

Effect of Flower Thinning and Spraying with Gibberellic Acid and Ethephon on Yield and Fruit Quality of Manfalouty Pomegranate Cultivar

By

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Abstract: This investigation was executed during two successive seasons of 2006 and 2007 at the Experimental Orchard of Fruit Section, Faculty of Agriculture, Assiut University on Manfalouty pomegranate cultivar. Fifty trees of Manfalouty pomegranate cultivar were selected and divided into ten treatments; each treatment represented five trees (Replicates). The study aimed to investigate the effect of flower thinning and ethrel with or without GA₃ spraying on yield and fruit quality of this cultivar. The treatments consisted of: manual thinning of all the flowers appeared during the last week of May till the end of flowering period, spraying with gibberellic acid (GA₃) at 50, 100 and 150 ppm., flower thinning + spraying with GA₃ at 100 ppm., spraying with Ethrel at 1000 ppm., spraying with Ethrel at 1000 ppm + GA₃ at 50, 100 and 150 ppm and the control (water spraying).

The study indicated that flower thinning recorded the highest number of grade I fruits. Flower thinning and the flower thinning + spraying caused a significant decrease in the fruit numbers of grade III while the remained treatments showed insignificant differences.

Concerning the effect of different treatments on the grade I yield weight (kg), most of treatments significantly surpassed the control. Flower thinning + 100 ppm GA₃ recorded the highest grade I yield followed by flower thinning and then, spraying with 50 ppm GA₃. There was no significant difference among the treatments regarding the yield weight of grade II. Flower thinning and flower thinning + 100 ppm GA₃ significantly decreased grade III yield weight compared to the control. Most of the treatments significantly decreased the percentage of fruit splitting especially the treatments consisted of GA₃. Spraying with ethrel or GA₃ and their combinations greatly decreased this phenomenon. There was insignificant effect of the treatments on most of the studied physical fruit properties on the first sampling date while the effect was significant on the second one. The results also indicated that ethrel alone or combined with GA₃ enhanced ripening.

Introduction

Pomegranate (*Punica granatum* L., Punicaceae) is an old fruit plant and is mentioned in the Holy books. Pomegranate culture and its usage are known in the human history. Pomegranate has important medical

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activities such as, protection against cardiovascular diseases, anticancer and antimicrobial activities. Pomegranate culture in Egypt has always been restricted and generally considered as a minor crop. In recent years, pomegranate acreage is rapidly increasing for exportation aims.

Pomegranate acreage is ranked the 13th among fruit corps in Egypt. According to the ministry of Agriculture Statistics (2004), the total area devoted for pomegranate is 5013 feddans with 3628 feddan fruiting area producing about 25510 tons with an average of 7.03 ton/feddan. This statistic also indicated that 60.8% of total pomegranate trees are located in Assiut (3048 feddan), while the remained governorates have 1964 feddans representing 39.2% of the total pomegranate area.

The fruit growers endeavor and prefer to obtain an optimum fruit density per tree although it reduces the fruit quality. Subsequently, fruit thinning is an important factor. Generally, in fruit trees, there are two suitable dates for fruit thinning. The first date is at full bloom and the other one is some weeks after blossom, the best time being about one and a half weeks after petal-fall (Bruinsma 1962). Although hormonal and chemical fruit thinning is widely used, it is very important now to rely and depend on the hand fruit thinning.

In some areas, the bloom periods may last from March until September or later. Accordingly, the fruit does not develop into a good size, color and late in maturity (Division of Agricultural Sciences, 1977). The early fruit set times produced larger first quality and earlier harvested fruits. While, the later fruit set times did not attain their maturity standards and give inferior and non commercial fruits (Mohamed,

2004). Accordingly, fruit thinning must be a common practice in pomegranate orchards. As well as, grading and sorting of the fruits during harvest according to the fruit sizes are very important and should be exercised for obtaining a good price. (El-Sese 1988 a,b; Mohamed 2004; El-Sese and Mohamed 2005)

The serious problem encounters pomegranate in the production regions is the fruit splitting. The fruit splits vertically or horizontally at any age of it. Moreover, there is further attack of insects or fungal attack on the cracked fruits, subsequently the fruits become unfit for marketing. It could reduce the fruit splitting effectively by spraying with growth regulators especially GA₃ (Sharifi and Sepahi, 1984; El-Kassas *et al.*, 1989; El-Masry, 1995; Mustafa 1998; El-Khawaga 2003; Singh *et al* 2003; Mohamed 2004; El-Khawaga 2007).

