

Impact of Spraying Some Plant Extracts on Fruiting and Storability of Balady Mandarin Trees

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Abstract: During 2013 and 2014 seasons, Balady mandarin trees received three sprays of five plant extracts and oils namely extract of turmeric as well as oils of garlic, onion, eucalyptus and flax each at 0.05 to 0.1%. The merit was testing the effect of these plant extracts on growth, tree nutritional status, yield, fruit quality and storability of the fruits on the trees. Treating the trees three times with these plant extracts (turmeric extract and oils of garlic, onion, eucalyptus and flax) at 0.05 to 0.1% proved to be very effective in enhancing shoot length, leaf area and number of leaves / shoot, in the Spring growth cycle, leaf pigments, leaf content of N, P, K, Mg, Ca, Zn, Fe and Mn fruit setting, yield and fruit quality over the check treatment. All plant extract treatments effectively prolonged storage duration of fruits on the trees and reduced loss in fruit weight. Physical and chemical characteristics of the fruits stored on the trees were greatly improved due to using these plant extracts. The promotion on all the investigated parameters was slight among the two studied concentrations. (0.0 & 0.1%) Treating Balady mandarin trees three times with turmeric extract or oils of garlic and onion at 0.05 % was responsible for promoting yield, fruit quality and storability of fruits on the trees of Balady mandarin trees.

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1. Introduction

Recently, more efforts were done to eliminate the use of synthetic substances throughout agricultural practices. Using natural plant extracts were the new alternatives for improving yield, fruit quality and storability of fruit crops. The higher content of turmeric from K, yellow colouring pigments mainly curcumin and volatile oils (Peter, 1999) encourages the researchers to carry out many trials for using it as an important plant extract. The beneficial effects of garlic on fruiting of fruit crops might be attributed to its higher content of the sulphur containing compounds that are responsible for amino acids and ethylene biosynthesis (Koch and Lawson, 1996). Onion oil as previously mentioned by many authors (Fenwick and Hanley, 1990) contains higher amounts of nutrients, vitamins, amino acids, sulphur and volatile flavour compounds that are lead to promote yield and fruit quality. Many studies carried out by Kirtikar and Basu (1948) showed that eucalyptus oil had higher amounts of flavonoids, tannins and ketones. Omeh and Mezza (1998) and Haggerty, (1999) found that flax oil had many saturated fatty acids such as myrestic and unsaturated fatty acids such as linolenic, linolic and oleic acids. All compounds namely pigments, volatile oils, fatty acids, tannins and other antioxidants substances have antioxidant properties since they are responsible for preventing reactive oxygen species and increasing the

tolerance of the trees to all stresses and diseases (Govinaraecian, 1980).

Previous studies showed that application of plant extracts was beneficial in improving yield, fruit quality and storability of fruit crops (Al- Mahmoudi *et al.*, 2010; Abd El- Razeq *et al.*, 2011; Zaghoul *et al.*, 2011; Mohamed and Mohamed, 2013; Ahmed *et al.*, 2013; Al- Wasfy *et al.*, 2013; Ahmed and Gad El- Kareem, 2014; Refaai, 2014; Uwakiem, 2014; Ahmed, 2014; Mansour, 2015, Hegazy, 2015 and Abd El- Rahman, 2015).

The target of this study was examining the effect of five plant extracts namely turmeric extract and oils of garlic, onion, eucalyptus and flax on yield, fruit quality and storability of Balady mandarin trees grown under Minia region conditions.

2. Material and Methods

This study was conducted during 2013 and 2014 seasons on 33 nearly uniform and similar in vigour 12- years old Balady mandarin trees (*Citrus reticulata* L. Blanco) budded on sour orange rootstock in a private vineyard located at El- Hawatra village at eastern bank of Minia city, Minia Governorate where the soil is silty clay and well drained and with a water table not less than two meters deep. The selected trees planted at 4x4 meters apart. Surface irrigation system was followed. Common horticultural practices were carried out as usual.

Analysis of the tested soil at 0.0 to 90 cm depth was carried out according to the procedures that outlined by **Wilde *et al.* (1985)** and the obtained data are shown in Table (1).

