0	17.7	0.626	0.625
Vitamin B complex at 50 ppm	21.0	20.3	18.6	18.3	0.591	0.594
Vitamin B complex at 100 ppm	21.2	20.5	19.1	18.4	0.590	0.592
Ascorbic acid at 250 ppm	22.0	21.0	19.2	19.0	0.560	0.561
Ascorbic acid at 500 ppm	22.5	21.6	19.8	19.5	0.529	0.530
Ascorbic acid at 1000 ppm	22.6	21.7	20.0	19.6	0.527	0.529
Citric acid at 250 ppm	23.0	22.3	20.5	19.9	0.510	0.525
Citric acid at 500 ppm	23.5	23.0	20.9	20.3	0.500	0.520
Citric acid at 1000 ppm	23.6	23.1	21.0	20.4	0.500	0.518
New L.S.D. at 5%	0.5	0.4	0.3	0.3	0.030	0.029

Therefore, the optimum concentration for each antioxidant was the medium one. Using the medium concentration of citric acid namely 500 ppm achieved the best results with regard to quality of the berries in both seasons. These results were true in 2005 and 2006 seasons.

These results are in accordance with the findings of El-Sayed *et al.,* (2000); Abd El- Hady and Ebrahim- Alia (2001); Numier- Safaa (2001); Attia (2002); Ahmed *et al.,* (2002) and Shoeib and El- Sayed (2003).

The positive effects of antioxidants on growth and fruiting might be attributed to their vital role in protecting the vines from free radicals as well as acting as natural auxins and their important effects on the biosynthesis of carbohydrate and other organic foods (Elade, 1992). Also, their action on controlling different disorders can not be neglected.

As a conclusion, the best results with regard to yield and quality of Thompson seedless grapes were obtained when vines were sprayed four times at growth start, just after berry setting and at 21 days intervals with citric acid at 500 ppm .

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Improving yield and quality of Thompson seedless grapes

محـــاولات لتحسين إنتاجية وجودة حبات العنب الطومسون سيدلس باستخدام بعض مضادات الأكسدة

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أجريت هذه الدراسة خلال موسمى ٢٠٠٥ ، ٢٠٠٦ لاختبار تـأثير اسـتخدام أربعة مواد مضادة للاكسدة هى حامض البنزويك بتركيز ٥٠ ، ١٠٠ ، ٢٠٠ جزء فـى المليون، فيتامين ب المركب بتركيز ٢٥ ، ٥٠ ، ١٠٠ جزء فـى المليـون، وحـامض الاسكوربيك والستريك بتركيز ٢٥٠ ، ٥٠٠ ، ١٠٠٠ جزء فى المليون بالاضافة الـى معاملة الكونترول التى تم رشها بالماء على مساحة الورقة والنسبة المئوية للنيتروجين والفوسفور والبوتاسيوم فى الأوراق والنسبة المئوية لعقد الحبات وكميـة المحـصول وخصائص الجودة للحبات فى العنب الطومسون سيدلس ولقد تم رش هذه المواد أربعة مرات أثناء موسم النمو فى بداية النمو وبعد عقد الحبات مباشرة وعلى فترات مرة كـل ٢١ يوم.

أشارت نتائج الدراسة ان رش جميع مضادات الأكسدة بجميع تركيزاتها كان لهم تاثيرات واضحة على مـساحة الورقـة والنـسبة المئويـة للنيتـروجين والفوسـفور والبوتاسيوم فى الأوراق وكمية المحصول والنسبة المئوية لعقد الحبـات والخـصائص الطبيعية والكيميائية للحبات وذلك بالمقارنة بمعاملـة الكـونترول. أدى رش حـامض الستريك، حامض الاسكوربيك وفيتامين ب المركب وحامض البنزويك بجميع التركيزات المستخدمة مرتبة ترتيبا تنازليا الى تحسين النمو وكمية المحـصول وجـودة الحبـات بصورة واضحة.

أمكن الحصول على أفضل النتائج بخصوص كمية المحـصول وجـودة حبـات العنب الطومسون سيدلس عند رش الكرمات أربعة مرات بحامض الستريك بتركيز ٥٠٠ جزء فى المليون.