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EFFECT OF SOME ANTIOXIDANTS ON FRUITING OF SULTANI FIG TREES

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Abstract: Four kinds of antioxidants, citric acid, ascorbic acid , salicylic acid and vitamin B at 250, 500 and 1000 ppm concentration were applied to evaluate their effect on leaf area and its mineral content, total yield and fruit quality for both first and second crops. Each antioxidant concentration was repeated four times.

Results showed that antioxidants had an announced effect on all aforementioned characteristics. Application of vitamin B, salicylic acid , ascorbic acid or citric acid at 250, 500 and 1000 ppm, in ascending order, was beneficial in improving growth , nutritional status of the trees , yield and fruit quality. In most cases, increasing concentrations from 500 to 1000 ppm had a slight effect on the studied characters.

This study concluded that four sprays of citric acid or ascorbic acid at 500 ppm is suggested to be very beneficial for obtaining an economical yield of sultani fig trees.

Key words: antioxidants, fruiting, fig.

Introduction

The major problem encounters sultani fig trees grown in sandy soil is the weakness of growth subsequently; the yield was reduced to the lowest extent. Thereby, any effort aimed to improve yield and fruit quality through using antioxidants will be appreciated .

Antioxidant compounds have an auxinic action, since they have synergistic effect on growth and productivity of most fruit trees. Their practical use on fruit trees under field conditions is favourably 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. At the same time, they are safe to human, animal and environment. They are very beneficial for avoiding free oxygen and reducing cell senescence. They are important in protecting the cells from senescence, enhancing the cell division and the biosynthesis of organic foods and controlling the incidence of fungal attack (Prusky, 1988). (Malamy *et al*., 1990 and Ruskin, 1992). They are used instead of auxins and chemicals for producing organic foods and

lowering pollution in our environment (Elade, 1992) .

The positive actions of antioxidants namely organic acids and vitamins on growth, yield and quality of fruit crops were previously studied e.g. (Prusky, 1988 ; Malamy *et al.*, 1990 ; Raskin, 1992 ; Elade, 1992 ; Zhang and Klessing , 1997 ; Buchala and Schmid, 1979 ; Ahmed *et al.*, 1997 ; Johnson *et al.*, 1999 ; Prestamo and Arroyo, 1999 ; Khiamy, 1999 ; Mansour *et al.*, 2000 ; Ahmed *et al.*, 2002 ; khiamy , 2003 ; Ahmed and Abdel-Hameed, 2004 and Rezk, 2005) .

The aim of this work is to study the effect of certain antioxidants on growth, leaf mineral content, yield and fruit quality of sultani fig trees .

Materials and methods

This study was executed during 2004 and 2005 seasons on 11 years old Sultani fig trees and planted at 3.5 x 3.5 m apart and grown in sandy loam soil at a private orchard situated at El – Balyna district, Sohag Governorate.

Analysis of the tested soil was conducted according to procedures outlined by Piper (1950) and Wilde *et al.*, (1985) and the obtained data are shown in Table (1) .

Table(1): Properties of the soil at the trial location

Constituents	Values
Sand %	72.5
Silt %	14.0
Clay %	13.5
Texture grade	Sandy loam
E.C. (mmhos / cm / 25°C) (1:2.5)	0.59
PH (1 . 2.5 extract)	8.2
$CaCO_3$ %	1.92
O.M. %	0.9
Total N %	0.05
Available P (ppm, Olsen)	3.3
Available K (ppm,)	131.0

The experiment included the following thirteen treatments :

1. Control (untreated trees) .
2. Spraying citric acid at 250 ppm.
3. Spraying citric acid at 500 ppm.
4. Spraying citric acid at 1000 ppm.
5. Spraying ascorbic acid at 250 ppm.
6. Spraying ascorbic acid at 500 ppm.
7. Spraying ascorbic acid at 1000 ppm.
8. Spraying salicylic acid at 250 ppm.
9. Spraying salicylic acid at 500 ppm.
10. Spraying salicylic acid at 1000 ppm.
11. Spraying vitamin B_1 at 250 ppm.
12. Spraying vitamin B_1 at 500 ppm.
13. Spraying vitamin B_1 at 1000 ppm.

Each treatment considered 16 trees (repeated 4 times), trees sprays were conducted for all antioxidants. Control treatment was sprayed with tap water. Triton B as a wetting agent at 0.1 % was added to all sprayed solutions on growth start and at one month intervals till run off. Regular horticultural practices were carried out as usual.