Table (1): Analysis of the tested soil:

Constituents	Values
Particle size distribution	
Sand %	4.7
Silt %	60.0
Clay %	35.3
Texture %	Silt clay
pH (1: 2.5 extract)	7.92
E.C. (1: 2.5 extract) mmhos/ cm/ 25°C	1.72
O.M. %	1.42
CaCO ₃ %	2.22
Total N %	0.09
Available P (ppm, Olsen)	5.2
Available K (ppm, ammonium acetate)	402.2

The present experiment included the following eleven treatments from different plant extracts:

- 1- Control (untreated trees).
- 2- Spraying garlic oil at 0.05%.
- 3- Spraying garlic oil at 0.1%.
- 4- Spraying onion oil at 0.05%.
- 5- Spraying onion oil at 0.01%.
- 6- Spraying eucalyptus at 0.05%.
- 7- Spraying eucalyptus at 0.1%.
- 8- Spraying flax oil at 0.05%.
- 9- Spraying flax oil at 0.1%.
- 10- Spraying turmeric extract at 0.05%.
- 11- Spraying turmeric extract at 0.1 %

Table (2): Nutritional composition of turmeric

Constituent	Values
Water %	6.0
Protein %	8.5
Fat %	8.9
Carbohydrate %	69.9
Ash %	6.8
Ca %	0.2
P (mg/ 100 g)	260
N (mg/ 100 g)	30
K (mg/ 100 g)	2000
Fe %	47.5
Thiamine (mg/ 100 g)	0.09
Riboflavin (mg/ 100 g)	0.19
Niacin (mg/ 100 g)	4.8
Ascorbic acid (mg/ 100 g)	50

Source: **Peter (1999)**

Each treatment was replicated three times, one tree per each. The selected trees sprayed three times with the investigated plant extracts at the first week of March, May and July. Triton B as a wetting agent was added to all plant extract solutions at 0.05 % and

spraying was done till runoff (25 L water / tree). The untreated trees received water containing Triton B.

Randomized complete block design was followed for statistical analysis of the present investigation.

Table (3): Analysis of garlic oil

Constituent	Values
Protein %	3.2
Fat %	0.1
Carbohydrates %	13.8
Fibre %	0.4
ash %	81.5
Ca (gm)	220
Fe (gm)	1
Mg (gm)	11
P (gm)	79
K (gm)	212
Zn (gm)	1

Source: **Peter (1999)**.

Table (4): Analysis of onion

Constituent	Values
Moisture %	88.6
Protein %	0.9-1.60
Fat %	0.2%
Carbohydrates %	5.0- 9.0
Ash %	0.6
Elements (mg/ 100 g F.W.)	
Ca	190-540
P	200-430
K	80-110
Na	31-50
Mg	81-150
Al	0.5-1.0
Ba	0.1-1.0
Fe	1.8-2.6
Sr	0.08-7.0
B	0.6-1.0
Cu	0.05-0.64
Zn	1.5-2.8
Mn	0.5-1.0
S	50-51
Vitamin D (mg)	0.3
Riboflavin (mg)	0.05
Nicotinic acid (mg)	0.2
Vitamin C (mg)	10.0
Folic acid (mg)	16.0
Biotin (mg)	0.9
Pantotheonic acid (mg)	0.14
Cysteine	1.0-1.2
Cystine	1.4-1.7
Methionene	1.9-2.1
Arginine	2.2-2.5
Glutamic acid	2.3-2.7

Source: **Fenwich and Hanley, 1990.**

During both seasons, the following measurements were recorded:

- 1- Shoot length (cm.), leaf area (cm²) and number of leaves/ shoot in the Spring growth cycle (**Ahmed and Morsy, 1999**).
- 2- Chlorophylls a & b, total chlorophylls and total carotenoids (as mg / 100 g FW. (**Von - Wettstein, 1957**), total carbohydrates (**A.O.A.C., 2000**) and C/N in the leaves.
- 3- Leaf content of N, P, K, Mg and Ca (as %) and Zn, Fe, Mn and Cu (as ppm) (**Summer, 1985, Wilde et al., 1985**)
- 4- Percentages of initial fruit setting and fruit retention.
- 5- Yield expressed in weight (kg.) and number of fruits / tree.
- 6- Physical and chemical characteristics of the fruits namely weight (g.), height and diameter (cm.) of fruits, fruit shape, percentages of fruit peel weight, pulp and juice, fruit peel thickness (cm.), T.S.S.%, total acidity % (as a citric acid/ 100 ml juice, (**A.O.A.C., 2000**) and vitamin C content (mg/ 100 ml juice (**A.O.A.C., 2000**).
- 7- Storability measurements namely storage duration of fruits on the trees (days), fruit weight (g.), loss in fruit weight % fibrosis fruit %, T.S.S. %, total acidity %, total reducing and non – reducing sugars and vitamin C content (**A.O.A.C., 2000**).

