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Effect of Spraying Gibberellic Acid (GA_3), Camphor Oil and Mixture of Them on Fruit Quality of "Manfalouty" Pomegranate Cultivar

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Abstract

This work was carried out at the experimental orchard of Pomology Department, Faculty of Agriculture, Assiut University to study the effect of spraying gibberellic acid (GA_3) (25 and 50 ppm), camphor oil (2 and 3 cm^3/L) and a mixture of them on fruit quality of "Manfalouty pomegranate" cultivar. The selected pomegranate trees were divided into three groups, the first group was sprayed at 6 weeks after fruit setting (the 1st time), the second group was sprayed at 6 weeks after the 1st time (The 2nd time), and the third group was sprayed twice (at the 1st and the 2nd time) during 2016 and 2017 seasons.

Since both of GA_3 and camphor oil play an important role in physiological and biological processes of plants. Recently, camphor oil was successfully used in synthezing carbon nanotubes as chemical vapor deposition process (Kumar and Ando, 2007).

Hence, the main objective of this study was to examine spraying a mixture of GA_3 (25 and 50 ppm) plus camphor oil (2 and 3 cm^3/L) on improving fruit quality of Manfalouty pomegranate cv.

According to the obtained results of this investigation all the treatments, specially the mixture of GA_3 and camphor oil increased fruit weight (g), aril weight/fruit, juice volume (cm^3)/100 g arils as well as the TSS % and TSS/TA ratio in fruit juice. Also, this mixture slightly decreased both of peel weight/fruit and the titratable acidity % (TA) during the two studied seasons.

Therefore, it could be recommended that spraying with a mixture of gibberellic acid (GA_3) plus camphor oil for improving fruit quality of Manfalouty pomegranate cv. under the conditions of this study.

Keywords: *Gibberellic acid, Camphor oil, Manfalouty Pomegranate cv., Fruit quality.*

Introduction

Pomegranate (*Punica granatum* L.) is one of the most important fruit crop in the tropical and sub-tropical regions.

Manfalouty pomegranate cv. is considered one of the most important cultivars grown in Upper Egypt. Pomegranate considered one of the esteemed dessert fruits. It is also highly valued for its nutritional and medicinal components benefits (Bakeer, 2016 and El-Akkad *et al*., 2016). Moreover, it is considered an important source of Anthocyanins, vitamin E and vitamin C, Shukla *et al*. (2008). GA_3 affects vegetative growth, flowering yield and fruit properties of pomegranate trees (Khalil and Aly, 2013, Merwad *et al*., 2016). Also, it can reduce the percentage of fruit cracking, Hegazi *et al*. (2014) and El-Akkad *et al*. (2016). Carbon nanotubes were successfully synthesized using camphor oil in chemical vapor deposition process (Kumar and Ando, 2007).

Many researchers dealing with the effect of natural extracts of plants on fruiting, fruit quality characteristics and yield of fruit crop trees (El-Boray *et al*., 2007; Badawy *et al*., 2011; Abada, 2014; Mostafa *et al*., 2015; El-Kenawy, 2018 and Faissal and Asmaa, 2019). Essential oils such as camphor oil a terpenoid with the chemical formula ($C_{10}H_{16}O$) and a strong aromatic odor (Mann *et al*., 1994). Have been investigated as alternative measures against pathological breakdown (Badawy *et al*., 2011). Mostafa *et al*. (2015) reported that spraying camphor oil increased weight of yield and berry quality of grapes. These result could be due to the enhancement effect of it on reducing the respiration rate by making a thin film of oil surrounding the fruit peel and induced a modification of microclimatic conditions of fruit. This investigation aimed to study the effect of spraying gibberellic acid (GA_3), camphor oil and a mixture of them on improving fruit quality parameters of "Manfalouty " pomegranate cultivar grown under Assiut climatic conditions.

