

Behavior of Valencia Orange Trees to Foliar Application of Some Plant Oils

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ABSTRACT

During 2013/2014 and 2014/2015 seasons, Valencia orange trees received three sprays; at growth start, directly after fruit setting and after one month with three plant oils; clove, ginger and turmeric each at 0.025, 0.05 and 0.1% besides the control treatment. Treating the trees three times with oil of clove, ginger or turmeric each at 0.025 to 0.1% effectively stimulated yield, fruit quality, leaf area and leaf content of pigments, N, P, K and Mg comparing with the control treatment. The promotion was related to the increase in concentrations of these plant oils. Negligible stimulation on all the previous parameters was revealed among the higher two concentrations namely 0.05 and 0.1%. Using oils of clove, ginger and turmeric was effective in an ascending order in this connection. It could be concluded that spraying Valencia orange trees grown under Assiut region conditions with turmeric oil (0.05%) three times resulted in the highest yield and the best fruit quality.

Keywords: Plant oils, clove oil, ginger oil, turmeric oil, Valencia oranges, yield, fruity quality.

INTRODUCTION

Recently, more efforts have been established to eliminate the use of chemicals throughout some horticultural practices. Using plant extracts such as natural oils which can be considered as new alternative for improving of the citrus yield as well as enhancing fruit quality and marketing.

The higher content of turmeric from K, amino acids, different nutrients, vitamins, antioxidants and plant pigments especially curcumin and volatile oils encourage the pomologists to undertake many attempts for using it as an important plant extract.

The clove, *Syzygium aromaticum* belongs to the family Myrtaceae. It is a source of eugenol in addition to containing nutrients like Ca, and K and vitamins such as thiamin, riboflavin, and niacin. It has antioxidant properties and it is a potent bactericide, nematocidal and fungicide (Tainter and Grenis, 1993 and Peter, 1999).

Ginger is a spice obtained from the rhizomes of *Zingiber officinale*, which belongs to family Zingiberaceae. It has excellent antioxidant properties and was responsible for reducing reactive oxygen species (Galal, 1996).

Previous studies showed that spraying plant extracts was useful in improving fruit quality and yield of various fruit species (Al-Mahmoudi *et al.*, 2010; Abd El-Razek *et al.*, 2011; Zaghoul *et al.*, 2011; Ahmed *et al.*, 2013; Al-Wasfy *et al.*, 2013; Kamra *et al.*, 2013; Melgarejo *et al.*, 2013; Mohamed and Mohamed, 2013; Mostafa and El-Yazal, 2013; Sellamuthu *et al.*, 2013; Ahmed *et al.*, 2014; Kim *et al.*, 2014; Mohamed *et al.*, 2014; Ahmed *et al.*, 2015; Hegazy, 2015; Mansour, 2015 and Shoug, 2015).

The main aim of the current study was testing the effect of certain concentrations of clove, ginger and turmeric oils on Valencia orange trees regarding the growth and fruiting.

MATERIALS AND METHODS

The current study was carried out during 2013/2014 and 2014/2015 seasons on thirty Valencia orange trees onto sour orange rootstock in a private orchard located at Sahel Saleem district, Assiut Governorate where the soil is well drained silty clay with a water table at least two meters deep. The selected trees were uniform in vigor 27-year old planted at 5x5 meters

apart and irrigated through surface irrigation system using Nile water. The selected trees received a basal recommended N, P, K and Zn Fe Mn fertilizers, the organic farmyard manure, pruning, hoeing, irrigation and pest management.

This study consisted of the following ten treatments:

- 1- Control (tap water)
- 2- Spraying clove oil at 0.025% (0.25 ml/L).
- 3- Spraying clove oil at 0.05% (0.50 ml/L).
- 4- Spraying clove oil at 0.1% (1.00 ml/L).
- 5- Spraying ginger oil at 0.025% (0.25 ml/L).
- 6- Spraying ginger oil at 0.05% (0.50 ml/L).
- 7- Spraying ginger oil at 0.1% (1.0 ml/L).
- 8- Spraying turmeric oil at 0.025% (0.25 ml/L).
- 9- Spraying turmeric oil at 0.05% (0.50 ml/L).
- 10- Spraying turmeric oil at 0.1% (1.0 ml/L).