Statistical analysis was done using new L.S.D at 5 % parameter (**Mead et al., 1993**).

3. Results and Discussion

1- Growth characters:

It is clear from the obtained data that spraying the trees with any one of the five plant extracts namely turmeric extract as well as oils of garlic, onion, eucalyptus and flax each at 0.05 to 0.1% significantly was accompanied with enhancing shoot length, leaf area and number of leaves / shoot in the Spring growth cycle over the check treatment. The promotion was slightly associated with increasing concentrations from 0.05 to 0.1%. The best plant extracts in this respect were turmeric extract and oils of garlic, onion, eucalyptus and flax, in descending order. The maximum values were recorded on the trees that treated with turmeric extract at 0.1%. The untreated trees produced the minimum values. These results were true during both seasons (Table 5).

2- Leaf chemical composition:

Data in Tables (5 to 8) clearly show that all plant extracts at 0.05 to 0.1% significantly enhanced chlorophylls a & b, total chlorophylls, total carotenoids, total carbohydrates, N, P, K, Mg, Ca, Zn, Fe and Mn in the leaves over the check treatment. The

promotion on these pigments and nutrients was slightly in proportional to increasing concentrations of each plant extract. The best plant extracts was turmeric extract followed by garlic oil and oil of flax occupied the last position in this respect. The studied plant extracts had no significant effect on the C/N and leaf content of Cu. Spraying the trees with turmeric extract at 0.1% gave the maximum values. These results were true during both seasons.

3- Fruit setting % and yield

It is clear from the data in Table (9) that treating the trees with any plant extracts at 0.05 to 0.1% significantly was followed by improving the percentages of initial fruit setting, and fruit retention, yield and number of fruits / tree rather than non-application. There was a slight and gradual stimulation on these parameters with increasing concentrations of each plant extract. Using turmeric extract as well as oils of garlic, onion, eucalyptus and flax, in descending order was significantly very effective in improving the percentages of initial fruit setting, fruit retention, yield and number of fruit/ tree. The maximum values of these parameters were recorded on the trees that supplied with turmeric extract at 0.1%. Economically point of view using turmeric extract at 0.05% gave yield/ tree reached 57.9 and 58.4 kg during both season, respectively, compared with the yield of untreated trees that reached 30.0 and 30.1 kg during both seasons, respectively. Similar results were announced during 2013 and 2014 seasons.

4- Fruit quality:

It is evident from the data in Tables (10 to 12) that treating the trees with any one of the five plant extracts (turmeric extract as well as one of plant extract namely garlic, onion, eucalyptus and flax) each at 0.05 to 0.1% significantly was very effective in improving fruit quality in terms of increasing weight, height and diameter of fruit, percentages of pulp and juice, T.S.S.%, total and reducing sugars and vitamin C content and decreasing fruit peel %, fruit peel thickness and total acidity % over the control treatment. The present plant extract treatments had no significant effect on fruit shape and percentage of non-reducing sugars. The promotion was insignificantly associated with increasing concentrations of each plant extract. The best plant extract in this respect was turmeric extract and flax oil ranked the last position in this respect. The best results from economical point of view were obtained on the trees that supplied with turmeric extract at 0.05%. These results were true during both seasons.

5- Storability characters:

It is clear from the data in Tables (13 & 14) that subjecting the trees to plant extracts namely turmeric extract as well as oils of garlic, onion, eucalyptus and

flax each at 0.05 to 0.1% significantly was accompanied with enhancing storage duration of the fruits on the trees, fruit weight, T.S.S. %, total and reducing sugars and vitamin C and decreasing the loss in fruit weight, fibrosis fruits %, and total acidity % over the check treatment. The effect of these plant extracts was significantly depended on the

concentration applied. Turmeric extract at 0.05 % gave the best results from economical point of view on storage duration as well as physical and chemical characteristics of the fruits. Untreated trees produced unfavourable effects on the storability of fruits on the trees. These results were true during both seasons.

Table (5): Effect of spraying some plant extracts on some growth characters and leaf pigments of Balady mandarin trees during 2013 & 2014 seasons.