Material and Methods

This study was carried out during two successive seasons of 2016, 2017 on Manfalouty Pomegranate cv. grown in clay soils and spaced 5x5 m apart in the Orchard of Faculty of Agriculture, Assiut University, Egypt.

The selected trees were healthy, nearly uniformed in shape, size and productivity, free of damage and insects.

This investigation included the following nine treatments:

1- Control (spraying with water only).
2- Spraying with 25 ppm gibberellic acid.
3- Spraying with 50 ppm gibberellic acid.
4- Spraying with 2 cm^3/L camphor oil.
5- Spraying with 3 cm^3/L camphor oil
6- Spraying mixture of 25 ppm GA_3 and 2 cm^3/L camphor oil.
7- Spraying mixture of 50 ppm GA_3 and 2 cm^3/L camphor oil.
8- Spraying mixture of 25 ppm GA_3 and 3 cm^3/L camphor oil.
9- Spraying mixture of 50 ppm GA_3 and 3 cm^3/L camphor oil.

Each treatment repeated three times three trees each, thus the experiment consisted of 81 trees. These selected trees were divided into three compartments:

- The first compartment was sprayed at the 1st time (6 weeks after fruit setting).
- The second compartment was sprayed at the 2nd time (6 weeks after the first time).
- The third compartment was sprayed at the first and second application times (two applications).

At commercial ripening stage of fruits the response of "Manfalouty" pomegranate trees to spraying of gibberellic acid, camphor oil and mixture of them were evaluated through the following determinations.

1- Fruit physical properties:

1.1- Fruit weight (g): A sample of ten fruits per replicate was weighted by digital balance and then the average fruit weight (g) was calculated.

1.2- Arils weight (g): Arils of ten fruits was weighted also by digital balance

1.3- Fruit peel percentage: this parameter was calculated as fallows

$$\text{Peel \%} = \frac{\text{Peel weight (g)}}{\text{Fruit weight (g)}} x100$$

2- Fruit chemical properties:

2.1- Total soluble solids percentage (TSS %): TSS was determined in fruit juice using hand refractometer.

2.2- Titratable Acidity percentage TA%: Using titration by NaOH at 0.1 N and phenolphthalein as an indictor then expressed as grams of citric acid per 100 ml juice according to A.O.A.C (1995).

2.3- Total soluble solids (T.S.S)/Acid ratio was calculated over the value of TA% by dividing the value of TSS%.

Statistical analysis

The experiments of this study were conducted as a split-plot arrangement in completely randomized block design (CRBD), whereas treatments with the compounds were put in whole plot (Factor A), while application times in split plot (Factor B), using three replicates for each treatment.

All data obtained throughout this study were tabulated and statistically analyzed, according to the methods described by Snedecor and Cochran (1995) and using new LSD test at 5% level of the probability to recognize the significance of the differences between various treatment means.

Results and Discussion

1- Fruit weight (g):

Data presented in Table 1 showed that the treatments significantly increased fruit weight compared to untreated trees (control) during the two studied seasons with an exception of GA_3 at 25 and 50 ppm during the 1st season.

Furthermore, results indicated that in season 2016, spraying a mixture of 50 ppm GA_3 + 2 cm^3/L camphor oil at the 1st time gave the heaviest fruit weight (514.67 g), while spraying 3 cm^3/L at the 2nd time of camphor oil gave the heaviest fruit weight (510.67 g), and spraying a mixture of 50 ppm GA_3 + 3 cm^3/L camphor oil at the 1st and the 2nd time (two sprays) gave the heaviest fruit weight (486.33 g), all compared with the other treatments and the untreated (control) trees.

In season 2017, it was found that spraying a mixture of 50 ppm GA_3 + 2 cm^3/L camphor oil at the 1st time induced the highest value of fruit weight (451.53 g), while spraying a mixture of 25 ppm GA_3 + 3 cm^3/L camphor oil at the 2nd time gave the heaviest fruit weight (467.93 g), and spraying twice applications of 50 ppm GA_3 exhibited the highest value of fruit weight (476.27 g), all compared with the other treatments and with the untreated (control) trees.