The objective of this study was to investigate the effect of flower thinning and ethrel with or without GA₃ spraying on yield components, quality and fruit splitting of Manfalouty pomegranate cultivar under Assiut climatic conditions.

Materials and Methods

This investigation was executed during two seasons of 2006 and 2007 at the Experimental Orchard of Fruit Section, Faculty of Agriculture, Assiut University on Manfalouty pomegranate cultivar.

The selected trees were planted in a clay soil. Regular agricultural managements were applied to all experimental trees as recommended. The trees space was (5x5 m) apart and they were (32) years old at the start of the experiment. Fifty uniform trees were selected and divided into ten treatments including the control. Each

treatment was executed on five trees (Replicates).

The treatment categories were as follows:

1 – Hand thinning of all the flowers that appeared during the last week of May till the end of flowering period as recommended by El-Sese (1988a,b) and (El-Sese and Mohamed 2005).

2 - Spraying with 50, 100 and 150 ppm gibberellic acid (GA₃).

3 – Hand flower thinning + spraying with 100 ppm.GA₃

4 - Spraying with 1000 ppm Ethrel.

5 - Spraying with Ethrel at 1000 ppm + 50, 100 and 150 ppm GA₃.

6 - Control.

GA₃ and Ethrel were dissolved according to the pre-mentioned concentrations. The fruits were sprayed with knapsack sprayer. A total volume of 16 L was sufficient for spraying 4 trees until runoff.

GA₃ was sprayed twice on the setting fruits on 3rd and 2nd June and 8th and 5th July at the two seasons, respectively. Ethrel was sprayed on September 18 in the first season and September 8 in the second one.

Samples of 5 fruits per tree were collected twice to determine the physical and chemical properties. The first sample was achieved on September 26 and 15 while the second one was taken at harvest on October 31 and 22 in the first and second season, respectively.

The fruit samples were taken and directly transported to the laboratory for determining the average fruit weight (g), average peel and granule weight (g) then the percentage of granule weight relative to the average fruit weight was calculated. Total soluble solids (TSS) percentage was estimated by using the

hand refractometer. Total acidity was determined using titration by NaOH at 0.1 N and phenolphthalein as an indicator, and then expressed as citric acid, according to A.O.A.C. (1975). T.S.S./acid ratio was then calculated.

At harvest, fruits of all treated trees were picked on October 31 and 22 in the first and second season, respectively. Fruits per tree were counted and weighted to estimate the number of fruits and yield/tree (kg). Then, fruits were graded into 3 grades as following: Grade I: fruits of 400-500 (or higher) gm in the weight.

Grade II: fruits of 300-400 gm in the weight.

Grade III: fruits of 200 (or lower) - 300 gm in the weight and then, the percentage of each grade was calculated relative to either the total number of fruits or to the total yield (kg/tree).

As well as the cracked fruits were sorted and counted and then the percentage of fruit splitting was calculated relative to either the total number of fruits or to the total yield (kg/tree).

The experiment was set up as a complete randomized design with five replicates one tree per each. The differences between treatments were tested by analysis of variance (ANOVA) according to Snedecor and Cochran (1972). Means of treatments were compared using LSD (least significant differences) value at 5% level of the probability.

Results and Discussion

1) Yield components and fruit splitting:

The results presented in Tables 1 – 4 show the effect of flower thinning,

spraying with gibberellic acid and ethrel on yield components of Manfalouty pomegranate cultivar during 2006 and 2007 seasons.

Data revealed that during the first season (2006), (Table 1) flower thinning alone or when combined with 100 ppm GA₃ recorded the highest number of grade I fruits. Moreover, flower thinning alone significantly exceeded all the treatments (except of flower thinning + GA₃ spraying) in this respect. The number of grade I fruits was 73.9 and 65.5 fruits/tree with an increment percentage of 40.5 and 24.5% over the control for flower thinning and flower thinning + 100 ppm GA₃, respectively. On the other hand, there were no significant differences between the remained treatments.

Data presented in the same Table showed that most of the treatments caused a significant increase in the number of grade II fruits compared to the control. On the other hand there were no significant differences between

flower thinning, 100 ppm GA₃, flower thinning + 100 ppm GA₃ and the control. Spraying with 150 ppm GA₃ recorded the highest number of grade II fruits, followed by 100 ppm GA₃ + 1000 pm ethrel and then, 150 ppm GA₃ + 1000 ppm ethrel. The number of grade II fruits associated with these treatments was 66.2, 63.5 and 62.2 fruits/tree with an increment percentage of 42.4, 36.6 and 33.8%, respectively.