Plant extract treatments	Main shoot length (cm.)		Leaf area (cm.)		No. of leaves / shoot		Chlorophylls a (mg/ 100 g F.W.)		Chlorophylls b (mg/ 100 g F.W.)		Total chlorophylls (mg/ 100 g F.W.)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1- Control (untreated trees)	31.3	32.0	6.62	6.70	26.0	25.6	8.1	7.9	3.1	3.0	11.2	10.9
2- Spraying garlic oil at 0.05%	38.4	39.1	7.66	7.75	40.0	39.0	11.3	11.5	5.6	6.0	16.9	17.5
3- Spraying garlic oil at 0.1 %	38.7	39.5	7.70	7.78	40.0	39.0	11.4	11.6	5.7	6.1	17.1	17.7
4- Spraying onion oil at 0.05%	36.8	37.5	7.41	7.49	37.0	37.7	10.3	10.5	5.0	5.4	15.3	15.9
5- Spraying onion oil at 0.1%	37.0	37.7	7.43	7.51	37.3	37.9	10.5	10.5	5.1	5.5	15.6	16.0
6- Spraying eucalyptus oil at 0.05%	34.6	35.3	7.15	7.24	34.0	34.0	9.5	9.4	4.1	4.5	13.6	13.9
7- Spraying eucalyptus oil at 0.1%	35.0	35.7	7.17	7.25	34.3	34.3	9.6	9.5	4.2	4.6	13.8	14.1
8- Spraying flax oil at 0.05%	32.7	33.5	6.85	6.94	30.0	30.0	8.7	8.8	3.5	3.8	12.2	12.6
9- Spraying flax oil at 0.1%	33.0	33.8	6.87	6.95	30.6	30.3	8.8	8.9	3.6	4.0	12.4	13.9
10- Spraying turmeric extract at 0.05%	41.1	41.8	8.11	8.33	42.3	43.0	12.2	12.4	6.1	6.5	18.3	18.9
11- Spraying turmeric extract at 0.1%	41.3	41.9	8.12	8.35	43.0	43.0	12.3	12.5	6.2	6.6	18.5	19.1
New L.S.D. at 5%	1.0	1.1	0.18	0.19	2.0	2.0	0.4	0.4	0.3	0.2	0.4	0.4

Table (6): Effect of spraying some plant extracts on total carotenoids and percentages of total carbohydrates N and P in the leaves of Balady mandarin trees during 2013 & 2014 seasons.

Plant extract treatments	Total carotenoids (mg/ 100 g F.W.)		of total carbohydrates		N %		P %	
	2013	2014	2013	2014	2013	2014	2013	2014
1- Control (untreated trees)	2.9	2.8	13.1	13.0	1.51	1.50	0.12	0.11
2- Spraying garlic oil at 0.05%	5.0	5.1	15.6	16.0	1.88	1.90	0.25	0.26
3- Spraying garlic oil at 0.1 %	5.1	5.2	15.7	16.1	1.89	1.91	0.26	0.27
4- Spraying onion oil at 0.05%	4.4	4.5	15.0	15.5	1.78	1.80	0.22	0.22
5- Spraying onion oil at 0.1%	4.5	4.5	15.1	15.5	1.79	1.81	0.23	0.23
6- Spraying eucalyptus oil at 0.05%	3.9	4.0	14.4	14.9	1.68	1.71	0.18	0.19
7- Spraying eucalyptus oil at 0.1%	4.0	4.1	14.5	15.0	1.69	1.72	0.19	0.20
8- Spraying flax oil at 0.05%	3.2	3.3	13.6	14.0	1.59	1.61	0.15	0.15
9- Spraying flax oil at 0.1%	3.3	3.4	13.7	14.0	1.60	1.62	0.16	0.16
10- Spraying turmeric extract at 0.05%	5.5	5.7	16.3	16.9	1.97	2.00	0.30	0.33
11- Spraying turmeric extract at 0.1%	5.6	5.8	16.4	17.0	1.98	2.01	0.31	0.34
New L.S.D. at 5%	0.3	0.4	0.4	0.4	0.06	0.05	0.02	0.02

Table (7): Effect of spraying some plant extracts on the leaf content of K, Mg and Ca (as %) and Fe, (as ppm) of Balady mandarin trees during 2013 & 2014 seasons.