Ten leaves were picked from the middle parts of new for measuring leaf area according to the equation of Ahmed and Morsy (1999) average

$$\text{leaf area } (cm)^2 = \frac{Leaves\ weight\ (g) \times 2}{Sections\ weight\ (g)}$$

In the same leaves on dry weight basis, percentages of N, P, K and Mg were determined according to Piper (1950) and Wilde *et al.*, (1985) as follows. Sample of leaves were taken, water washed and oven dried at 70°C till constant weight. Dried samples were pulverized separately and samples of 0.2 (g) each was digested with a mixture of sulfuric acid and hydrogen peroxide, to determine the following:

1- Total nitrogen percentage was measured by the micro-kjeldahl methods.

2- Phosphorus percentage was determined colorimetricaly.

3- Potassium percentage was determined using flame photometer.

4- Magnesium percentage was measured using titration with Na_2-EDTA by EBT indicator.

At the commercial harvesting date, the fig trees usually bear 2 crops. The early or first crop (berba crop) picked at last week of July fruits inferior and frequently to acid, and only. Those of the second or main crop of actual value at mid-August which twice weekly collected and finally at mid-October yield was recoded (kg/tree) then the total yield was estimated. Average fruit weight (g) and chemical properties of fruits such as total soluble solids %, total sugars % and total acidity % (expressed as g citric acid/100 mL juice) were determined as outlined in A.O.A.C. (1985).

Statistical analysis was done according to Mead *et al.* (1993) using New L.S.D. at 5% for making all comparisons among all treament means.

Results and discussion

1. Leaf area and its content of N,P,K and Mg :

Data in Table (2) clearly show that there were significant differences on leaf area and its content of N,P,K and Mg among the four studied antioxidants. Application of citric acid, ascorbic acid, salicylic acid and vitamin B_1 at 250, 500 and 1000 ppm significantly improved the leaf area and its content of N,P,K compared to the control. The promotion was associated with increasing concentration from 250 to 500 ppm of each antioxidant as well as using vitamin B_1, salicylic acid, ascorbic acid and citric acid, in ascending order. In most cases, increasing concentration from 500 to 1000 ppm from each antioxidant had a slight effect. Significant differences in these parameters were observed among all treatments except between the higher two concentrations of each antioxidant. They were maximized production in the trees when received four sprays of citric acid at 1000 ppm. The untreated trees produced the minimum values. These results were true in both seasons .

These results are in harmony with those obtained by Ahmed *et al.*, (1997) ; Khiamy (1999) and Mansour *et al.*, (2000). They reported that application spraying with antioxidant increases leaf area also N, P, K and Mg content in levaes.

2. First and second crop and total yield :

As shown in Table (2), the first and second crop as well as total yield were positively affected by foliar application of the four antioxidants. Spraying these antioxidants at 250, 500 and 1000 ppm significantly improved the yield compared to the control. The promotion on the yield was attributed to using citric acid, ascorbic acid, salicylic acid and vitamin B_1. In descending order. A slight and insignificant promotion on the first and second yield and the total yield was observed between the higher two concentrations (500 and 1000 ppm) from each antioxidant. Application of 500 ppm from each antioxidant was suggested to be beneficial for obtaining an economical yield. The striking treatment was using citric acid at 500 ppm four times. Under such promising treatment , first and second crops reached 5.5 as well as 26.2 and 25.1 kg in both seasons, respectively while total yield was 31.7 and 30.6 kg in both seasons, respectively. The untreated trees produced 2.5, 16.3 and 18.8 kg for first and second crop and total yield, respectively in the first season of study, while in the second season these values were 2.1 , 17.1 and 19.2 kg / tree, respectively.

The results of Ahmed *et al.*, (1997); Khiamy (1999) and Ahmed *et al.*, (2002) supported the current findings concerning the promotion on the yield in response to application of these antioxidants .

Table(2): Effect of some antioxidants on leaf area, percentages of N, P, K and Mg, first and second crop and total yield (kg/tree) of Sultani fig trees during 2004 and 2005 seasons .

