Effect of spraying olive, garlic and clove oils on productivity and quality of superior seedless grapevine cultivar

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Abstract During 2016 and 2017 seasons, Superior grapevines grown under Minia region conditions treated three times with oils of olive, clove and garlic each at 0.05 to 0.2%. The merit was examining the effect of these plant oils on growth, vine nutritional status, yield and berries quality. Varying types of oils had an announced differences on all the investigated parameters. Treating the vines three times with oils of olive, clove and garlic each at 0.05 to 0.2% resulted in great promotion on growth aspects, plant photosynthetic, NPKMg, yield and quality parameters over the control. The best oils were clove, olive and garlic, in ascending order. Material differences on the studied parameters were detected among the three oils. Increasing concentrations of each plant oil was followed by a gradual promotion on all growth aspects, pigments, NPKMg, yield and quality parameters, except total acidity that tended to reduce gradually. The best results with regard to yield and berries quality of Superior grapevines grown under Minia region conditions were obtained due to treating the vines via leaves with garlic oil at 0.1% three times.
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1. Introduction

Recently, more efforts were done to eliminate the use of synthetic substances throughout using newly agricultural and horticultural practices for improving yield and fruit quality. Using natural plant extracts was the new alternative compounds for improving yield and fruit quality as safety agents for human and environment.

However, the use of natural products in horticultural practices instead of other synthetic chemical products is becoming a main target for many fruit crop species, where, the world markets has been growing rapidly in recent years for organic fruit production (**Dimitri and Oberholtzer, 2006**).

Recently, plant extracts are used for improving production and storability of grapes instead of using chemicals. The change for using plant extract against chemicals was performed because pathogens resistance to the fungicides has developed as well as for protecting our environment from pollution. The higher own content of these plant extracts from plant pigments, phenolic compounds, vitamins and essential oils seem to have synergistic effects on the yield of grapevines (**Kirtikare and Basu, 1984; Maia *et al.*, 2014 and Dhekney, 2016**).

Most antioxidants and vitamins in these plant extracts are responsible for protecting cells from agening and reducing the biosynthesis of reactive oxygen species (ROS), **(Robinson, 1973; Oretili, 1987 and Samiullah *et al.*, 1988**).

Previous studies showed that using oils and plant extracts were favourable in stimulating growth, vine nutritional status, yield and berries quality in different grapevine cvs (**Botelho *et al.*, 2007; Mekawy, 2008; Botelho *et al.*, 2010; El- Helw- Hanna *et al.*, 2011; Sabry- Gehabn *et al.*, 2011; Melgarejo *et al.*, 2013; Gad El- Kareem and Abd El- Rahman, 2013; Abdelaal and Aly, 2013; Sabry- Gehan *et al.*, 2014; Hamouda *et al.*, 2014. Uwakiem, 2014; Ahmed *et al.*, 2014; Abda, 2014; Osman 2014; Samra, 2015; Razkalla, 2016; Abd El- Jafez, 2017; Khalil, 2017 and Abo Al- Ola- Pakistan, 2018)**.

The merit of this study was examining the effect of spraying oils of clove, olive and garlic on fruiting of Superior grapevines.

2. Materials and methods

This study was carried out during the two consecutive seasons of 2016 and 2017 on 60 uniform in vigour own rooted 10 years Superior grapevines grown in a private vineyard located at El-Hawarta village Minia city, Minia Governorate, where the soil texture is sandy and well drained water since water table depth is not less than two meters. The chosen vines are planted at 2 x 3 meters apart. Cane pruning system was followed at the first week of Jan. during both seasons leaving 84 eyes per vine (on the basis of 6 fruiting canes x 12 eyes plus six renewal spurs x two eyes). The vines were irrigated through surface irrigation system.