Generally, it was noticed that spraying a mixture of 50 ppm GA_3 + 2 cm^3/L camphor oil gave the highest value of fruit weight average during season 2016 and 2017 (465.00 and 450.89 g, respectively).

These results could be due to that gibberellic acid induced cell elongation, moreover, spraying camphor oil resulted in reducing the respiration rate of fruits.

The above results are in agreement with those found by Lal and Ahmed (2011), Hegazi *et al*. (2014), Mostafa *et al*. (2015), Bakeer (2016), El-Akkad *et al*. (2016) and Kishor *et al*. (2017).

Table 1. Effect of spraying gibberellic acid (GA_3), camphor oil and mixture of them on fruit weight (g) of "Manfalouty" pomegranate cv. during 2016 and 2017 seasons.

Time (B) / Treatment (A)	Season 2016				Season 2017			
	1st time	2nd time	1st +2nd time	Mean	1st time	2nd time	1st +2nd time	Mean
control	368.67	368.67	368.67	368.67	301.80	301.80	301.80	301.80
GA_3 (25 ppm)	434.00	442.00	385.33	413.78	381.45	428.82	398.30	402.86
GA_3 (50 ppm)	420.33	411.67	428.00	420.00	397.83	380.03	476.27	418.04
Camphor oil (2cm^3/L)	495.00	450.00	396.67	447.22	415.82	393.93	436.93	415.56
Camphor oil (3cm^3| L)	354.333	510.67	453.33	439.44	429.4	427.20	448.90	435.17
GA_3 (25 ppm) + Camphor oil (2cm^3/L)	406.33	491.00	438.00	445.11	434.42	392.93	489.73	439.03
GA_3 (50 ppm)+ Camphor oil (2 cm^3/L)	514.67	406.00	474.33	465.00	451.53	450.28	450.87	450.89
GA_3 (25 ppm) + Camphor oil (3 cm^3/L)	414.67	425.67	451.67	430.67	419.50	467.93	398.30	428.58
GA_3 (50 ppm)+ Camphor oil (3 cm^3/L)	398.00	504.33	486.33	462.89	427.85	427.98	421.47	425.77
Mean	426.22	455.48	435.69	-	406.62	424.11	427.18	-
New LSD at 5%								
Treatments (A)=	54.83				40.28			
Time (B)=	31.48				26.94			
Interaction (A×B)=	94.45				80.82			

2- Aril weight (g)/fruit:

Data presented in Table (3) showed the effect of spraying gibberellic acid (AG_3), Camphor oil and mixture of them on aril weight (g) of "Manfalouty" pomegranate trees during 2016 and 2017 seasons.

Data presented in Table 2 showed that all treatments are significantly increased aril weight (g)/fruit, compared with untreated trees (control) of Manfalouty pomegranate cv. during the two studied seasons.

In season 2016, it was observed that spraying 50 ppm GA_3 + 2 cm^3/L camphor oil at the 1st time gave the heaviest aril weight (g)/fruit (333.34 g), while spraying 3 cm^3/L camphor oil at the 2nd time induced the highest value of aril weight (g)/fruit (303.50 g), and spraying two times of a mixture of 50 ppm GA_3 + 3 cm^3/L camphor oil gave the highest value of aril weight (g)/fruit (282.33 g), compared with untreated trees (202.33 g).

During season 2017, it was found that spraying a mixture of 50 ppm GA_3 + 3 cm^3/L camphor oil at the 1st time induced the heaviest aril weight (g)/fruit (276.90 g), while spraying mixture of 25 ppm GA_3 + 3 cm^3/L camphor oil at the 2nd time gave the highest value of aril weight (g)/fruit (292.52 g), and spraying 50 ppm GA_3 two times induced the highest value of aril weight (g)/fruit (300.38 g), all compared with untreated trees (178.5 g).