The obtained results also showed that the flower thinning and the flower thinning + spraying with 100 ppm GA₃ caused a significant decrease of the fruit numbers of grade III while the remained treatments showed insignificant differences. The number of grade III fruits was 34.8 and 41.6 fruits/tree with an decrement percentage of 108.3 and 74.3% for flower thinning and flower thinning + 100 ppm GA₃, respectively.

Table 1: Effect of flower thinning, gibberellic acid (GA₃) and ethrel on yield components per tree of Manfalouty pomegranate cultivar during 2006 season.

Characteristic	Fruit No. I	Fruit No. II	Fruit No. III	Yield (kg) I	Yield (kg) II	Yield (kg) III	Total no. Fruits	Total yield Weight (kg/tree)
1) Flower thinning	73.9	55.7	34.8	39.4	20.6	8.1	164.4	68.1
2) 50 ppm GA ₃	62.7	61.5	70.8	37.8	23.4	18.2	195.0	79.4
3) 100 ppm GA ₃	60.3	51.7	65.0	32.8	20.0	18.6	177.0	71.4
4) 150 ppm GA ₃	57.2	66.2	66.8	33.6	24.1	19.7	190.2	77.4
5) Flower thinning + 100 ppm GA ₃	65.5	41.3	41.6	42.1	14.5	10.6	148.5	67.2
6) 1000 ppm Ethrel	59.8	61.6	59.4	34.4	23.0	15.8	180.8	73.2
7) 50 ppm GA ₃ + 1000 ppm Ethrel	59.6	61.0	64.0	36.6	21.2	17.5	184.6	75.3
8) 100 ppm GA ₃ + 1000 ppm Ethrel	62.6	63.5	65.7	35.9	24.2	15.5	191.8	75.6
9) 150 ppm GA ₃ + 1000 ppm Ethrel	60.4	62.2	66.2	36.4	24.4	16.2	188.8	77.0
10) Control	52.6	46.5	72.5	25.4	16.4	18.8	171.6	60.6
LSD _{0.05}	10.3	11.2	21.1	8.7	N.S	5.4	18.2	N.S

I First grade

II Second grade

III Third grade

The previous work made by El-Sese, 1988b recommended removing the flowers that appeared beyond the beginning of June to improve the fruit quality. The author also, in 1988a found that the early fruit setting during April and May produced high quality fruits while the later one had more acidity and lower TSS. Investigators found that the fruit thinning of pomegranate increased the fruit weight, decreased the fruit cracking and enhanced the fruit quality (Hussein *et al.*, 1994a; Amin *et al.*, 2000; El-Sese and Mohamed, 2005). On the other hand, the effects of GA₃ mentioned in the current study were in accordance with those reported by Sharifi and Sepahi, 1984; El-Kassas *et al.*, 1994 and Mohamed, 2004.

Concerning the effect of different treatments on the grade I yield weight (kg) (Table1) it could be found that most of the treatments significantly surpassed the control. Flower thinning + 100 ppm GA₃ recorded the highest grade I yield weight followed by flower thinning and then, spraying with 50 ppm GA₃. The later treatments gave 42.1, 39.4 and 37.8 kg/tree with an increment percentage of 65.7, 55.1 and 48.8%, respectively. The increment percentage of grade I yield weight was higher than, and did not attend, the increment percentage of grade I fruit number. This observation primarily due to the increase of fruit weight associated with these treatments and that reflected on the increase of yield weight.

The results also showed that, all the treatments (except of flower thinning + spraying by 100 ppm GA₃) increased the grade II yield weight as compared to the control, but these increase were not significant. The results showed that

only flower thinning and flower thinning + 100 ppm GA₃ significantly decreased the grade III yield weight comparing to the control. They gave 8.1 and 10.6 kg/tree, respectively with a decrement percentage of 132.1 and 77.4%, respectively. However, the remained treatments showed insignificant differences in this respect.

Concerning the effect of treatments on the total number of fruits/tree, it could be found that spraying with 50 ppm GA₃, 150 ppm GA₃ and 100 ppm GA₃ + 1000 ppm ethrel caused a significant increase comparing to the control. The total number of fruits for the later treatments was 195.0, 190.2 and 191.8, respectively. However, the remained treatments had insignificant effect. On the other hand, there were no significant differences between the treatments in case of total yield weight (kg/tree).