Plant extract treatments	K %		Mg %		Ca %		Fe ppm	
	2013	2014	2013	2014	2013	2014	2013	2014
1- Control (untreated trees)	1.19	1.17	0.49	0.47	1.95	2.00	50.0	47.5
2- Spraying garlic oil at 0.05%	1.50	1.54	0.71	0.72	2.50	2.55	72.0	72.7
3- Spraying garlic oil at 0.1 %	1.51	1.55	0.72	0.73	2.51	2.57	72.9	73.6
4- Spraying onion oil at 0.05%	1.40	1.46	0.64	0.65	2.33	2.39	66.0	66.8
5- Spraying onion oil at 0.1%	1.41	1.47	0.65	0.65	2.35	2.40	66.7	67.5
6- Spraying eucalyptus oil at 0.05%	1.32	1.32	0.58	0.59	2.20	2.25	60.0	60.8
7- Spraying eucalyptus oil at 0.1%	1.33	1.33	0.59	0.60	2.21	2.26	60.7	61.5
8- Spraying flax oil at 0.05%	1.25	1.24	0.53	0.54	2.06	2.10	55.0	55.9
9- Spraying flax oil at 0.1%	1.26	1.25	0.54	0.55	2.07	2.11	55.3	56.0
10- Spraying turmeric extract at 0.05%	1.60	1.62	0.79	0.83	2.64	2.75	80.0	81.0
11- Spraying turmeric extract at 0.1%	1.60	1.63	0.80	0.84	2.65	2.76	81.0	81.7
New L.S.D. at 5%	0.04	0.04	0.03	0.04	0.07	0.08	3.1	3.4

Table (8): Effect of spraying some plant extracts on the leaf content of Zn, Mn and Cu (as ppm) and C/N in the leaves of Balady mandarin trees during 2013 & 2014 seasons.

Plant extract treatments	Zn ppm		Mn ppm		Cu ppm		C/N	
	2013	2014	2013	2014	2013	2014	2013	2014
1- Control (untreated trees)	55.0	54.9	61.0	61.0	59.9	1.9*2	1.90	8.7
2- Spraying garlic oil at 0.05%	80.0	81.2	79.9	79.9	80.0	1.94	1.90	8.3
3- Spraying garlic oil at 0.1 %	80.9	81.9	80.0	80.0	80.1	1.95	1.91	8.3
4- Spraying onion oil at 0.05%	71.5	72.3	75.9	75.9	76.0	1.94	1.90	8.4
5- Spraying onion oil at 0.1%	72.0	73.0	76.0	76.9	76.1	1.94	1.91	8.4
6- Spraying eucalyptus oil at 0.05%	65.0	66.0	71.9	71.9	72.0	1.93	1.92	8.6
7- Spraying eucalyptus oil at 0.1%	66.0	66.3	72.0	72.0	72.3	1.93	1.92	8.6
8- Spraying flax oil at 0.05%	60.0	60.9	66.0	66.0	66.7	1.93	1.92	8.6
9- Spraying flax oil at 0.1%	60.9	61.0	66.3	66.3	67.0	1.93	1.92	8.6
10- Spraying turmeric extract at 0.05%	87.9	90.0	88.0	88.0	89.0	1.95	1.93	8.3
11- Spraying turmeric extract at 0.1%	88.1	90.9	88.9	88.9	89.3	1.95	1.93	8.3
New L.S.D. at 5%	3.1	3.0	3.0	2.9	3.1	NS	NS	NS

Table (9): Effect of spraying some plant extracts on the percentages of initial fruit setting and fruit retention, yield and number of fruits / tree of Balady mandarin trees during 2013 & 2014 seasons.

Plant extract treatments	Initial fruit setting %		Fruit retention %		Yield / tree %		Number of fruits / tree	
	2013	2014	2013	2014	2013	2014	2013	2014
1- Control (untreated trees)	4.1	3.8	0.74	0.69	281.0	287.0	30.0	30.1
2- Spraying garlic oil at 0.05%	6.1	5.9	1.09	1.10	371.0	371.0	52.3	51.9
3- Spraying garlic oil at 0.1 %	6.2	5.9	1.10	1.11	372.0	373.0	52.8	52.6
4- Spraying onion oil at 0.05%	5.6	5.6	1.01	1.02	337.0	339.0	45.8	45.8
5- Spraying onion oil at 0.1%	5.7	5.7	1.02	1.02	338.0	340.0	46.3	46.1
6- Spraying eucalyptus oil at 0.05%	5.0	4.9	0.91	0.92	315.0	316.0	39.1	38.9
7- Spraying eucalyptus oil at 0.1%	5.1	5.0	0.92	0.92	317.0	317.0	39.6	39.3
8- Spraying flax oil at 0.05%	4.5	4.4	0.82	0.83	291.0	292.0	32.6	32.1
9- Spraying flax oil at 0.1%	4.5	4.4	0.83	0.84	292.0	293.0	33.0	32.5
10- Spraying turmeric extract at 0.05%	6.6	6.8	1.19	1.20	399.0	400.0	57.9	58.4
11- Spraying turmeric extract at 0.1%	6.7	7.0	1.20	1.21	400.0	402.0	58.4	59.1
New L.S.D. at 5%	0.4	0.4	0.06	0.07	15.0	14.9	1.3	1.4

Table (10): Effect of spraying some plant extracts on some physical characters of the fruits of Balady mandarin trees during 2013 & 2014 seasons.