Table 2. Effect of spraying gibberellic acid (GA_3), camphor oil and mixture of them on aril weigh (g) of "Manfalouty" pomegranate fruit During 2016 and 2017 seasons.

Time(B) / Treatment (A)	Season 2016				Season 2017			
	1st time	2nd time	1st +2nd time	Mean	1st time	2nd time	1st +2nd time	Mean
control	202.33	202.33	202.33	202.33	178.5	178.5	178.5	178.5
GA_3 (25 ppm)	270.33	269.73	261.66	267.22	222.65	271.79	251.55	248.76
GA_3 (50 ppm)	252.33	242.70	278.67	257.90	234.78	230.75	300.38	255.30
Camphor oil (2cm^3/L)	280.00	267.53	268.00	271.84	240.34	246.95	270.57	252.62
Camphor oil (3cm^3| L)	234.33	303.50	272.53	270.12	266	279.37	277.60	274.32
GA_3 (25 ppm) + Camphor oil (2cm^3/L)	251.33	271.07	252.53	258.31	260.77	236.36	282.31	259.81
GA_3 (50 ppm)+ Camphor oil (2 cm^3/L)	333.34	239.60	266.73	279.89	259.08	284.06	278.86	273.98
GA_3 (25 ppm) + Camphor oil (3 cm^3/L)	249.00	258.84	234.44	247.42	249.97	292.52	263.17	268.55
GA_3 (50 ppm)+ Camphor oil (3 cm^3/L)	265.33	295.57	282.33	281.07	276.90	260.05	261.67	266.20
Mean	259,81	261.21	257.69		243.22	253.37	262.73	
New LSD at 5%								
Treatments (A)=	42.62				22.31			
Time (B)=	24.47				20.09			
Interaction (A×B)=	73.41				60.28			

3- Peel weight percentage fruit:-

Data in Table (3) showed that all the treatments are significantly decreased peel weight percentage compared to untreated trees (control) during the two seasons.

During season 2016, spraying a mixture of 50 ppm GA_3 + 3 cm^3/L camphor oil at the 1st time, induced the lowest peel weight %/fruits (32.77%), while spraying 25 ppm GA_3 at the 2nd time resulted in the lowest peel weight %/fruit (39.00%), and also spraying the same treatment with 25 ppm at the 1st and 2nd time (two sprays) gave the lowest peel weight %/fruit (33.80%).

On the other hand, in season 2017, spraying a mixture of 50 ppm GA_3 + 3 cm^3/L camphor oil at the 1st time gave the lowest peel weight %/fruit (36.17%), while spraying 3 cm^3/L camphor oil at the 2nd time induced the lowest peel weight %/fruit (34.93%), moreover spraying 2 cm^3/L camphor oil two times at the 1st and 2nd time gave the lowest peel weight %/fruit (35.75%), all treatments compared with the other treatments and with the untreated trees during the two seasons.

These results may be due to the effect of GA_3 and Camphor in increasing aril weight, the results are in agreement with those found by EL-Akkad *et al*. (2016) and Kishor *et al*. (2017).

Table 3. Effect of spraying gibberellic acid (GA_3), camphor oil and mixture of them on peel weight percentage of ' Manfalouty ' pomegranate fruit During 2016 and 2017 seasons .