Antioxidant treatment	Leaf area		Leaf N %		Leaf P %		Leaf K %	
	2004	2005	2004	2005	2004	2005	2004	2005
Control	410.0	433.0	1.39	1.44	0.21	0.18	1.08	1.11
Citric acid at 250 ppm	443.0	464.0	1.53	1.56	0.25	0.21	1.21	1.22
Citric acid at 500 ppm	439.0	469.0	1.59	1.66	0.29	0.24	1.27	1.26
Citric acid at 1000 ppm	440.0	469.5	1.60	1.66	0.29	0.25	1.27	1.26
Ascorbic acid at 250 ppm	427.0	455.0	1.52	1.56	0.25	0.21	1.20	1.22
Ascorbic acid at 500 ppm	430.0	459.0	1.58	1.65	0.28	0.24	1.26	1.26
Ascorbic acid at 1000 ppm	430.5	460.0	1.58	1.66	0.29	0.25	1.26	1.27
Salicylic acid at 250 ppm	420.0	445.0	1.51	1.56	0.25	0.21	1.20	1.22
Salicylic acid at 500 ppm	423.0	449.0	1.57	1.65	0.28	0.24	1.25	1.26
Salicylic acid at 1000 ppm	423.5	449.5	1.57	1.65	0.29	0.25	1.25	1.27
Vitamin B_1 at 250 ppm	418.3	437.0	1.50	1.56	0.25	0.21	1.19	1.22
Vitamin B_1 at 500 ppm	416.0	440.0	1.56	1.64	0.28	0.24	1.25	1.26
Vitamin B_1 at 1000 ppm	417.0	441.0	1.57	1.65	0.29	0.25	1.25	1.26
New L.S.D at 5 %	0.9	2.2	0.06	0.08	0.02	0.02	0.04	0.04
	Leaf Mg %		First crop		Second crop		Total yield	
Control	0.24	0.25	2.5	2.1	16.3	17.1	18.8	19.2
Citric acid at 250 ppm	0.28	0.32	5.0	5.0	25.0	24.0	30.0	29.0
Citric acid at 500 ppm	0.30	0.36	5.5	5.5	26.2	25.1	31.7	30.6
Citric acid at 1000 ppm	0.30	0.37	5.6	5.6	26.2	25.1	31.7	30.7
Ascorbic acid at 250 ppm	0.28	0.31	5.0	4.1	22.2	21.9	27.2	26.0
Ascorbic acid at 500 ppm	0.30	0.34	5.4	4.5	24.0	22.9	29.4	27.4
Ascorbic acid at 1000 ppm	0.30	0.34	5.4	4.5	24.0	23.0	29.4	27.5
Salicylic acid at 250 ppm	0.27	0.31	4.0	3.3	19.9	19.5	23.9	22.8
Salicylic acid at 500 ppm	0.29	0.34	4.4	3.6	21.5	20.6	25.9	24.2
Salicylic acid at 1000 ppm	0.29	0.34	4.5	3.7	21.6	20.6	26.1	24.3
Vitamin B_1 at 250 ppm	0.27	0.31	3.0	2.4	17.3	17.3	20.3	19.7
Vitamin B_1 at 500 ppm	0.29	0.34	3.5	2.8	18.5	18.5	22.0	21.1
Vitamin B_1 at 1000 ppm	0.29	0.35	3.5	2.8	18.6	18.3	22.1	21.1
New L.S.D at 5 %	0.02	0.02	0.4	0.3	1.0	0.9	0.8	0.9

3. Physical and chemical fruit properties:

Table (3) shows that foliar application of antioxidants at 250, 500 and 1000 ppm significantly inhanced fruit quality of sultani fig trees in terms of increasing fruit weight, total soluble solids % and total sugars % and in reducing the total acidity % in both crops compared to the control. The improving effect of fruit quality was ascribed to using vitamin B_1, salicylic acid, ascorbic acid and citric acid, in ascending order.

Table(3): Effect of some antioxidants on some physical and chemical characteristics of Sultani fig trees during 2004 and 2005 seasons .