Three replications one tree for each were employed for each treatment. The three plant oils (Tables 1, 2, 3) were sprayed three times; the first of which was at growth start (1st week of Mar.), the second time was just after fruit setting (mid. of Apr.) and the third time was after one month later (mid. of May). Triton B as a wetting agent was applied at 0.05% and the spray was done till runoff. Control trees were sprayed with tap water containing Triton B.

Table 1. Chemical analysis of turmeric oil

Constituent	Values (per 100 g)
Proteins	8.5 (g)
Ca	0.2 (g)
P	265 (mg)
Na	30 (mg)
K	2000 (mg)
Fe	47.5 (mg)
Thiamine	0.09 (mg)
Riboflavin	0.19 (mg)
Niacin	4.8 (mg)
Ascorbic acid	50 (mg)
Volatile oils	2.0%
Curcumin	2.9

Source: Peter (1999)

(RCBD) Randomized complete block design was followed:

Four one-year old branches were chosen / tree. Four shoots from the current spring growth cycle were labeled. To measure leaf area, twenty 7-month-old mature leaves were selected from non-fruiting shoots (1st week of July). The following equation reported by

Ahmed and Morsy (1999) was used; $La = 0.49 (L \times W) + 19.09$, where $La =$ leaf area (cm^2), $L =$ the maximum leaf length and $W =$ the maximum leaf width (cm). In fresh leaves, chlorophylls a and b, total chlorophylls and total carotenoids (mg/ 100 g F.W.) were determined according to the procedure of Von- Wettstein (1957).

Table 2. Chemical analysis of ginger oil

Constituent	Values (per 100 g)
Proteins	8.5 (g)
Ca	0.1 (g)
P	150 (mg)
Na	30 (mg)
K	1400 (mg)
Fe	11.3 (mg)
Thiamine	0.05 (mg)
Riboflavin	0.13 (mg)
Niacin	1.90 (mg)

Source : Peter and Kandiannan (1999) and Peter (1999)

Table 3. Chemical analysis of clove oil

Constituent	Values (per 100 g)
Proteins	5.98 (g)
Ca	61.2 (g)
P	0.67 (mg)
Na	105 (mg)
K	243 (mg)
Fe	1102 (mg)
Thiamine	8.68 (mg)
Riboflavin	0.115 (mg)
Niacin	0.267 (mg)
Ascorbic acid	1.458 (mg)
Volatile oils	80.81%
Curcumin	53
Total eugenol	91.0%

Source : Tainter and Grenis (1993)

To determine leaf content (%) of N, P, K and Mg, twenty 7-month old mature leaves picked from non-fruited shoots during the spring growth cycle (1st week of Sept.) were taken according to the method described by Summer (1985). These leaves were dried at 70°C to constant weight and digested using H₂SO₄ and H₂O₅ (according to the method described by Piper 1950). The digested solutions were used to measure N, P, K and Mg on dry weight basis according to the method described by Black *et al.* (1965) and Wilde *et al.* (1985).

Harvesting was done in the commercial harvesting time (Mid. of April) under Assiut Governorate conditions

in both seasons where TSS/ acid in the fruit juice of the control treatment reached 8 : 1 (according to Hulme, 1971). Yield was expressed in number of fruits/tree as well as weight (kg).

Ten fruits chosen randomly from each tree and from all directions were transferred to the laboratory for the determination of different physical and chemical characteristics of the fruits as follows:

- 1-Average fruit weight (g.) by using analytical balance.
- 2-Average fruit dimensions (height and diameter in cm by vernier caliper.
- 3-Average fruit peel weight (%) and thickness (cm.).
- 4-Total soluble solids (%) by using hand refractometer.
- 5-Total acidity (%) (as citric acid/ 100 ml juice) by titration against 0.1 N sodium hydroxide using phenolphthalein as an indicator according to AOAC (2000).
- 6-Total and reducing sugars (%) were determined according to the volumetric method stated by Lane and Eynon in AOAC (2000).
- 7-Vitamin C content (as mg ascorbic acid/ 100 ml juice) done by titration against 2.6 dichlorophenolindophenol according to AOAC (2000).

The obtained data were statistically analyzed according to the procedures of Snedecor and Cochran (1980). The individual comparisons on the investigated parameters in the present treatment means were compared using new L.S.D. test at 5%.