Plant extract treatments	Fruit weight (g)		Fruit height (cm)		Fruit diameter (cm)		Fruit shape		Fruit peel %	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1- Control (untreated trees)	106.9	105.0	5.18	5.20	6.05	6.10	0.86	0.85	24.1	23.8
2- Spraying garlic oil at 0.05%	141.0	140.0	5.65	5.66	6.49	6.59	0.87	0.86	17.8	17.8
3- Spraying garlic oil at 0.1 %	142.0	141.0	5.66	5.67	6.50	6.60	0.87	0.86	17.6	17.6
4- Spraying onion oil at 0.05%	136.0	135.0	5.53	5.55	6.39	6.45	0.87	0.87	19.0	18.7
5- Spraying onion oil at 0.1%	137.0	135.6	5.54	5.55	6.40	6.47	0.87	0.86	18.9	18.6
6- Spraying eucalyptus oil at 0.05%	124.0	123.0	5.41	5.43	6.28	6.33	0.86	0.86	21.0	20.7
7- Spraying eucalyptus oil at 0.1%	125.0	124.0	5.42	5.44	6.29	6.34	0.86	0.86	20.9	20.6
8- Spraying flax oil at 0.05%	112.0	110.0	5.29	5.31	6.16	6.21	0.86	0.86	23.0	22.7
9- Spraying flax oil at 0.1%	113.0	111.0	5.30	5.32	6.17	6.22	0.86	0.86	22.9	22.6
10- Spraying turmeric extract at 0.05%	145.0	146.0	5.77	5.80	6.60	6.71	0.87	0.86	16.3	15.9
11- Spraying turmeric extract at 0.1%	146.0	147.0	5.78	5.81	6.61	6.73	0.87	0.86	16.2	15.8
New L.S.D. at 5%	11.1	11.9	0.09	0.10	0.09	0.10	NS	NS	0.8	0.9

Table (11): Effect of spraying some plant extracts on some physical and chemical characteristics of the fruits of Balady mandarin trees during 2013 & 2014 seasons.

Plant extract treatments	Pulp %		Juice %		Fruit peel thickness %		T.S.S. %		Total acidity %	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1- Control (untreated trees)	75.9	76.2	51.1	50.0	0.36	0.37	11.1	11.0	1.388	1.375
2- Spraying garlic oil at 0.05%	82.2	82.2	58.9	59.0	0.26	0.25	12.5	12.6	1.290	1.283
3- Spraying garlic oil at 0.1 %	82.4	82.4	59.0	59.1	0.26	0.24	12.6	12.7	1.288	1.281
4- Spraying onion oil at 0.05%	81.0	81.3	57.0	57.1	0.28	0.28	12.2	12.3	1.318	1.311
5- Spraying onion oil at 0.1%	81.1	81.4	57.6	57.5	0.28	0.27	12.3	12.4	1.317	1.310
6- Spraying eucalyptus oil at 0.05%	79.0	79.3	54.6	54.8	0.30	0.29	11.8	11.9	1.339	1.332
7- Spraying eucalyptus oil at 0.1%	79.1	79.4	55.0	55.0	0.29	0.28	11.9	12.0	1.338	1.331
8- Spraying flax oil at 0.05%	77.0	77.3	52.7	53.0	0.33	0.33	11.4	11.5	1.360	1.353
9- Spraying flax oil at 0.1%	77.1	77.4	53.0	53.1	0.32	0.32	11.5	11.6	1.358	1.352
10- Spraying turmeric extract at 0.05%	83.7	84.1	61.7	62.3	0.24	0.22	13.0	13.1	1.260	1.250
11- Spraying turmeric extract at 0.1%	83.8	84.2	62.0	62.7	0.23	0.21	13.1	13.2	1.259	1.249
New L.S.D. at 5%	0.9	1.0	1.3	1.4	0.02	0.02	0.02	0.02	0.019	0.018

Table (12): Effect of spraying some plant extracts on some physical and chemical characteristics of the fruits of Balady mandarin trees during 2013 & 2014 seasons.