Time(B) / Treatment (A)	Season 2016				Season 2017			
	1st time	2nd time	1st +2nd time	Mean	1st time	2nd time	1st +2nd time	Mean
control	45.07	45.07	45.07	45.07	39.20	39.20	39.20	39.20
GA_3 (25 ppm)	38.27	39.00	33.80	37.02	41.33	36.57	36.83	38.24
GA_3 (50 ppm)	40.10	40.57	34.83	38.50	40.87	39.01	37.00	38.96
Camphor oil (2cm^3/L)	43.00	40.50	42.27	41.92	42.10	37.30	35.75	38.38
Camphor oil (3cm^3| L)	43.333	40.73	40.87	41.64	37.2	34.93	38.10	36.74
GA_3 (25 ppm) + Camphor oil (2cm^3/L)	38.13	44.30	42.47	41.63	39.60	36.67	39.43	38.57
GA_3 (50 ppm)+ Camphor oil (2 cm^3/L)	34.77	40.93	43.63	39.78	42.47	36.87	38.10	39.15
GA_3 (25 ppm) + Camphor oil (3 cm^3/L)	43.83	40.73	43.63	42.73	40.39	37.53	39.47	39.13
GA_3 (50 ppm)+ Camphor oil (3 cm^3/L)	32.77	41.07	41.93	38.59	36.17	39.53	38.00	37.90
Mean	39.92	40.94	40.23		39.93	37.21	37.94	
New LSD at 5%								
Treatments (A)=	5.20				2.47			
Time (B)=	3.22				2.01			
Interaction (A×B)=	9.67				6.03			

4- Total soluble solids percentage (TSS%):

As shown in Table (4) it was clear that all treatments with GA_3, camphor oil and their mixtures significantly increased TSS% in juice of Manfalouty pomegranate fruits during 2016 and 2017 seasons.

Throughout season 2016, spraying 25 ppm GA_3 at the 1st time gave the highest value of TSS% in fruit juice (17.5 %), while spraying 3 cm^3/L camphor oil induced the highest value of TSS% (17.7%), and the low concentration of GA_3 sprayed twice (at the 1st and the 2nd times) resulted in the highest percentage of TSS in fruit (17.4%) juice, all compared with the other treatments and with the untreated trees (16.0%).

As well as in season 2017, the obtained results showed the same trend in season 2016, with the exception of spraying 50 ppm GA_3 twice applications gave the highest TSS% (17.4%) in fruit juice, all treatments compared with the other treatments and with the untreated trees.

Generally, it was found that the highest average value of TSS% in fruit juice was 17.1% in response to treatment with lowest concentration of GA_3 in season 2016, while spraying the high concentration of camphor oil gave the highest average value of TSS% in fruit juice (16.1%) in season 2017, compared with untreated trees (16.0% and 15.7%, respectively).

These results are in agreement with those of Digrase *et al*. (2016) and El-Akkad *et al*. (2016).

Table 4. Effect of spraying gibberellic acid (GA_3), camphor oil and mixture of them on total soluble solids (TSS %) in juice of 'Manfalouty' pomegranate fruits during 2016 and 2017 seasons.

Time (B) / Treatment (A)	Season 2016				Season 2017			
	1st time	2nd time	1st +2nd time	Mean	1st time	2nd time	1st +2nd time	Mean
control	16.0	16.0	16.0	16.0	15.7	15.7	15.7	15.7
GA_3 (25 ppm)	17.5	16.3	17.4	17.1	15.7	15.3	17.0	16.0
GA_3 (50 ppm)	16.0	15.8	17.1	16.3	15.4	15.2	17.4	16.0
Camphor oil ($2cm^3$/L)	16.5	16.9	16.6	16.7	14.0	16.0	16.7	15.6
Camphor oil ($3cm^3$| L)	16.2	17.7	15.9	16.6	14.7	16.5	17.0	16.1
GA_3 (25 ppm) + Camphor oil ($2cm^3$/L)	15.6	16.0	15.0	15.5	14.2	15.7	16.9	15.6
GA_3 (50 ppm)+ Camphor oil (2 cm^3/L)	16.4	17.1	14.8	16.1	15.3	16.3	16.3	16.0
GA_3 (25 ppm) + Camphor oil (3 cm^3/L)	16.4	15.9	14.9	15.7	15.3	15.6	15.5	15.5
GA_3 (50 ppm)+ Camphor oil (3 cm^3/L)	16.2	16.0	15.3	15.8	14.7	16.3	15.8	15.6
Mean	16.3	16.4	16.0	-	15.0	15.9	16.4	-
New LSD at 5%								
Treatments (A)=	0.7330				0.6924			
Time (B)=	0.3590				0.5610			
Interaction (A×B)=	1.077				1.683			

1.5- Titratable acidity percentage (TA%):

Data presented in Table (5) showed a slight significant difference in the titratable acidity percentage (TA%) in fruit juice of Manfalouty pomegranate cv. in response to some treatments during the two seasons.