Except those dealing with the present treatments (application of plant extracts), all the selected vines (60 vines) received the usual horticultural practices that are commonly applied in the vineyard including the application of 10 tons F.Y.M. and 120 kg ammonium nitrate, 100 kg triple calcium phosphate 200 kg potassium, sulphate (48 % K_2O). as well as chelated Zn (21% Zn) and Mn (13% Mn) and chelated Fe each at 0.05 % via leaves. F.Y.M. was added once just after winter pruning (3rd week of January). Mineral N was splitted in three unequal bakege. Another horticultural practices such as twice hoeings, irrigation, pinching and pest management were carried out as usual.

Soil is classified as clay in texture with water table depth not less than two meters deep. The results of orchard soil analysis according to (**Wilde *et al.*, 1985** are given in Table (1).

Table (1): Mechanical, physical and chemical analysis of the tested orchard soil:

Characters	**Values**
Particle size distribution	
Sand %	10.5
Silt %	28.1
Clay %	61.4
Texture grade	clay
pH (1:2.5 extract)	8.0
E.C. (1: 2.5 extract) mmhos/ 1cm/ 25°C)	0.9
O.M. %	2.09
CaCO%	1.22
Macronutrients values	
Total N%	1.0
P (olsen method, ppm)	20.0
K ammonium acetate, ppm)	419
Mg (ppm)	80
S (ppm)	6.9
B (hot water extractable) (ppm)	0.27
EDTA extractable micronutrients (ppm)	
Zn	1.31
Fe	1.1
Mn	1.00
Cu	0.88

This experiment included the following ten treatments from three plant oils is namely clove, olive and garlic.

1- Control.
2- Spraying olive oil at 0.05%.
3- Spraying olive oil at 0.1 %.
4- Spraying olive oil at 0.2 %.
5- Spraying clove oil at 0.05 %.
6- Spraying clove oil at 0.1 %.
7- Spraying clove oil at 0.2 %.
8- Spraying garlic oil at 0.05 %.
9- Spraying garlic oil at 0.1 %.
10- Spraying garlic oil at 0.2 %.

Each treatment was replicated three times, two vines per each. Plant oils (clove, olive and garlic) were sprayed three times started on growth start last week of Feb.) just after berry setting 1st week of Apr.) and at one month later first week of May) using Triton B as a wetting agent at 0.05%. Spraying was done till runoff.

A randomized complete block design (RCBD) was followed where this experiment included ten treatments each replicated three time two vines per each.

At the last week of May during both seasons, twenty mature leaves from the opposite side to the basal clusters on the shoots were picked for calculating the leaf area using the following equation outlined by **Ahmed and Morsy (1999)**

Leaf area (cm^2) = 0.45 0.79 x diameter ^{2}) + 17.77.

The average leaf area was recorded. Average main shoot length (cm) was recorded as a result of measuring the length of ten shoots per vine (cm) and the average shoot length was recorded. Number of leaves per shoot was also recorded Dynamic of wood ripening coefficient was calculated by dividing the length of the ripened part of shoot that had brownished colour by the total length of the shoots (green colour) in the ten shoots/ vine (middle of Oct.) according to **Bouard (1966)**. Weight of pruning (kg.) / vine was recorded just after carrying out pruning by

weighing the removal one year old wood (1st week of Jan.). Average cane thickness (cm) was estimated in the five basal internodes of ten canes per vine by using a Vernier caliper.

Fresh leaves of each vine were cut into small pieces and a known sample (0.5 g) from each sample was taken, homogenized and extracted using 25% acetone with the assistance of little amounts of Na_2CO_3 and clean sand. Filtration was washed several times with acetone till the filtrate was colorless. Acetone was used as a blank. In the filtrates, the optical density was determined using spectrophotometer at the leave length of 662 and 644 mm to determine chlorophylls a and b, respectively. The following equations were used for determination of these plant pigments according to **Von- Wettstein (1975).**

Ck.1= (9.784- E 622) – 0.99 - E 644) = mg/1

Ch.b = (21.246- E 644) – 4.65- E 662) + mg/l

Total chl.= ch.A + Ch.B

where E= optical density at a given wave length. Calculations were estimated as mg/ 100 g F.W.