RESULTS AND DISCUSSION

1- Leaf area and its content of leaf pigments and nutrients:

The data shown in Tables (4 & 5) indicates that spraying Valencia orange trees three times with oils of clove , ginger and turmeric each at 0.025 to 0.1% significantly enhanced the leaf area, chlorophylls a & b , total chlorophylls , total carotenoids, N, P, K and Mg compared with the check treatment. The increase in these chemical constituents was in line with the increase in concentrations of these plant oils. Using oils of turmeric, ginger and clove, in a descending order was responsible for enhancing these parameters. The highest values were noticed on the trees sprayed three times with turmeric oil at 0.1% while the untreated trees (the control) showed the lowest values in both seasons.

Table 4. Effect of some plant oils on leaf area , leaf content of pigments, N and P of Valencia orange trees during 2013/2014 and 2014/2015 seasons.

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 (%)		Leaf P (%)	
	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015
	Control	29.1	29.0	5.1	5.0	2.1	2.1	7.2	7.1	1.9	2.0	1.61	1.54	0.18
Clove oil at 0.025%	31.0	30.9	5.7	5.8	2.5	2.7	8.2	8.5	2.2	2.4	1.71	1.64	0.21	0.22
Clove oil at 0.05%	32.3	32.9	6.2	6.3	2.9	3.1	9.1	9.4	2.5	2.8	1.79	1.74	0.24	0.25
Clove oil at 0.1%	32.6	33.0	6.3	6.5	3.0	3.1	9.3	9.6	2.6	2.9	1.80	1.75	0.25	0.26
Ginger oil at 0.025%	34.0	34.7	7.0	7.1	3.6	3.7	10.6	10.8	3.0	3.3	1.88	1.84	0.28	0.29
Ginger oil at 0.05%	35.6	36.0	7.5	7.7	4.2	4.4	11.7	12.1	3.3	3.7	1.99	1.91	0.31	0.32
Ginger oil at 0.1%	36.0	36.3	7.6	7.8	4.3	4.5	12.0	12.3	3.4	3.8	2.00	1.92	0.32	0.33
Turmeric oil at 0.025%	38.0	39.0	8.2	9.3	5.0	5.5	13.2	13.8	3.9	4.2	2.10	2.00	0.35	0.36
Turmeric oil at 0.05%	39.3	41.0	9.0	9.3	5.4	5.8	14.4	15.1	4.4	4.5	2.18	2.10	0.38	0.40
Turmeric oil at 0.1%	39.4	41.3	9.1	9.4	5.5	5.9	14.6	15.3	4.5	4.6	2.19	2.11	0.39	0.40
New L.S.D. at 5%	1.0	1.1	0.4	0.3	0.3	0.3	0.5	0.5	0.2	0.2	0.05	0.06	0.03	0.03

2- Yield per tree:

It is clear from the data shown in Table (5) that yield as weight (kg.) as well as number of fruits / tree significantly improved in response to spraying the three plant oils namely turmeric , ginger and clove each at 0.025 to 0.1% relative to the control. Increasing concentrations of each oil from 0.025 to 0.1% caused a gradual improvement on the yield. Meanwhile, promotion on the yield was observed when the concentrations were increased from 0.05 to 0.1%. The best oil in this respect was turmeric oil followed by ginger oil, while clove oil ranked the last

position in this connection. Significant differences on the yield among the three plant oils. From an economical point of view, the best results were recorded when the trees were sprayed three times with turmeric oil at 0.05%. Under the same treatment, yield per tree reached 61.5 and 62.0 kg in both seasons, respectively. Comparatively, the untreated trees yielded 35.2 and 36.9 kg/ tree during 2013 / 2014 and 2014/ 2015 seasons, respectively. Yield of trees treated with turmeric oil at 0.05% surpasses the non-treated ones by 74.7 and 68.0 % in both seasons, respectively.

Table 5. Effect of some plant oils on percentages of K and Mg in the leaves , yield and fruits physical Properties of Valencia orange trees during 2013/2014 and 2014/2015 seasons.