During the 1st season, it was found that all treatments significantly decreased the TA% in fruits juice, whereas 25ppm GA_3 or, 2 cm3/L and 3 cm3/L camphor oil resulted in the lowest percentage of TA, moreover all treatments were more effected at the first time, followed by the twice application time, then and the second time all compared with untreated trees.

On the other hand, in the second season the effect of the treatments exhibited the same trend of there effects during the first season, Although the treatments with both AG_3 (25,50 ppm) and camphor oil (2 cm3/L and 3 cm3/L) induced slight nonsignificant increase in TA% in fruit juice compared with other treatments and untreated trees.

These results are in agreement with those reported by Hegazi *et al*. (2014), Mostafa *et al*. (2015) and Faissal and Asmaa (2019).

Table 5. Effect of spraying gibberellic acid (GA_3), camphor oil and mixture of them on titratable acidity percentage (TA%) in juice of 'Manfalouty' pomegranate fruit during 2016 and 2017 seasons.

Time (B) / Treatment (A)	Season 2016				Season 2017			
	1st time	2nd time	1st +2nd time	Mean	1st time	2nd time	1st +2nd time	Mean
control	1.4	1.4	1.4	1.4	1.6	1.6	1.6	1.6
GA_3 (25 ppm)	1.0	1.4	1.2	1.2	1.8	1.8	1.8	1.8
GA_3 (50 ppm)	0.8	1.2	1.0	1.0	1.8	1.7	1.8	1.7
Camphor oil (2cm^3/L)	0.9	1.1	1.0	1.0	1.6	1.8	1.5	1.6
Camphor oil (3cm^3| L)	0.8	1.1	1.1	1.0	1.7	1.9	1.4	1.6
GA_3 (25 ppm) + Camphor oil (2cm^3/L)	0.9	1.5	1.0	1.1	1.4	1.8	1.7	1.6
GA_3 (50 ppm)+ Camphor oil (2 cm^3/L)	0.9	1.2	1.4	1.2	1.2	1.8	1.5	1.5
GA_3 (25 ppm) + Camphor oil (3 cm^3/L)	0.9	1.4	1.1	1.1	1.5	1.8	1.4	1.5
GA_3 (50 ppm)+ Camphor oil (3 cm^3/L)	1.1	1.3	1.1	1.2	1.7	1.7	1.7	1.7
Mean	0.9	1.2	1.1		1.6	1.5	1.6	
New LSD at 5%								
Treatments (A)=	0.43				0.14			
Time (B)=	0.24				0.11			
Interaction (A×B)=	0.71				0.33			

1.6- Total soluble solids/acid ratio:

Data in Table (6) showed the effect of spraying gibberellic acid, Camphor oil, and mixture of them on T.S.S/TA ratio in juice of "Manfalouty" pomegranate fruits. It could be noticed that in the first season all treatments slightly increased T.S.S/ TA ratio. While in the second season all treatment at the first application time.

On the other hand there were a significant differences between the different times of application during the two studied seasons.

The best treatment which applicated with a mixture of 2 cm^3/L camphor oil + 50 ppm GA3 which significantly increase T.S.S /TA ratio in fruit juice during the 2nd season.

The differences between the TSS/TA ratio in fruit juice could be due to the variation between both of TSS% and TA% in response to spraying GA3 or camphor oil and their mixtures.

Table 6. Effect of spraying gibberellic acid (GA_3), camphor oil and mixture of them on TSS / TA ratio in juice of 'Manfalouty pomegranate fruits during 2016 and 2017 seasons.