Plant extract treatments	T.S.S. /acid		total – sugars %		Reducing sugars %		Non reducing sugars %		Vitamin C ((mg/ 100 ml juice)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1- Control (untreated trees)	8.0	8.0	7.50	7.46	3.29	3.25	4.21	4.21	31.9	32.0
2- Spraying garlic oil at 0.05%	9.7	9.8	8.01	8.02	3.73	3.75	4.28	4.27	41.9	42.4
3- Spraying garlic oil at 0.1 %	9.8	9.9	8.02	8.03	3.74	3.76	4.28	4.27	42.0	42.4
4- Spraying onion oil at 0.05%	9.3	9.4	7.94	7.95	3.60	3.61	4.34	4.34	38.9	39.4
5- Spraying onion oil at 0.1%	9.3	9.5	7.95	7.97	3.62	3.62	4.33	4.35	39.0	39.4
6- Spraying eucalyptus oil at 0.05%	8.8	8.9	7.81	7.82	3.47	3.48	4.34	4.34	36.0	36.5
7- Spraying eucalyptus oil at 0.1%	8.9	9.0	7.82	7.85	3.48	3.49	4.34	4.36	396.3	36.7
8- Spraying flax oil at 0.05%	8.4	8.5	7.62	7.63	3.36	3.36	4.26	4.27	33.3	33.7
9- Spraying flax oil at 0.1%	8.5	8.6	7.63	7.64	3.37	3.37	4.26	4.27	33.5	33.8
10- Spraying turmeric extract at 0.05%	10.3	10.5	8.14	8.24	3.89	3.91	4.25	4.33	47.8	47.6
11- Spraying turmeric extract at 0.1%	10.4	10.6	8.15	8.27	3.90	3.92	4.25	4.35	48.0	48.0
New L.S.D. at 5%	0.3	0.3	0.08	0.07	0.05	0.05	NS	NS	1.0	1.0

Table (13): Effect of spraying some plant extracts on storage duration of the fruits on the trees, fruit weight loss in fruit weight, fibrosis fruits % and T.S.S. % in the fruits of Balady mandarin trees during 2013 & 2014 seasons.

Plant extract treatments	Storage duration of the fruits (days)		Fruit weight at the end of storage		Loss in fruit weight %		Fibrosis fruits %		T.S.S. %	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1- Control (untreated trees)	20.0	22.0	95.4	95.3	10.8	9.2	50.0	49.7	11.5	11.3
2- Spraying garlic oil at 0.05%	37.0	40.0	131.9	131.5	6.5	6.1	22.0	20.0	13.8	14.0
3- Spraying garlic oil at 0.1 %	38.0	41.0	132.9	132.5	6.4	6.0	21.0	19.0	13.9	14.1
4- Spraying onion oil at 0.05%	33.0	36.0	126.8	126.2	6.8	6.5	30.0	28.0	13.1	13.3
5- Spraying onion oil at 0.1%	34.0	37.0	128.1	126.9	6.5	6.4	29.0	27.0	13.2	13.3
6- Spraying eucalyptus oil at 0.05%	28.0	30.0	115.3	114.3	7.0	7.1	37.0	34.0	12.6	12.8
7- Spraying eucalyptus oil at 0.1%	29.0	31.0	116.3	115.3	7.0	7.0	36.9	33.7	12.7	12.9
8- Spraying flax oil at 0.05%	25.0	26.0	103.0	100.7	8.0	8.5	42.0	39.0	12.0	12.3
9- Spraying flax oil at 0.1%	25.0	27.0	104.1	101.7	7.9	8.4	41.9	38.0	12.2	12.4
10- Spraying turmeric extract at 0.05%	46.0	48.0	137.8	138.4	5.0	5.2	11.9	10.0	14.0	14.8
11- Spraying turmeric extract at 0.1%	47.0	48.0	138.8	139.5	4.9	5.1	11.7	9.9	14.7	14.9
New L.S.D. at 5%	2.0	2.0	8.1	8.8	0.4	0.3	2.2	2.0	0.03	0.03

4. Discussion:

The outstanding effect of turmeric on growth characters, trees nutritional status, yield, fruit quality and storability of Balady mandarin trees might be attributed to its higher content of potassium oleorasin and oils, since oleoresin is considered a mixture of compounds namely curcumin, volatile oil, non-volatile fatty acids. It contains 0.5% volatile oil that composed from 60% turmeric 25% zingiberene – d-aphelle endrene, d- sabinene, cineole and forneol. Turmeric is valued mainly for its principal yellow colouring pigments namely curcumin, demethoxy curcumin. These compounds as antioxidants play an important roles in protecting plant cells from aging and were responsible for enhancing cell division and the biosynthesis of all organic foods (**Govinaerain, 1980 and Peter, 1999**).