During the second season of study, (2007), (Table 2) data showed that the flower thinning, spraying with 150 or 50 ppm GA₃ and flower thinning + 100 ppm GA₃ gave the highest number of grade I fruits/tree where these treatments significantly exceeded the control. The number of fruits was 111.6, 105.6, 103.2 and 102.0 fruit/tree with an increment percentage of 38.5, 31.0, 28.0 and 26.6% for the previous treatments, respectively.

Concerning the number of grade II fruits/tree it could be from such Table found that flower thinning and flower thinning + 100 ppm GA₃ recorded the lowest values. They gave 60.8 and 78.4 fruits/tree with a decrement percentage of 40.2 and 22.8% compared to the control, respectively. The number of grade III fruits/tree took the same trend

of the number of grade II fruits. The previous two treatments gave 45.0 and 63.6 fruits/tree with a decrement percentage of 52.7 and 33.2% comparing with the control. On the other hand, there were insignificant differences between the remained treatments in most cases.

Respecting to the effect of different treatments on yield weight (kg) of grade I, it could be found that all the treatments (except of ethrel at 1000 ppm) led to a significant increase of grade I yield weight as compared to the control. The highest value obtained from the flower thinning, spraying with GA₃ at 150 or 50 and flower thinning + 100 ppm GA₃. The values associated with these treatments were 60.6, 60.2, 59.2 and 58.5 kg/tree with an increment percentage of 42.3, 41.3, 39.0 and 37.1% over the control, respectively. Data presented in the same Table revealed that there were no significant differences between the treatments

respecting the yield weight of grade II. In respect of grade III yield weight, only flower thinning and flower thinning + 100 ppm GA₃ significantly decreased it as compared to the control. The two treatments recorded 12.1 and 16.6 kg/tree, respectively. The decrement percentages associated with these two treatments were 48.3 and 41.0%, respectively. The remained treatments showed insignificant differences.

Mohamed (2004) noted that the commercial fruits of Manfalouty pomegranate cultivar produced from the first waves of fruit set. The early fruit set times produced larger, first quality and earlier harvested fruits. While the later fruit set times did not attain their maturity standards and gave inferior and non-commercial fruits. Such fruit are poor in quality because they are not able to ripen in appropriate time and are affected by low temperature during fruit ripening (El-Sese, 1988b).

Table 2: Effect of flower thinning, gibberellic acid (GA₃) and ethrel on yield components per tree of Manfalouty pomegranate cultivar during 2007 season.

Characteristic	Fruit No. I	Fruit No. II	Fruit No. III	Yield (kg) I	Yield (kg) II	Yield (kg) III	Total No. fruits	Total yield weight (kg/tree)
1) Flower thinning	111.6	60.8	45.0	60.6	27.8	12.1	217.4	100.5
2) 50 ppm GA₃	103.2	110.2	117.4	59.2	41.8	30.8	330.8	131.8
3) 100 ppm GA₃	98.0	102.6	82.4	53.6	39.8	24.6	283.0	118.0
4) 150 ppm GA₃	105.6	111.6	97.0	60.2	43.2	30.0	314.0	133.4
5) Flower thinning + 100 ppm GA₃	102.0	78.4	63.6	58.4	30.8	16.6	244.0	105.8
6) 1000 ppm Ethrel	93.4	96.0	88.0	51.4	34.4	25.6	277.4	111.4
7) 50 ppm GA₃ + 1000 ppm Ethrel	98.2	120.0	114.4	52.0	44.0	26.2	332.6	123.0
8) 100 ppm GA₃ + 1000 ppm Ethrel	95.2	92.8	80.4	53.2	32.2	24.9	268.4	110.3
9) 150 ppm GA₃ + 1000 ppm Ethrel	96.0	102.2	91.2	52.8	39.8	27.4	289.4	120.0
10) Control	80.6	101.6	95.2	42.6	40.4	23.4	277.4	106.4
LSD_{0.05}	20.1	22.3	25.6	9.1	N.S.	9.3	30.8	25.3

I First grade

II Second grade

III Third grade

Total number of fruits/tree significantly decreased as affected by hand flower thinning and flower thinning + 100 ppm GA₃. They recorded 217.4 and 244.0 fruits/tree, respectively while the control gave 277.4 fruit/tree. The remained treatments showed insignificant effect in this respect.

The results of total yield weight (kg/tree) showed that spraying with 150 and 50 ppm GA₃ gave the highest values (133.4 and 131.8 kg/tree, respectively) while the remained treatments had insignificant effect on this trait.