Petioles of the same leaves that were taken for measuring the leaf area according to **Balo *et al.*, (1988)** were washed several times with water and distilled water and then oven dried at 70°C and grounded, then 0.5 g weight of each sample was digested using H_2SO_4 and H_2O_2 until clear solution (**Chapman and Pratt, 1965**). In the digesterd solutions, the following nutrients were determined:

1- N % by the modified micro Kejdahl method as described by (**Peach and Tracey, 1968**).

2- P % by using Olsen method as reported by **Wilde *et al.*, (1985)**.

3- K % by using flame photometer as outlined by (**Wilde *et al.*, 1985**).

4- Mg as ppm by titration against EDTA (versene method) (**Peach and Tracey, 1968**).

When T.S.S./ acid in the control treatment reached 25:1, clusters were harvested of (2nd week of June). The yield of each vine was recorded in terms of weight (kg.) and number of clusters/ vine. Five clusters per each vines were taken for determination of the following physical and chemical characteristics of the berries.

1- Average cluster weight (g.) and average cluster compactness (number of berries / cluster length).

2- Percentage of shot berries by dividing number of small berries by total number of berries and multiplying the product by 100.

3- Average berry weight (g.) and dimensions (longitudinal and equatorial in cm).

4- Percentage of total soluble solids in the juice by using handy refractometer.

5- Percentage of total acidity in the juice as a tartaric acid/ 100 ml juice) by titration against 0.1 N NaOH using phenolphthalein indicator (**A.O.A.C., 2000**).

6- The ratio between T.S.S. and acid.

7- The percentage of reducing sugars in the juice (**Lane and Eynon, 1965**) as described by **A.O.A.C. (2000)**.

Statistical analysis was done and the different treatment means were compared using new L.S.D. at 5% (**Snedecor and Cochran, 1980 and Steel and Torrie, 1980**).

3. Results and discussion

1-Vegetatiev growth aspects:

It is clear from the data in Table (2) that treating the vines with oils of clove, olive and garlic each at 0.05 to 0.2% significantly enhanced the six growth aspects namely main shoot length, number of leaves/ shoot, leaf area, wood ripening coefficient, cane thickness and pruning wood weight relative to the control. The promotion on these growth aspects was associated to the increase in concentrations of each oil type. The application of clove, olive and garlic oils, in ascending order caused significant increase on these growth traits. Increasing concentrations of each oil from 0.1 to 0.2% failed to show significant promotion on these growth characteristics. The maximum values were recorded on the vines that received three sprays of garlic oil at 0.2%. The untreated vines produced the lowest values. These results were true during both seasons.

2- Leaf chemical components:

As shown in Table (3) chlorophylls a & b, total chlorophylls N, P, K, Mg were significantly enhanced in response to subjecting the vines to any one of the there plant oils at 0.05 to 0.2% over the control. There was a gradual promotion on these chemical constituents with increasing concentrations of each oil from 0.05 to 0.2%. Meaningless promotion on these leaf chemical components was observed among the higher two concentrations of each oil namely 0.1 and 0.2 %. The maximum values were recorded on the vines treated with clove, olive and garlic, in ascending order. Treating the vines three times with garlic oil at 0.2% gave the maximum values.

The minimum values were recorded on the untreated vines. Similar trend was noticed during both seasons.

3- Yield/ vine:

It is obvious from the data in Table (4) that treating Superior grapevines three times with oils of clove, olive or garlic each at 0.05 to 0.2% significantly was responsible for improving the yield expressed in weight and number of clusters per vine relative to the control. There was a gradual promotion

on the yield with increasing concentrations of each oil from 0.05 to 0.2%. Significant differences on the yield were observed among all the higher two concentrations namely 0.1 and 0.2 %. The best oil that was responsible for promoting the yield was garlic oil followed by olive oil and clove oil ranked the last position in this respect. The maximum yield (12.5 & 18.0 kg) from economical point of view was presented in the vines that received garlic oil at 0.1% (since no significant promotion was recorded among the higher two concentrations namely 0.1 and 0.2% during both seasons, respectively. The untreated vines produced the minimum values (10.3 & 10.4 kg) during both seasons, respectively. The percentage of increment on the yield due to application of the previous recommended treatment over the control reached 21.4 and 73.1% during 2016 and 2017 seasons, respectively. Number of clusters in the first season of study was significantly unaffected by the oil treatments. These results were true during both seasons.

