International Journal of Plant & Soil Science
3(10): 1333-1342, 2014; Article no. IJPSS.2014.10.011

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A Comparative Study for the Effect of Green Tea Extract and Some Antioxidants on Thompson Seedless Grapevines

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Author's contribution

This whole work was carried out author MAMA.

Conference Proceeding Full Paper

Received 22nd December 2014
Accepted 9th May 2014
Published 26th July 2014

ABSTRACT

Leaf area, plant pigments, leaf content of N, P, K, Mg, Ca, Zn, Fe and Mn, yield and berry quality of Thompson seedless grapevines in response to spraying green tea extract, ascorbic acid and citric acid each at 250 to 1000 ppm as well as salicylic acid at 50 to 200 ppm were investigated during 2012 and 2013 seasons.

Spraying green tea extract or any one of the three antioxidants was very effective in stimulating the leaf area, plant pigments, all nutrients in the leaves, yield as well as physical and chemical characteristics of the grapes in relative to the check treatment. The promotion was associated with using ascorbic acid, green tea extract, salicylic acid and citric acid, in descending order. In all cases, no clear effect was detected on all the investigated parameters among the higher two concentration of green tea extract and the three antioxidants.

Treating Thompson seedless grapevines three times with ascorbic acid at 500 ppm or green tea at the same concentration is suggested to be beneficial for promoting yield quantitively and qualitively.

Keywords: Green tea extract; as well as ascorbic; citric; salicylic acids- Thompson seedless grape; yield; grapes quality.

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Note: Full paper submitted at the First International Conference on "Food and Agriculture: New Approaches" held in the National Research Centre, Cairo, Egypt from December 2 to 4, 2013.

1. INTRODUCTION

Antioxidants with their protectant properties play an important role in plant defense against oxidative stress as well as the biosynthesis of most organic foods and activation of cell division process [1]. Recently, public health and environmental safety encourage the use of plant extracts for improving growth, nutritional status and productivity.

The higher own content of these extracts from plant pigments, phenolic compounds and essential oils seem to have synergistic effects on fruiting of fruit crops [2,3].

It has been postulated that application of various antioxidants was responsible for enhancing growth, vine nutritional status, yield and fruit quality of fruit crops [4,5,6,7,8,9].

Previous studies showed that using plant extracts was very effective in enhancing fruiting in different fruit crops [10,11,12,13,14,15]. GC and GC/MS to determine their chemical constituents. To the authors knowledge it is the first report on the extraction of volatile oils from the aerial parts of *F. angulata* by MAHD.

2. MATERIALS AND METHODS

This study was carried out during 2012 and 2013 seasons on seventy- eight uniform in vigour 13- years old Thompson seedless grapevines grown in a private vineyard located at Estal village, Samalout district, Minia Governorate. Vines were spaces at 1.5 x 3.0 m apart and grown in a clay soil (Table 1). Cane pruning method using Gable supporting system was followed to give 72 eyes per vine (6 fruiting canes x 10 eyes + 6 renewal spurs ×twoe yes). Surface irrigation system is used for irrigation.

This experiment included the following thirteen treatments:

1- Untreated vines(control treatment).
2- Spraying ascorbic acid at 250 ppm(0.250 g/ L).
3- Spraying ascorbic acid at 500 ppm(0.5 g/ L).
4- Spraying ascorbic acid at 1000 ppm(1.0 g/ L).
5- Spraying green tea at 250 ppm.
6- Spraying green tea at 500 ppm.
7- Spraying green tea at 1000 ppm.
8- Spraying Salicylic acid at 50 ppm.
9- Spraying Salicylic acid at 100 ppm.
10- Spraying Salicylic acid at 200 ppm.
11- Spraying citric acid at 250 ppm.
12- Spraying citric acid at 500 ppm.
13- Spraying citric acid at 1000 ppm.

Each treatment was replicated three times, two vines per each. All antioxidants and green tea extract were sprayed three time sat growth start (1stwweek of Mar.), just after berry setting (mid. of April) and at one month later (mid. of May). Triton B as a wetting agent was added to all spraying solutions at 0.05%. Spraying was continued till run off (2 L/vine). Other horticultural practices were carried out as usual. Randomized complete block design was followed.