Data presented in Tables 3 and 4 showing the effect of different treatments on the percentage of fruit number, yield weight and fruit splitting of Manfalouty pomegranate during 2006 and 2007 seasons.

The obtained results (Table 3) revealed that the flower thinning and flower thinning + spraying with 100 ppm GA₃ caused a significant increase in the percentage of fruit number (grade I). They recorded 44.9 and 44.4%, respectively while the other treatments showed insignificant effect. Concerning the percentage of fruit number (grade II), the results showed

that there were no significant differences between the treatments. Although the flower thinning and flower thinning + spraying with 100 ppm GA₃ greatly decreased the percentage of grade III fruit number (21.4 and 27.7%, respectively) there were no significant differences between the treatments in this respect.

Data presented in such Table revealed that flower thinning and flower thinning + 100 ppm GA₃ significantly increased the percentage of yield weight (grade I). These treatments gave 57.6 and 62.7% while the differences between the rests of treatments were not significant. The results also revealed that there were no significant differences between the treatments in respect of the percentage of grade II yield weight. The results also showed that all the treatments (except of spraying with 100 and 150 GA₃) led to a significant decrease in the percentage of grade III yield weight. The flower thinning and flower thinning + spraying with 100 ppm GA₃ recorded the lowest percentage (11.5 and 16.0%, respectively) while the control recorded the highest value (31%).

Table 3: Effect of flower thinning, gibberellic acid (GA₃) and ethrel on yield components (per tree) and fruit splitting percentages of Manfalouty pomegranate cultivar during 2006 season.

Characteristic	Fruit No. % I	Fruit No. % II	Fruit No. % III	Yield % I	Yield % II	Yield % III	Fruit splitting No. %	Fruit splitting weight %
1) Flower thinning	44.9	33.9	21.4	57.6	30.8	11.5	8.0	7.2
2) 50 ppm GA ₃	32.3	31.4	36.2	47.0	30.0	22.9	3.8	3.8
3) 100 ppm GA ₃	34.8	29.4	36.0	45.5	28.4	26.0	2.4	2.3
4) 150 ppm GA ₃	30.1	34.7	35.1	43.1	31.1	25.6	3.6	3.9
5) Flower thinning + 100 ppm GA ₃	44.4	27.9	27.7	62.7	21.2	16.0	5.2	5.2
6) 1000 ppm Ethrel	33.9	33.9	32.4	46.7	31.5	21.7	1.2	1.7
7) 50 ppm GA ₃ + 1000 ppm Ethrel	33.0	33.2	34.1	48.7	28.4	23.0	3.1	2.8
8) 100 ppm GA ₃ + 1000 ppm Ethrel	32.2	33.6	34.1	47.3	32.4	20.2	2.9	3.1
9) 150 ppm GA ₃ + 1000 ppm Ethrel	32.0	32.5	35.8	47.2	31.2	21.4	2.9	3.2
10) Control	30.3	27.7	41.9	41.6	27.3	31.0	13.6	11.9
LSD _{0.05}	8.0	N.S	N.S	11.6	N.S	7.5	8.5	2.8

I First grade

II Second grade

III Third grade

Concerning the effect of various treatments on the percentage of fruit splitting calculated relative to either the total number of fruits or yield weight, it could be found that all the treatments (except of flower thinning) significantly decreased the percentage of fruit splitting. Spraying with ethrel or GA₃ and different combinations of them greatly decreased this phenomenon.

During the second season of study (2007) the results (Table 4) took approximately the same trend of the first season. The flower thinning and flower thinning + 100 ppm GA₃ gave the highest percentage of grade I fruits. They recorded 51.1 and 41.2%, respectively, while the differences between the remained treatments were not significant. Additionally the percentage of grade II or III fruits did not significantly affect by the treatments.

The percentage of yield weight (grade I) significantly affected by the flower thinning and flower thinning + 100 ppm GA₃. The percentage of grade I yield weight associated with these two treatments was 60.2 and 55.9%, respectively, while the remained treatments had insignificant effect in this respect. Data also showed that there were insignificant differences

between the treatments concerning the percentage of grade II yield weight. On the other hand, the flower thinning and flower thinning + 100 ppm GA₃ recorded the lowest percentage (11.3 and 15.1, respectively) of grade III yield weight while the remained treatments had insignificant effect. Respecting the fruit splitting %, it could be from such Table showed that most of the treatments significantly decreased the fruit splitting %. GA₃ spraying recorded the lowest values in this respect.