4- Weight and compactness of cluster

It is evident from the data in Table (4) that subjecting the vines to the oils of clove, olive and garlic each at 0.05 to 0.2% three times was significantly followed by improving weight and compactness of cluster over the control. The promotion was associated with increasing concentrations of oils. The best oil in this connection was garlic oil followed by olive oil and clove oil ranked the last position in this respect. No. significant promotion was observed on weight and compactness of cluster among the higher two concentrations of each oil. The maximum values were recorded on the vines that received garlic oil at 0.2%. The lowest values were recorded on the untreated vines. These results were true during both seasons.

5- Physical and Chemical characteristics of the berries

It is clear from the data in Tables (4 & 5) that treating Superior grapevines three times with oils of clove, olive and garlic each at 0.05 to 0.2% was significantly very effective in improving quality of the berries in terms of increasing berry weight and dimensions (equatorial and longitudinal), T.S.S. reducing sugars %, T.S.S. /acid and reducing total acidity % relative to the control. There was a progressive promotion on quality of the berries with increasing concentrations of the three oils. The best oil was garlic oil followed by olive oil. Glove oil occupied the last position in this respect. Increasing concentrations of each oil form 0.1 to 0.2 % failed to show significant promotion on quality of the berries. From economical point of view the best results with regard to quality of the berries were obtained due treating the vines three times with garlic oil at 0.1% (since no significant promotion was recorded among the higher two concentrations). The untreated vines produced unfavourable effects on quality of the berries. These results were true during both seasons.

Table (2): Effect of spraying olive, garlic and clove oils on some vegetative growth aspects of Superior grapevines during 2016 and 2017 seasons.

Treatments	Main shoot length (cm)		No. of leaves. shoot		Leaf area (cm)2		Wood ripening coefficient		Cane thickness (cm)		Pruning wood kg./ vine	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	103.3	104.3	14.0	13.0	107.1	108.0	0.59	0.60	0.78	0.85	2.11	2.04
Olive oil at 0.05 %	108.3	109.2	20.7	21.0	112.5	113.4	0.75	0.74	0.92	0.99	2.75	2.80
Olive oil at 0.1 %	110.0	110.9	22.8	23.0	114.0	114.9	0.80	0.79	0.96	1.05	3.06	3.04
Olive oil at 0.2 %	110.3	111.2	23.0	23.0	114.3	115.2	0.81	0.80	0.97	1.06	3.06	3.05
Clove oil at 0.05%	105.0	106.0	16.0	17.0	108.6	109.5	0.64	0.66	0.82	0.90	2.31	2.37
Clove oil at 0.1 %	106.1	107.1	18.0	20.0	110.7	111.6	0.70	0.72	0.87	0.96	2.52	2.60
Clove oil at 0.2 %	106.3	107.3	18.6	20.0	111.0	111.7	0.71	0.72	0.88	0.98	2.54	2.61
Garlic oil at 0.05%	112.0	112.9	25.0	26.0	116.0	118.0	0.86	0.87	1.05	1.17	3.22	3.31
Garlic oil at 0.1 %	113.3	115.0	27.0	29.0	117.5	120.0	0.90	0.91	1.11	1.25	3.50	3.60
Garlic oil at 0.2 %	113.7	115.6	27.3	29.0	118.0	120.7	0.91	0.92	1.12	1.27	3.53	3.61
New L.S.D. at 5%	1.0	0.7	2.0	3.0	1.1	0.7	0.04	0.03	0.003	0.04	0.14	0.12

Table (3): Effect of spraying olive, garlic and clove oils on the leaf chemical components of Superior grapevines during 2016 and 2017 seasons.