Treatments	leaf K (%)		Leaf Mg (%)		No.of fruits / tree		Yield/ tree		Fruit weight		Fruit diameter (cm)		Fruit height (cm)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
	/2014	/2015	/2014	/2015	/2014	/2015	/2014	/2015	/2014	/2015	/2014	/2015	/2014	/2015
Control	1.11	1.09	0.51	0.48	241.0	250.0	35.2	36.9	146.0	147.5	6.31	6.32	6.81	6.90
Clove oil at 0.025%	1.18	1.17	0.56	0.53	150.0	260.0	38.1	39.5	151.9	152.0	6.37	6.38	6.87	6.96
Clove oil at 0.05%	1.26	1.24	0.62	0.59	260	271.0	40.8	42.8	157.0	158.0	6.45	6.47	6.93	6.97
Clove oil at 0.1%	1.27	1.25	0.63	0.60	261	272.0	41.2	43.2	158.0	159.0	6.46	6.48	6.95	6.97
Ginger oil at 0.025%	1.36	1.32	0.70	0.67	272	285.0	45.7	48.5	168.0	170.0	6.56	6.59	7.02	7.06
Ginger oil at 0.05%	1.41	1.40	0.75	0.72	285	294.0	51.3	52.6	180.0	179.0	6.62	6.65	7.09	7.13
Ginger oil at 0.1%	1.42	1.41	0.76	0.76	286	245.0	51.8	53.1	181.0	180.0	6.63	6.66	7.10	7.14
Turmeric oil at 0.025%	1.50	1.47	0.82	0.78	301.0	303.0	57.5	57.9	191.0	191.0	6.71	6.75	7.16	7.22
Turmeric oil at 0.05%	1.56	1.53	0.87	0.83	312.0	313.0	61.5	62.0	197.0	198.0	6.81	6.85	7.22	7.30
Turmeric oil at 0.1%	1.57	1.54	0.88	0.84	313.0	314.0	61.9	62.3	198.0	198.5	6.82	6.86	7.23	7.31
New L.S.D. at 5%	0.05	0.05	0.04	0.03	8.0	8.0	2.5	2.6	4.9	5.0	0.04	0.04	0.05	0.05

3- Fruit quality:

Data in Tables (5 & 6) obviously reveal that subjecting Valencia orange trees three times to oils of turmeric , ginger and clove each at 0.025 to 0.1% was significantly favorable in enhancing fruit quality in terms of increasing weight, height and diameter of fruit, TSS%, total and reducing sugars and vitamin C and decreasing fruit peel weight and thickness and total acidity % compared with the control treatment. The enhancement was connected to the use of turmeric, ginger and clove oils, in a descending order. Increasing concentrations of oils was followed by a gradual promotion on fruit quality. The three plant oils showed significant differences regarding the fruit quality parameters. The higher two concentrations of each plant oil (0.05 and 0.1%) exhibited slight promotion in fruit

quality. Therefore, the best results in this connection were observed when the trees were sprayed three times with turmeric oil at 0.05% . Unfavorable aspects with respect to fruit quality were revealed on non-treated trees. Similar results were announced in both seasons.

The positive effect of oils turmeric , ginger and clove on growth , tree nutritional status , yield and fruit quality could be due to their higher content of proteins, Ca, P, K, Fe thiamine, Riboflavin, niacin, ascorbic acid, volatile oils, curcumin, carbohydrates, amino acids, and different pigments. (Tainter and Grenis, 1993, Peter, 1999 and Peter and Kandiannan, 1999). Most constituents of these plant oils are considered antioxidants that are responsible for reducing reactive oxygen species that destroys plant cells (Kamra *et al.*, 2012 and Kim, *et al.*, 2014).

Table 6. Effect of some plant oils on fruits physical and chemical properties of Valencia orange trees during 2013/2014 and 2014/2015 seasons.