The above-mentioned results revealed that spraying with some growth regulators e.g.; GA₃ and ethrel had a pronounced effect on the yield components as well as decreased the fruit splitting. The present study revealed that the flower thinning should be a common practice in pomegranate orchards. Although the flower thinning decreased the total number of fruits/tree, it had insignificant effect on the total yield weight (kg/tree). It also increased the commercial fruits that are salcable with high price; moreover it decreased the fruit splitting percentage. On the other hand, grading and sorting the fruits during the harvest time are very important and should be exercised to obtain a good price.

Table 4: Effect of flower thinning, gibberellic acid (GA₃) and ethrel on yield components (per tree) and fruit splitting percentages of Manfalouty pomegranate cultivar during 2007 season.

Characteristic	Fruit No. %	Fruit No. %	Fruit No. %	Yield %	Yield %	Yield %	Fruit splitting No. %	Fruit splitting weight %
Treatment	I	II	III	I	II	III		
1) Flower thinning	51.1	27.5	21.3	60.2	28.4	11.3	5.3	3.4
2) 50 ppm GA ₃	31.4	34.0	34.5	44.9	31.8	23.2	2.0	1.9
3) 100 ppm GA ₃	35.0	36.6	28.3	45.5	33.8	20.6	1.7	1.2
4) 150 ppm GA ₃	34.2	36.1	29.6	45.4	32.5	22.1	1.9	1.1
5) Flower thinning + 100 ppm GA ₃	41.2	32.5	26.2	55.9	28.9	15.1	3.8	4.0
6) 1000 ppm Ethrel	33.8	34.7	31.4	46.2	30.9	22.9	2.3	2.5
7) 50 ppm GA ₃ + 1000 ppm Ethrel	30.1	36.6	33.2	42.7	36.3	20.7	6.3	5.2
8) 100 ppm GA ₃ + 1000 ppm Ethrel	35.1	34.4	30.5	48.9	28.1	22.9	5.4	5.0
9) 150 ppm GA ₃ + 1000 ppm Ethrel	33.9	34.4	31.6	44.0	33.0	23.2	4.5	3.9
10) Control	29.6	36.1	34.6	40.0	38.1	21.7	10.0	10.0
LSD _{0.05}	9.4	N.S.	N.S.	8.0	N.S.	5.5	4.6	3.6

I First grade

II Second grade

III Third grade

The effect of GA₃ on decreasing the fruit splitting was on line with those reported by El-Kassas *et al.*, 1989, Sepahi (1986), El-Salhy (1996), El-Masry (1995), Mohamed (2004), Cline and Through (2007).

On the other hand, Hussein *et al.* (1994a), Amin *et al.* (2000), El-Sese and Mohamed (2005) and Ahmed (2007) agreed upon the effectiveness of fruit thinning on decreasing the fruit splitting and enhancing the fruit quality of pomegranates.

2) Physical fruit properties:

Data presented in Tables 5 and 6 showing the effect of different treatments on the average fruit weight, peel weight, granule weight and granule weight percentage of Manfalouty pomegranate cultivar during 2006 and 2007 seasons.

Data presented in Table 5 (the first sample of 2006 season) showed that there were insignificant effects of the treatments on all the studied traits. However, in the second sampling date during such season (Table 6) it could be found significant differences on the fruit weight and granule weight. Spraying with 50 ppm GA₃, 100 ppm GA₃ +

1000 ppm ethrel and 150 ppm GA₃ + 1000 ppm ethrel resulted in a significant increase of fruit weight as compared to the control. The values of these treatment were 533.3, 536.5 and 530.5, respectively, with an increment percentage of 15.4, 16.1 and 14.7, respectively. Additionally, flower thinning, spraying with 150 ppm GA₃ and flower thinning + 100 ppm GA₃ led to an increase, but not significant, of fruit weight where it reached 520.6, 524.0 and 523.7 (g), for the previous treatments, respectively, while it was 462.4 (g) in the control.

There were insignificant differences between the treatments on the average peel weight (g). However, flower thinning; 50 ppm GA₃; 100 ppm GA₃ + 1000 ppm ethrel and 150 ppm GA₃ + 1000 ppm ethrel significantly increased the average granule weight as compared to the control. The average granule weight (g) for the later treatments was 295.0, 297.3, 294.0 and 292.5 (g), respectively. Although, the remained treatments increased the average granule weight (g), this increase was not significant. The percentage of granule weight did not significantly affect by the treatments.