Time (B) / Treatment (A)	Season 2016				Season 2017			
	1st time	2nd time	1st +2nd time	Mean	1st time	2nd time	1st +2nd time	Mean
Control	14.9	14.9	14.9	14.9	9.8	9.8	9.8	9.8
GA_3 (25 ppm)	16.3	10.8	15.4	14.2	7.9	9.1	8.8	8.6
GA_3 (50 ppm)	18.9	12.3	16.8	16.0	9.5	7.6	9.9	9.0
Camphor oil (2cm^3/L)	15.5	14.2	16.1	15.3	10.7	9.7	9.5	10.0
Camphor oil (3cm^3| L)	21.5	15.3	15.1	17.3	10.0	9.8	11.2	10.3
GA_3 (25 ppm) + Camphor oil (2cm^3/L)	15.9	10.6	16.4	14.3	11.2	9.3	8.9	9.8
GA_3 (50 ppm)+ Camphor oil (2 cm^3/L)	17.4	14.1	12.2	14.6	15.5	9.1	10.2	11.6
GA_3 (25 ppm) + Camphor oil (3 cm^3/L)	16.3	11.0	14.1	13.8	11.6	7.8	10.7	10.0
GA_3 (50 ppm)+ Camphor oil (3 cm^3/L)	13.8	12.8	15.3	14.0	9.6	9.6	9.8	9.7
Mean	16.7	12.7	15.2		11.0	9.0	9.8	
New LSD at 5%								
Treatments (A)=	2.53				2.39			
Time (B)=	1.26				1.92			
Interaction (A×B)=	3.77				5.77			

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تأثير رش حمض الجبريليك وزيت الكافور وخليط منهما على جودة ثمار الرمان المنفلوطي

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الملخص

أجريت هذه الدراسة خلال موسمي ٢٠١٦، ٢٠١٧ بهدف التعرف علي استجابة ثمار الرمان المنفلوطي لرش حمض الجبريليك (٢٥ ، ٥٠ جزء في المليون)، زيت الكافور (٢ سم^3/لتر ، ٣ سم^3/لتر) وخليط منهما في الميعاد الأول (٦ أسابيع بعد العقد) والميعاد الثاني بعد الميعاد الأول بستة أسابيع. علاوة علي ذلك فقد تم رش معاملات في الميعادين السابقين معاً.

ولقد استخدم في هذه الدراسة ٨١ شجرة تم تقسيمها إلي ثلاثة مجموعات الأولي تم رشها في الميعاد الأول والثانية تم رشها في الميعاد الثاني والثالثة تم رشها في الميعادين المشار إليهما أعلاه. ولقد صممت التجربة في صورة قطع منشقة كاملة العشوائية في مستوي واحد خلال نظام القطاعات كاملة العشوائية (CRBD) مع تكرار كل معاملة ثلاث مرات وتخصيص شجرة لكل مكررة.

وقد تم تقييم تأثير المعاملات علي صفات جودة ثمار الرمان خلال تقدير الصفات الطبيعية (وزن الثمرة، وزن حبوب الثمرة، نسبة وزن القشرة للثمرة) والكيميائية (نسبة المواد الصلبة الذائبة الكلية (TSS%)، نسبة الحموضة الكلية (TA%) والعلاقة بينهما (TSS/TA ratio في عصير الثمرة) للثمار. وأتضح من النتائج أن أهم المعاملات في تحسين جودة ثمار الرمان المنفلوطي هو رش مخلوط من حمض الجبريليك مع زيت الكافور (٥٠ جزء في المليون من الأول مع ٢ أو ٣ سم^3/لتر من الثاني) في الميعادين سالفي الذكر معاً. وعليه يمكن التوصية برش مخلوط حمض الجبرليك مع زيت الكافور المشار إليه سابقاً مرتين في الميعاد الأول والثاني للحصول علي أفضل صفات جودة لثمار الرمان المنفلوطي تحت ظروف هذه الدراسة.

الكلمات الدالة: *حمض الجبريليك، زيت الكافور، صنف الرمان المنفلوطي، جودة الثمرة.*