Table 1. Analysis of the tested soil

Constituents	Values
Particle size distribution	
Sand %	14.0
Silt %	18.0
Clay %	68.0
Texture	Clay
pH(1: 2.5 extract)	7.66
O.M %	1.69
CaCO3%	1.77
Total N %	0.08
Available P (Olsen method) ppm	4.1
Available K (ammonium acetate) ppm	394
EDTA extractable micronutrients (ppm)	
Fe	7.1
Zn	1.99
Mn	4.8
Cu	1.94

At the last week of May, twenty leaves picked form leaves opposite to the basal clusters [16] per each vine were taken for measuring the leaf area (cm2) using the following equation that outlined by [17], Leaf area (cm2) = 0.45 (0.79 x maximum diameter) + 17.77. In the dry petioles, leaf content of N, P, K, Mg and Ca (as percentages) as well as Zn, Fe and Mn (as ppm) were determined according to the procedures that outline by [18]. In the fresh blades, chlorophylls a & b, total chlorophylls and total carotenodis were determined (as mg/ 100 g F.W.) according to the methods that outlined by [19]. When T.S.S./ acid in the berries of the check treatment reached 25/1 (mid. of July) [20], yield expressed in number of clusters/vine and weight (kg.) was recorded. Five clusters from each vine were taken for measuring cluster weight (g.) and dimensions (length & width, in cm.); berry weight (g.) and dimensions (equatorial & longitudinal in cm), total soluble solids %, total sugars % and total acidity % (as g tartaric acid/ 100 ml juice) according to A.O.A.C. (1995). Statistical analysis was done using new L.S.D. test at 5% for made all comparisons among the thirteen treatment means according to the Procedure of [21].

3. RESULTS AND DISCUSSION

3.1 Leaf Area and Its Content of Plant Pigments and Nutrients

Looking at the effect of spraying green tea and some antioxidants on the leaf area and its content of plant pigments and various nutrients, data in Tables (2 & 3 & 4) clearly show that foliar application of ascorbic acid, green tea and citric acid each at 250 to1000 ppm as well as salicylic acid at 50 to 200 ppm significantly enhanced the leaf area, chlorophylls a & b, total carotenoids, total chlorophylls and nutrients namely N, P,K, Mg, Ca, Zn, Fe and Mn in the leaves in relative to the check treatment. Using ascorbic acid was superior than using green tea and the other two antioxidants namely salicylic acid and citric acid in improving growth and vine nutritional status. Green tea extract occupied the second position in this respect. Citric acid application ranked the last position. The promotion on these parameters was significantly associated with increasing concentration from 0.0 to 500 ppm. A slight and unsignificant promotion on these aspects was detected among the higher two concentrations

of each material (500 and 1000 ppm for ascorbic acid, green tea and citric acid and 100 and 200 ppm for salicylic acid). The maximum values were recorded on the vines that treated three times with ascorbic acid at 1000 ppm. Untreated vines produced the minimum values. These results were true during both seasons.

3.2 Yield and Cluster Characters

It is clear from the data in Table (4) that significant differences on the yield expressed in weight (kg.) and number of clusters per vine as well as cluster weight and dimensions (width & length) were recorded among the thirteen treatments of green tea and the three antioxidants. Spraying ascorbic acid, green tea and citric acid each at 250 to 1000 ppm, salicylic acid at 50 to 200 ppm significantly was accompanied with stimulating the yield as well as weight, length and width of cluster rather than non- application. Spraying ascorbic acid, green tea, salicylic acid and citric acid, in descending order was very effective in enhancing the yield and cluster characters. In other words, the best material in this respect was ascorbic acid followed by green tea and using citric acid occupied the last position. Increasing concentrations of each material in most cases caused a gradual and significant promotion on these parameters. Economically point of view the best results with regard to yield and cluster characters were recorded on the vines that treated three times with ascorbic acid or green tea at 500 ppm (since no significant difference were observed among the higher two concentrations on the yield and cluster characters). Under such promised treatment, yield per vine reached 8.3 and 11.8 kg compared to 6.6 and 6.9 kg produced by untreated vines during both seasons, respectively. The percentage of increase on the yield due to using ascorbic acid at 500 ppm three times over the check treatment reached 25.8 and 71.1 % during both seasons, respectively. The lowest yields were observed on the untreated vines. These results were true for both seasons.