Table 5: Effect of flower thinning, gibberellic acid (GA₃) and ethrel on the fruit, peel and granule weight of Manfalouty pomegranate cultivar at the first sampling date during 2006 and 2007 seasons.

Characteristic Treatment	Average fruit weight (g)		Average peel weight (g)		Average granule weight (g)		Average granule weight (%)	
	2006	2007	2006	2007	2006	2007	2006	2007
1) Flower thinning	483.0	375.0	202.6	138.5	280.3	237.0	58.0	63.2
2) 50 ppm GA ₃	497.0	371.3	221.0	147.5	276.0	223.7	55.4	60.1
3) 100 ppm GA ₃	463.6	391.4	203.6	149.3	260.0	242.1	56.1	61.9
4) 150 ppm GA ₃	474.6	334.1	206.3	132.4	268.3	201.7	56.7	59.0
5) Flower thinning + 100 ppm GA ₃	473.3	336.0	215.3	132.4	258.0	203.5	54.5	60.7
6) 1000 ppm Ethrel	469.3	327.2	198.9	118.8	270.7	208.4	57.2	63.6
7) 50 ppm GA ₃ + 1000 ppm Ethrel	484.5	373.9	220.0	137.5	264.6	236.4	54.4	63.3
8) 100 ppm GA ₃ + 1000 ppm Ethrel	492.3	349.2	217.3	129.1	275.0	220.1	55.9	62.8
9) 150 ppm GA ₃ + 1000 ppm Ethrel	495.3	361.8	209.7	124.0	285.6	237.9	57.5	65.7
10) Control	442.0	325.0	200.3	120.0	241.9	205.0	54.0	63.1
LSD _{0.05}	N.S.	N.S.	N.S.	25.4	N.S.	N.S.	N.S.	N.S.

Table 6: Effect of flower thinning, gibberellic acid (GA₃) and ethrel on the fruit, peel and granule weight of Manfalouty pomegranate cultivar at the second sampling date during 2006 and 2007 seasons.

Characteristic	Average fruit weight (g)		Average peel weight (g)		Average granule weight (g)		Average granule weight (%)	
	2006	2007	2006	2007	2006	2007	2006	2007
1) Flower thinning	520.6	418.8	225.6	192.6	295.0	226.2	56.3	54.2
2) 50 ppm GA₃	533.3	411.3	236.0	182.2	297.3	229.0	55.7	55.8
3) 100 ppm GA₃	473.6	423.8	212.6	187.6	261.0	236.2	55.5	55.7
4) 150 ppm GA₃	524.0	388.8	240.3	180.0	283.6	208.8	54.2	53.6
5) Flower thinning + 100 ppm GA₃	523.7	400.0	237.0	181.4	286.7	218.6	54.7	54.8
6) 1000 ppm Ethrel	488.0	361.6	211.6	139.8	276.3	221.8	56.6	61.3
7) 50 ppm GA₃ + 1000 ppm Ethrel	494.5	388.6	230.0	145.1	264.6	238.4	53.5	61.3
8) 100 ppm GA₃ + 1000 ppm Ethrel	536.5	390.5	242.5	149.7	294.0	240.8	54.8	61.8
9) 150 ppm GA₃ + 1000 ppm Ethrel	530.5	386.2	238.0	146.0	292.5	240.2	55.3	62.1
10) Control	462.3	373.9	216.0	162.7	246.3	211.2	53.3	56.5
LSD_{0.05}	67.7	37.0	N.S.	24.2	42.4	N.S.	N.S.	3.6

During the second season of study (2007), the results of the first sampling date showed that the average fruit weight and average granule weight did not significantly affect by the treatments. However, the averages peel weight significantly affected by application of 50 or 100 ppm GA₃. The later treatments recorded 147.5 and 149.3 (g), respectively while it was 120.0 (g) in the control. However, the remained treatments had insignificant effect as compared to the control.

On the second sampling date, it could be found that flower thinning, spraying with 50 ppm and 100 ppm GA₃ significantly increased the average fruit weight. They gave 418.8, 411.3 and 423.8 (g), respectively, while it was 373.9 (g) in the control. The remained treatments had insignificant effect in this respect. Average peel weight significantly increased by flower thinning and 100 ppm GA₃. Both of the treatments gave 192.6 and 187.6 (g), respectively, while the control recorded 162.7 (g). The average granule weight (g) did not significantly affect by the treatments. Respecting the average granule weight %, it could be found that all the treatments comprised of ethrel had a significant affect. Application of 50, 100, 150 GA₃ + 1000 ppm ethrel

and ethrel alone at 1000 ppm recorded 61.3, 61.8, 62.1 and 61.3%, respectively while, the percentage was 56.5 in the control.