The promoting effect of garlic oils on growth, fruiting and storability of Balady mandarin trees might be ascribed to its content of sulphur containing compounds, the amino acid allium which includes the presence of the volatile flavour compounds. Sulphur is responsible for the biosynthesis of amino acids and proteins that aid in the building of natural hormones

such as ethylene and enhancing cell division (**Koch and Lawson, 1996**).

The beneficial effects of onion oils on growth, yield, fruit quality and storability of Balady mandarin trees might be attributed to its higher content of various nutrients namely Ca, P, K, Na, Mg, Al, Ba, Fe, Sr, B, Cu, Zn, Mn and S vitamins B riboflavin, m nicotinic acid, C folix acid biotin and panththenic acid, amino acids namely cystine, systeine, methionene arginine and glutamic acid onion contains 50% sulphur that formed from non- protein amino acids which include the processors of volatile flavour compounds (**Fenwick and Hanley, 1990**).

The present results regarding the positive action of eucalyptus oil on fruiting and storability of Balady mandarin trees are in concordance with those obtained by many authors that it contains flavonoids namely eucalyptin hyperoside, querectin, quercian, rutin, rucalyptol, B- pinene, d- limonene, p- cymeme, σ – phelandrene, comphene, d- terpene and sesquiterpenes, ketones, tannins, gallic acid, caffeix acid. All compounds in eucalyptus have antioxidants properties, since they are responsible for preventing reactive oxygen species (**Kirtikar and Basu, 1948**).

Table (14): Effect of spraying some plant extracts on the chemical characteristics of the fruits of Balady mandarin trees during 2013 & 2014 seasons.

Plant extract treatments	Total acidity %		Total sugars %		Reducing sugars %		Non reducing sugars %		Vitamin C (100 / ml juice)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1- Control (untreated trees)	1.310	1.310	8.00	8.01	3.56	3.50	4.44	4.51	33.1	32.7
2- Spraying garlic oil at 0.05%	1.219	1.200	8.61	8.62	4.09	4.10	4.52	4.52	40.0	40.7
3- Spraying garlic oil at 0.1 %	1.216	1.199	8.62	8.63	4.10	4.11	9.52	4.52	40.6	41.4
4- Spraying onion oil at 0.05%	1.240	1.220	8.40	8.39	3.99	4.00	4.41	4.39	38.0	38.7
5- Spraying onion oil at 0.1%	1.238	1.218	8.42	8.40	4.00	4.01	4.42	4.39	38.9	39.7
6- Spraying eucalyptus oil at 0.05%	1.270	1.250	8.25	8.28	3.11	3.71	4.54	4.57	36.3	37.0
7- Spraying eucalyptus oil at 0.1%	1.269	1.249	8.27	8.29	3.73	3.73	4.54	4.56	36.4	37.1
8- Spraying flax oil at 0.05%	1.290	1.271	8.11	8.09	3.64	3.66	4.47	4.43	34.9	35.7
9- Spraying flax oil at 0.1%	1.288	1.270	8.12	8.10	3.65	3.67	4.47	4.43	35.0	35.8
10- Spraying turmeric extract at 0.05%	1.194	1.170	8.94	8.97	4.18	4.22	4.76	4.75	41.9	42.9
11- Spraying turmeric extract at 0.1%	1.190	1.167	8.95	8.98	4.19	4.24	4.76	4.74	42.0	43.0
New L.S.D. at 5%	0.017	0.016	0.08	0.08	0.04	0.05	NS	NS	0.9	1.0

The higher own content of flax seed oil from alpha saturated inolenic acid content and fatty acids such as myristic, stearic and palmitic acid as well as unsaturated fatty acids such as linolenic, linolic and oleic acids (Omah and Mezza, 1998 and Haggerty, 1999) could explain the present results.

The promoting effect of different plant extracts on growth, yield, fruit quality and storability of Balady mandarin trees are in harmony with those obtained by Al- Mohamoudi *et al.* (2010), Abd El-Razek *et al.* (2011), Zaghoul *et al.* (2011); Mohamed and Mohamed (2013); Ahmed *et al.* (2013); Abdelaal and Abd El- Rahman (2013), Al-Wasfy *et al.*, (2013); Ahmed and Gad El- Kareem (2014), Refaai (2014), Uwakiem (2014); Ahmed (2014); Mansour (2015), Hegazy (2015) and Abd El- Rahman (2015).

Conclusion:

The best results with regard to yield, fruit quality and storability of fruits of Balady mandarin. Trees were obtained due to spraying the trees three times with turmeric extract at 0.05%.

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