Antioxidant treatments	Fruit weight (g)				T.S.S %			
	1st crop		2nd crop		1st crop		2nd crop	
	2004	2005	2004	2005	2004	2005	2004	2005
Control	50.2	51.6	36.0	37.0	15.5	15.8	16.1	16.3
Citric acid at 250 ppm	61.9	76.6	59.0	55.0	17.1	17.8	17.8	18.6
Citric acid at 500 ppm	70.1	78.9	63.0	59.5	17.3	18.1	18.3	18.9
Citric acid at 1000 ppm	70.3	79.0	63.5	60.0	17.5	18.1	18.3	19.0
Ascorbic acid at 250 ppm	57.0	70.0	48.0	51.0	16.8	17.1	17.6	18.0
Ascorbic acid at 500 ppm	58.5	75.0	51.0	53.0	17.1	17.4	17.9	18.5
Ascorbic acid at 1000 ppm	59.0	75 3	51.5	53.3	17.1	17.5	18.0	18.5
Salicylic acid at 250 ppm	55.0	62.0	41.9	44.5	16.5	16.8	17.2	17.3
Salicylic acid at 500 ppm	56.2	66.0	43.0	47.0	16.8	17.1	17.5	17.6
Salicylic acid at 1000 ppm	56.3	66.5	43.5	47.5	16.9	17.1	17.5	17.6
Vitamin B_1 at 250 ppm	52.2	55.5	38.0	40.0	15.8	16.1	16.3	16.6
Vitamin B_1 at 500 ppm	53.3	58.0	40.0	42.0	16.2	16.4	16.6	16.9
Vitamin B_1 at 1000 ppm	53.4	58.5	40.3	42.5	16.2	16.5	16.6	17.0
New L.S.D at 5 %	1.1	1.2	1.4	1.2	0.3	0.3	0.2	0.3
	Total sugars %				Total acidity %			
	1st crop		2nd crop		1st crop		2nd crop	
Control	13.5	14.5	14.5	14.6	0.341	0.350	0.299	0.301
Citric acid at 250 ppm	16.3	17.0	17.3	17.4	0.200	0.230	0.155	0.135
Citric acid at 500 ppm	16.6	17.5	17.6	17.8	0.180	0.260	0.135	0.115
Citric acid at 1000 ppm	16.6	17.6	17.7	18.0	0.180	0.200	0.135	0.110
Ascorbic acid at 250 ppm	15.5	16.3	16.6	16.5	0.220	0.260	0.195	0.160
Ascorbic acid at 500 ppm	15.9	16.9	16.9	17.0	0.200	0.230	0.175	0.130
Ascorbic acid at 1000 ppm	16.0	16.6	17.0	17.1	0.199	0.228	0.175	0.130
Salicylic acid at 250 ppm	14.8	15.6	15.5	15.8	0.275	0.295	0.240	0.230
Salicylic acid at 500 ppm	15.1	15.9	15.8	16.1	0.250	0.265	0.218	0.200
Salicylic acid at 1000 ppm	15.2	16.0	15.9	16.1	0.248	0.264	0.215	0.196
Vitamin B_1 at 250 ppm	13.9	14.9	14.2	15.2	0.318	0.320	0.280	0.279
Vitamin B_1 at 500 ppm	14.4	15.2	14.9	15.5	0.269	0.295	0.260	0.255
Vitamin B_1 at 1000 ppm	14.5	15.2	15.0	15.5	0.295	0.294	0.260	0.250
New L.S.D at 5 %	0.3	0.3	0.3	0.3	0.022	0.022	0.018	0.20

Also, the promotion on fruit quality was associated with increasing the concentration from 250 to 500 ppm of each antioxidant. While, raising concentration from 500 to 1000 ppm had a slight promotion on fruit quality. Fruit quality parameters were significantly affected among all the studied treatments except between the two higher concentrations of each antioxidant. The best results regarding to fruit quality were obtained on the trees treated four times with citric acid at 500 ppm. The untreated trees produced unfavourable effects on fruit quality. Similar results were detected on both seasons .

These results are in harmony with those obtained by Khiamy (2003) ; Ahmed and Abd El-Hameed (2004) and Rezk (2005). They reported that improving fruit quality is a result of antioxidant sprayers.

The previous effects of antioxidants on fruiting of Sultani fig trees might be attributed to their important role in protecting the cells from internal oxidation as well as from the incidence of diseases and stimulating the biosynthesis of organic foods and enhancing cell division, since they are acted as natural oxidants (Prusky, 1988 ; Malamy *et al*., 1990 and Rasking , 1992) .

As a conclusion, four sprays of citric acid or ascorbic acid each at 500 ppm is suggested to be very beneficial for improving yield and fruit quality of Sultani fig trees .

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تأثير بعض مضادات الأكسدة علي الإثمار في التين السلطاني

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تـم تقيـيم تأثير اربعة مضادات اكسدة هي حامض الستريك ، حامض الاسكوربيك ، حامض السليسيلك وفيتامين ب، بتركيز ٢٥٠ إلى ١٠٠٠ جزء فى المليون علي مساحة الورقة ومحتواها المعدنـي ، وكمـية المحصـول الأول والثانـي والمحصول الكلي وخصائص جودة الثمار في المحصول الأول والثاني لاشجار التين السلطاني ولقد تم رش كل مادة من مضادات الاكسدة اربعة مرات وذلك عند ابتداء النمو ومرة كل شهر ثلاث مرات .

أشـارت نتائج الدراسة إلى أن اختلاف مضادات الاكسدة له تأثير واضح علي الصفات تحت الدراسة . وكان استخدام فيتامين ب، ، حامض السليسيلك وحامض الاسكوربيك وحامض الستريك مرتـبة ترتيباً تصاعدياً فعالا في تحسين النمو ، الحالة الغذائية للاشجار ، المحصول وخصائص الجـودة . وفي جميع الاحوال فان رفع التركيز المستخدم من ٥٠٠ إلى ١٠٠٠ جزء فى المليون كـان له تأثـير طفـيف علي الصفات تحت الدراسة . كما أن رش حامض الستريك أو حامض الاسـكوربيك اربعة مرات بتركيز ٥٠٠ جزء من المليون يعتبر مفيدا في الحصول علي محصول اقتصادي فى اشجار التين السلطاني .