Treatments	Fruit peel weight (%)		Fruit peel thickness(cm.)		TSS (%)		Total Acidity (%)		Reducing sugars %		Total Sugars (%)		Vitamin C content (mg/ 100 ml/ juice)		
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2015
	/2014	/2015	/2014	/2015	/2014	/2015	/2014	/2015	/2014	/2015	/2014	/2015	/2014	/2015	/2015
Control	21.5	21.0	0.36	0.37	11.6	11.4	1.460	1.466	3.1	3.0	7.0	7.9	41.6	42.0	
Clove oil at 0.025%	21.0	20.5	0.33	0.34	11.9	11.8	1.420	1.423	3.3	3.4	7.3	7.4	42.9	43.3	
Clove oil at 0.05%	20.4	20.0	0.30	0.31	12.3	12.2	1.390	1.392	3.5	3.6	7.6	7.7	44.1	44.5	
Clove oil at 0.1%	20.2	19.9	0.30	0.30	12.4	12.3	1.389	1.397	3.6	3.7	7.7	7.8	44.2	44.6	
Ginger oil at 0.025%	19.0	18.8	0.27	0.27	12.8	12.7	1.355	1.357	3.8	3.9	8.1	8.2	46.0	46.5	
Ginger oil at 0.05%	18.0	18.0	0.26	0.26	13.1	13.0	1.320	1.320	4.0	4.2	8.5	8.6	47.5	47.9	
Ginger oil at 0.1%	17.9	17.9	0.26	0.26	13.2	13.1	1.319	1.316	4.0	4.3	8.6	8.7	48.0	48.4	
Turmeric oil at 0.025%	16.3	16.0	0.24	0.23	13.4	13.3	1.281	1.261	4.2	4.6	9.0	9.1	50.0	50.5	
Turmeric oil at 0.05%	15.9	15.5	0.22	0.22	13.6	13.6	1.241	1.229	4.5	4.8	9.2	9.4	51.1	51.5	
Turmeric oil at 0.1%	15.8	15.5	0.22	0.21	13.7	13.7	1.240	1.228	4.6	4.9	9.3	9.5	51.2	51.7	
New L.S.D. at 5%	0.3	0.4	0.3	0.3	0.2	0.2	0.031	0.033	0.2	0.2	0.2	0.2	0.9	0.8	

The aforementioned results are in accordance with those obtained by Al- Mahmoudi *et al.* (2010); Abd El- Razek *et al.* (2011); Zaghoul *et al.* (2011); Al- Wasfy *et al.* (2013); Ahmed *et al.* (2013); Mohamed and Mohamed (2013); Ahmed *et al.* (2014 and 2015); Hegazy (2015); Mansour (2015) and Shoug (2015).

CONCLUSION

For promoting fruit yield and quality of Valencia orange trees cultivated under Assiut region, it is advised to spray the trees three times with turmeric oil at 0.05%.

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سلوك أشجار البرتقال الفالانشيا للرش الورقى لبعض الزيوت النباتية علاء عبد الجابر بدوى مسعود و رشاد عبدالوهاب ابراهيم قسم الفاكهه- كلية الزراعة- جامعة أسيوط- مصر

تم رش أشجار البرتقال الفالانشيا خلال موسمي ٢٠١٣/٢٠١٤، ٢٠١٤/٢٠١٥ ثلاثه مرات في بداية النمو الخضري، بعد عقد الثمار مباشرة وبعدها بشهر بثلاثة زيوت نباتية وهي زيوت القرنفل والجنزبيل والكركم بتركيز ٠.٠٢٥ و ٠.٠٥ و ٠.١% بالإضافة الى معاملة الكونترول. أدى رش الأشجار ثلاثة مرات بزيوت القرنفل والجنزبيل والكركم بتركيز ما بين ٠.٠٢٥ الى ٠.١% الى حدوث تحسن واضح في مساحة الورقة وصبغات الورقة والنتروجين والفوسفور والبوتاسيوم والمغنسيوم وكمية محصول الشجرة وخصائص الجودة للثمار وذلك بالمقارنة بمعاملة الكونترول وكان التحسن مرتبطا بزيادة التركيز المستخدم من هذه الزيوت وكان التحسن طفيفا غير معنوي على هذه الصفات ما بين التركيزين الاعلى من كل زيت نباتي وهي ٠.٠٥ إلى ٠.١% أن استخدام زيوت القرنفل والجنزبيل والكركم مرتبة ترتيبا تصاعديا يكون فعالا في هذا الصدد. أمكن الحصول على أفضل النتائج بخصوص كمية محصول الشجرة وخصائص الجودة للثمار في أشجار البرتقال الفالانشيا النامية تحت ظروف منطقة أسيوط عند رش الأشجار ثلاثة مرات بزيت الكركم بتركيز ٠.١%.

الكلمات الدالة: زيوت نباتية – زيت القرنفل – زيت الجنزبيل – أشجار البرتقال الفالانشيا.