Treatments	Chlorophyll a (mg/ g F.W.)		Chlorophyll b (mg/ g F.W.)		Total Chlorophylls (mg/ g F.W.)		Leaf N %		Leaf P %		Leaf K %		leaf Mg %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	4.1	3.8	1.2	1.1	5.3	4.9	1.59	1.60	0.14	0.13	1.15	1.12	0.59	0.57
Olive oil at 0.05 %	5.3	5.4	2.1	2.1	7.4	7.5	1.77	1.78	0.21	0.22	1.36	1.35	0.65	0.65
Olive oil at 0.1 %	5.8	5.9	2.3	2.4	8.1	8.3	1.83	1.84	0.24	0.25	1.42	1.41	0.70	0.70
Olive oil at 0.2 %	5.9	5.9	2.3	2.5	8.2	8.4	1.84	1.85	0.25	0.25	1.42	1.41	0.71	0.71
Clove oil at 0.05%	4.4	4.5	1.4	1.5	5.8	6.0	1.65	1.67	0.17	0.16	1.21	1.20	0.64	0.65
Clove oil at 0.1 %	4.8	5.0	1.7	1.8	6.5	6.8	1.71	1.71	0.19	0.18	1.29	1.28	0.69	0.70
Clove oil at 0.2 %	4.9	5.1	1.8	1.9	6.7	7.0	1.72	1.72	0.19	0.19	1.29	1.28	0.70	0.71
Garlic oil at 0.05%	6.4	6.5	2.6	2.7	9.0	9.2	1.90	1.91	0.27	0.28	1.50	1.51	0.75	0.76
Garlic oil at 0.1 %	6.7	6.8	3.0	2.9	9.7	9.7	1.96	1.97	0.30	0.30	1.59	1.60	0.79	0.80
Garlic oil at 0.2 %	6.8	6.8	3.0	3.0	9.8	9.8	1.97	1.99	0.31	0.30	1.60	1.61	0.80	0.82
New L.S.D. at 5%	0.3	0.3	0.2	0.2	0.3	0.3	0.4	0.05	0.02	0.02	0.05	0.06	0.04	0.06

Table (4): Effect of spraying olive, garlic and clove oils on yield weight and compactness sof cluster and weight and longitudinal of berry of Superior grapevines during 2016 and 2017 seasons.

Treatments	No. of clusters / vine		Yield./ (kg.). vine		Av., cluster weight (g.)		Cluster compactness		Av. Berry weigh		Av. Berry longitudinal (cm)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	23.0	23.0	10.3	10.4	446	451	4.0	3.99	3.50	3.49	2.11	2.09
Olive oil at 0.05 %	24.0	29.0	11.6	14.2	485	490	4.41	4.50	3.72	3.75	2.22	2.23
Olive oil at 0.1 %	24.0	30.0	11.9	15.0	496	501	4.55	4.65	3.80	3.83	2.26	2.27
Olive oil at 0.2 %	24.0	30.0	11.9	15.1	497	502	4.56	4.66	3.81	3.84	2.27	2.28
Clove oil at 0.05%	24.0	25.0	11.0	11.7	460	466	4.11	4.20	3.57	3.60	2.14	2.15
Clove oil at 0.1 %	24.0	27.0	11.3	12.9	471	477	4.26	4.35	3.65	3.70	2.17	2.19
Clove oil at 0.2 %	24.0	27.0	11.3	12.9	472	478	4.27	4.36	3.66	3.71	2.18	2.20
Garlic oil at 0.05%	24.0	32.0	12.2	16.5	510.0	516	4.71	4.82	3.90	3.95	2.31	2.31
Garlic oil at 0.1 %	24.0	34.0	12.5	18.0	522.0	529	4.85	4.99	3.99	4.02	2.35	2.36
Garlic oil at 0.2 %	24.0	34.0	12.6	18.0	523.0	530	4.86	5.00	4.00	4.04	2.36	2.37
New L.S.D. at 5%	NS	2.0	0.3	0.6	11.0	11.2	0.11	0.12	0.06	0.07	0.03	0.04

Table (5): Effect of spraying olive, garlic and clove oils on average berry weight and some chemical characteristics of the berries of Superior grapevines during 2016 and 2017 seasons.