3.3 Some Physical and Chemical Characteristics of the Berries

Table (5) shows that spraying the three antioxidants namely ascorbic acid, salicylic acid and citric acid as well as the plant extract green tea three times significantly was very effective in improving quality of the berries in terms of increasing berry weight and dimensions (longitudinal and equatorial), T.S.S. % and total sugars % and decreasing total acidity % in relative to the check treatment. The promotion on fruit quality was significantly associated to the increase in the concentrations of each material. Using ascorbic acid at 250 to 1000 ppm significantly was preferable in improving quality of the berries than the other materials. Using green tea occupied the second position in this connection. Citric acid ranked the last position in this respect. Meaningless promotion on the quality of the berries was recorded among the higher two concentrations of each material. The best results with regard to quality of the berries from economical point of view were obtained due to using ascorbic acid three times at 500 ppm. Unfavorable effects on fruit quality were recorded on untreated vines. Similar results were announced during both seasons.

Table 2. Effect of spraying green tea extract and some antioxidants on the leaf area, some plant pigments and percentages of N in the leaves of Thompson seedless grapevines during 2012 and 2013 seasons

Green tea extract and antioxidant treatments	Leaf area (cm)2		Chlorophyll a (mg/ 100 g F.W)		Chlorophyll b (mg/ 100 g F.W)		Total chlorophylls (mg/ 100 g F.W)		Total carotenoids (mg/ 100 g F.W)		Leaf N %	
years	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
Control	94.7	95.8	16.1	17.0	7.0	7.7	23.1	24.7	9.7	10.0	1.57	1.65
Ascorbic acid at 250 ppm	110.6	111.7	27.7	28.9	14.0	14.6	41.7	43.5	16.6	17.0	2.22	2.30
Ascorbic acid at 500 ppm	112.3	113.4	29.0	30.0	14.8	15.5	43.8	45.5	17.4	17.8	2.31	2.40
Ascorbic acid at 1000 ppm	112.5	113.5	29.3	30.6	15.0	15.8	44.3	46.4	17.7	18.0	2.32	2.40
Green tea at 250 ppm	107.3	108.4	23.0	24.4	11.8	12.6	34.8	37.0	14.8	15.1	2.00	2.09
Green tea at 500 ppm	108.9	110.0	25.7	25.7	12.5	13.2	38.2	38.9	15.5	15.9	2.07	2.16
Green tea at 1000 ppm	109.0	110.3	26.0	26.0	12.6	13.2	38.6	39.2	15.6	16.0	2.08	2.18
Salicylic acid at 50 ppm	101.6	102.7	20.1	21.8	10.0	10.6	30.1	32.4	13.0	13.4	1.86	1.95
Salicylic acid at 100 ppm	104.1	105.2	21.2	22.9	10.7	11.3	31.9	34.2	14.0	14.5	1.95	2.03
Salicylic acid at 200 ppm	104.4	105.3	21.6	23.0	10.9	11.6	32.5	34.6	14.2	14.6	1.96	2.04
Citric acid at 250 ppm	96.3	97.5	17.3	18.2	7.8	8.5	25.1	26.7	12.0	12.4	1.65	1.74
Citric acid at 500 ppm	98.1	98.7	18.6	19.5	8.7	9.3	27.3	28.8	13.0	13.3	1.74	1.85
Citric acid at 1000 ppm	98.3	99.1	19.0	19.7	9.0	9.7	28.0	29.4	13.1	13.4	1.75	1.87
New L.S.D. at 5 %	1.1	1.2	0.9	0.8	0.5	0.6	0.8	1.0	0.5	0.6	0.05	0.06

Table 3. Effect of spraying green tea extract and some antioxidants on the percentages of P, K, Mg and Ca as wells Zn and Fe as (ppm)in the leaves of Thompson seedless grapevines during 2012 and 2013 seasons

Green tea extract and antioxidant treatments	Leaf P %		Leaf K %		Leaf Mg %		Leaf Ca%		Leaf Zn (ppm)		Leaf F (ppm)	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Control	0.11	0.14	1.41	1.45	0.51	0.48	2.95	2.84	53.3	55.0	55.5	55.9
Ascorbic acid at 250 ppm	0.33	0.37	1.99	2.06	0.80	0.84	3.85	3.90	77.0	81.9	82.3	83.0
Ascorbic acid at 500 ppm	0.36	0.40	2.05	2.12	0.86	0.90	3.95	4.00	80.0	87.9	86.6	86.6
Ascorbic acid at 1000 ppm	0.36	0.41	2.05	2.13	0.87	0.91	3.97	3.02	80.5	88.0	86.7	87.3
Green tea at 250 ppm	0.25	0.29	1.92	1.99	0.71	0.76	3.61	3.66	69.0	75.9	76.0	76.6
Green tea at 500 ppm	0.28	0.32	1.97	2.06	0.76	0.80	3.65	3.71	72.0	78.3	80.0	80.7
Green tea at 1000 ppm	0.29	0.33	1.98	2.07	0.77	0.80	3.66	3.72	73.0	79.0	81.0	81.7
Salicylic acid at 50 ppm	0.21	0.25	1.75	1.84	0.65	0.70	3.41	3.46	64.0	68.0	68.9	69.3
Salicylic acid at 100 ppm	0.23	0.27	1.80	1.90	0.71	0.75	3.52	3.58	67.0	71.9	73.0	73.7
Salicylic acid at 200 ppm	0.24	0.28	1.86	1.91	0.72	0.76	3.55	3.60	67.3	72.0	73.6	74.0
Citric acid at 250 ppm	0.14	0.18	1.50	1.56	0.58	0.64	3.15	3.22	57.0	60.0	60.0	60.9
Citric acid at 500 ppm	0.17	0.21	1.59	1.63	0.64	0.70	3.27	3.35	60.3	62.9	64.0	64.8
Citric acid at 1000 ppm	0.18	0.22	1.68	1.64	0.65	0.71	3.29	3.36	60.5	63.0	64.7	65.1
New L.S.D. at 5 %	0.02	0.03	0.05	0.04	0.04	0.05	0.08	0.07	2.2	2.2	2.4	2.3

Table 4. Effect of spraying green tea extract and some antioxidants on the leaf content of Mn (as ppm)yield and characters of cluster of Thompson seedless grapevines during 2012 and 2013 seasons

Green tea extract and antioxidant treatments	Leaf Mn (ppm)		No. of clusters per vine		Yield / vine (kg)		Average cluster weight (cm)		Average cluster length (cm)		Average cluster width (cm)	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Control	47.3	46.9	22.0	23.0	6.6	6.9	301.0	300.0	19.0	18.9	11.0	11.4
Ascorbic acid at 250 ppm	71.9	72.8	24.0	31.0	8.3	11.0	344.0	355.0	25.9	26.0	15.1	15.5
Ascorbic acid at 500 ppm	75.0	76.0	24.0	33.0	8.3	11.8	347.0	359.0	27.0	27.2	16.2	16.6
Ascorbic acid at 1000 ppm	75.3	76.3	24.0	34.0	8.4	12.2	348.0	360.0	27.2	27.3	16.3	16.7
Green tea at 250 ppm	65.0	65.9	24.0	30.0	8.2	10.6	341.0	352.3	24.0	27.3	14.0	14.3
Green tea at 500 ppm	67.9	68.8	24.0	31.0	8.3	11.0	344.0	356.0	25.0	24.3	14.6	15.0
Green tea at 1000 ppm	68.0	68.9	24.0	32.0	8.3	11.4	345.0	357.0	25.3	25.2	14.6	15.1
Salicylic acid at 50 ppm	58.3	59.2	23.0	28.0	7.6	9.6	330.0	341.3	21.9	25.3	13.0	13.3
Salicylic acid at 100 ppm	61.0	59.3	24.0	30.0	8.0	10.3	333.0	345.0	22.9	22.3	13.5	14.0
Salicylic acid at 200 ppm	61.7	60.6	24.0	31.0	8.0	10.7	335.0	346.6	23.0	23.3	13.6	14.1
Citric acid at 250 ppm	51.5	52.5	23.0	26.0	7.2	8.4	311.0	322.0	19.8	20.3	11.7	12.1
Citric acid at 500 ppm	54.6	55.8	23.0	27.0	7.2	8.8	315.0	327.0	20.7	21.0	12.2	12.6
Citric acid at 1000 ppm	55.0	56.0	23.0	27.0	7.3	8.9	318.0	329.0	21.0	21.3	12.3	12.7
New L.S.D. at 5 %	2.0	2.1	NS	2.0	0.5	0.6	9.9	10.0	0.5	0.6	0.5	0.4