Treatments	Av. Berry equatorial		T.S.S. %		Total acidity %		T.S.S. /acid		Reducing sugars %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	1.82	1.81	16.9	17.0	0.677	0.678	25.0	25.1	15.5	15.4
Olive oil at 0.05 %	1.95	1.97	18.6	18.7	0.629	0.629	29.6	29.7	16.8	16.9
Olive oil at 0.1 %	1.98	2.00	19.1	19.2	0.609	0.610	31.4	31.5	17.2	17.2
Olive oil at 0.2 %	2.00	2.01	19.2	19.3	0.608	0.609	31.6	31.7	17.3	17.3
Clove oil at 0.05%	1.86	1.87	17.4	17.5	0.663	0.666	26.2	26.5	15.8	16.0
Clove oil at 0.1 %	1.90	1.92	18.0	18.1	0.649	0.650	27.7	27.8	16.3	16.3
Clove oil at 0.2 %	1.91	1.93	18.1	18.1	0.648	0.648	27.9	27.9	16.4	16.4
Garlic oil at 0.05%	2.05	2.06	19.7	20.0	0.590	0.588	33.4	34.0	17.8	18.0
Garlic oil at 0.1 %	2.10	2.11	20.1	20.3	0.575	0.570	35.0	35.6	18.2	18.3
Garlic oil at 0.2 %	2.11	2.12	20.2	20.4	0.574	0.569	35.2	35.9	18.3	18.3
New L.S.D. at 5%	0.02	0.03	0.4	0.3	0.011	0.010	0.9	0.8	0.3	0.2

4. Discussion

1- Effect of plant extracts:

The present promoting effect of plant oils on vegetative growth characteristics, leaf nutrients, yield and quality of the berries of Superior grapevines might be attributed to its higher content of vitamins beta carotene, E.A, B1, B12, C and K as well as essential nutrients namely N, P, K, Mg, Ca and some amino acids namely lysine, lucine, threonine, isoleucine, arginine, cysteine, methionine and tyrptophan. The occurrence of vitamins and amino acids as important antioxidants is accompanied with preventing reactive oxygen species (ROS) and protecting plant cells from aging and death as well as enhancing cell division, biosynthesis of pigments and most organic foods the tolerance of plants to biotic and abiotic stress **Robinson, (1973); Oretili, (1987) and Samiullah *et al.*, (1988).** The higher content of essential nutrients of these plant extracts surely reflected on stimulating cell division, photosynthesis, pigments formation and building of most organic foods (**Nijjar, 1985**).

These results are in agreement with those obtained by **Botelho *et al.*, (2007)** on Cabernet Sauvignon grapevines **Mekawy, (2008)** on Red Roomy grapevines, **Botelho *et al.*, (2010)** on Nigara grapevines, **El- Helw- Hanaa *et al.*, (2011)** on Flame seedless grapevines, **Gad El- Kareem and Abd El-Rahman (2013)** on Ruby seedless grapevines, **Abdelaal and Aly, (2013)** on Ruby seedless grapevines, **Ahmed *et al.*, (2014)** on Superior grapevines, **Uwakiem (2014), Abada (2014), Hamouda *et al.*, (2014)** on Thompson seedless grapevines, **Samra (2015)** on Crimson seedless grapevines **Rizkalla (2016)** on Flame seedless grapevines and Thompson seedless grapevines and **Abo Al- Ola - Pakestan (2018)** on Superior grapevines.

Conclusion:

Carrying out there sprays at growth start, just after berry setting and at one month later of garlic oil at 0.1% gave the best results with regard to yield and berries quality of Superior grapevine.

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