Table 5. Effect of spraying green tea extract and some antioxidants on some physical and chemical characteristics of the berries of Thompson seedless grapevines during 2012 and 2013 seasons

Green tea extract and antioxidant treatments	Average berry weight (g.)		Average berry longitudinal (cm)		Average berry equatorial (cm.)		T.S.S. %		Total sugars %		Total acidity %	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Control	1.75	1.77	1.59	1.64	1.38	1.40	17.5	17.7	16.2	16.3	0.692	0.701
Ascorbic acid at 250 ppm	2.41	2.45	1.97	2.02	1.67	1.70	20.9	21.0	18.1	18.4	0.531	0.530
Ascorbic acid at 500 ppm	2.48	2.52	2.01	2.06	1.72	1.75	21.4	21.5	18.4	18.7	0.520	0.518
Ascorbic acid at 1000 ppm	2.50	2.55	2.01	2.07	1.73	1.75	21.5	21.6	18.5	18.8	0.517	0.515
Green tea at 250 ppm	2.20	2.25	1.83	1.89	1.57	1.60	20.0	20.1	17.5	17.8	0.572	0.571
Green tea at 500 ppm	2.30	2.35	1.88	1.94	1.60	1.64	20.4	20.5	17.8	18.1	0.551	0.550
Green tea at 1000 ppm	2.31	2.36	1.89	1.95	1.61	1.65	20.5	20.6	17.9	18.2	0.550	0.547
Salicylic acid at 50 ppm	1.98	2.03	1.73	1.80	1.48	1.51	19.0	19.1	17.0	17.4	0.620	0.618
Salicylic acid at 100 ppm	2.05	2.10	1.77	1.85	1.52	1.56	19.4	19.5	17.2	17.6	0.603	0.601
Salicylic acid at 200 ppm	2.06	2.11	1.78	1.86	1.53	1.57	19.5	19.6	17.3	17.6	0.601	0.599
Citric acid at 250 ppm	1.83	1.88	1.64	1.70	1.42	1.45	18.0	18.1	16.5	16.7	0.671	0.668
Citric acid at 500 ppm	1.90	1.99	1.68	1.77	1.45	1.48	18.4	18.5	16.7	17.0	0.650	0.647
Citric acid at 1000 ppm	1.91	2.00	1.69	1.78	1.46	1.49	18.5	18.6	16.8	17.1	0.647	0.646
New L.S.D. at 5 %	0.06	0.05	0.03	0.04	0.03	0.03	0.4	0.3	0.2	0.3	0.015	0.016

3.4 Discussion

The present promoting effect of antioxidants on fruiting of Thompson seedless grapevines could be explained on the light of their positive action on cell division, biosynthesis of organic foods and enhancing the tolerance of fruit crop trees to all stresses due to increasing antioxidants defense systems. Antioxidant action was determined by their ability to scavenge reactive oxygen species and inhibit the formation of lipid peroxidation [1].

The previous positive action of the investigated antioxidants on growth, vine nutritional status, yield and quality of the berries are in harmony with those obtained by [4,5,9]

The higher own content of green tea extract from different polyphenols namely gallic acid, catechin; theogallin, gallocatechin, epicatechin; pigalla catechin; vitamins A, C and E, flavonids, theonine, caffeine, tannius, volatile oils and zinc that counter the effects of reactive oxygen species and promote the activity of the plant cells [22] could explain the previous results. These results regarding the beneficial effects of plant extracts on growth and fruiting of fruit crops are in agreement with those obtained by [12,13,14,15]

4. CONCLUSION

Carrying out three sprays of ascorbic acid or green tea each at 500 ppm was responsible for promoting yield quantitively and qualitatively of Thompson seedless grapevines.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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