3) Chemical fruit properties:

The effect of different treatments on TSS, acidity and TSS/acid ratio was presented in Tables 7 and 8.

The results of the first sampling date (Table 7) in the first season revealed that most of the treatments had insignificant effect on all the studied traits. However, the flower thinning was the only treatments which caused a significant effect on the percentage of TSS. This treatment recorded 16.7% while the percentage of TSS in the control was 14.9.

On the second sampling date of such season (Table 8) it could be from the obtained results observed that there were insignificant effect of all the treatments on the percentage of TSS and acidity. However, the flower thinning and flower thinning + 100 ppm GA₃ gave a significant effect on TSS/acid ratio. The ratio of TSS/acid associated with these both treatments was 18.1 and 17.6, respectively, while it was 13.9 in the control.

Table 7: Effect of flower thinning, gibberellic acid (GA₃) and ethrel on TSS%, acidity % and TSS/acid ratio of Manfalouty pomegranate cultivar at the first sampling date during 2006 and 2007 seasons.

Treatment	Characteristic	TSS %		Acidity %		TSS/acid ratio	
		2006	2007	2006	2007	2006	2007
1) Flower thinning		16.7	15.2	1.087	0.885	15.5	17.1
2) 50 ppm GA ₃		15.5	14.3	1.186	1.083	13.1	13.3
3) 100 ppm GA ₃		15.3	14.1	1.239	1.092	12.3	13.0
4) 150 ppm GA ₃		15.3	14.6	1.187	1.090	12.8	13.4
5) Flower thinning + 100 ppm GA ₃		15.0	14.4	0.979	0.885	15.4	16.2
6) 1000 ppm Ethrel		15.2	15.4	1.064	0.894	14.2	17.2
7) 50 ppm GA ₃ + 1000 ppm Ethrel		15.6	15.0	1.094	0.925	14.4	16.1
8) 100 ppm GA ₃ + 1000 ppm Ethrel		15.0	14.5	1.045	0.964	14.4	15.0
9) 150 ppm GA ₃ + 1000 ppm Ethrel		15.2	15.2	1.087	0.977	14.0	15.5
10) Control		14.9	14.3	1.186	1.038	12.7	13.9
LSD _{0.05}		1.0	N.S.	N.S.	N.S.	N.S.	2.2

Table 8: Effect of flower thinning, gibberellic acid (GA₃) and ethrel on TSS%, acidity % and TSS/acid ratio of Manfalouty pomegranate cultivar at the second sampling date during 2006 and 2007 seasons.

Treatment	Characteristic	TSS %		Acidity %		TSS/acid ratio	
		2006	2007	2006	2007	2006	2007
1) Flower thinning		15.0	14.2	0.831	0.781	18.1	18.2
2) 50 ppm GA ₃		14.8	13.9	1.090	0.885	13.6	15.6
3) 100 ppm GA ₃		14.4	14.2	1.089	0.888	13.4	16.0
4) 150 ppm GA ₃		14.0	13.6	0.992	0.925	14.1	14.7
5) Flower thinning + 100 ppm GA ₃		14.9	14.3	0.850	0.768	17.6	18.5
6) 1000 ppm Ethrel		13.9	14.6	0.951	0.768	14.7	18.9
7) 50 ppm GA ₃ + 1000 ppm Ethrel		14.2	13.5	0.902	0.742	15.7	18.1
8) 100 ppm GA ₃ + 1000 ppm Ethrel		13.9	13.7	0.992	0.845	14.2	16.2
9) 150 ppm GA ₃ + 1000 ppm Ethrel		14.4	13.5	0.965	0.768	14.9	17.5
10) Control		13.8	13.9	0.992	0.888	13.9	15.7
LSD _{0.05}		N.S.	N.S.	N.S.	N.S.	2.7	2.3

During the second season, it could be found that there were insignificant effects of all the treatments on TSS and acidity % of the first sampling fruits. However, flower thinning, flower thinning + 100 ppm GA₃ and 1000 ppm ethrel had a significant effect on TSS/acid ratio. They recorded 17.1, 16.2 and 17.2, respectively, while the ratio in the control was 13.9.

On the second sampling date of such season, same trend could be observed. Flower thinning, flower thinning + 100 ppm GA₃, 50 ppm GA₃ + 1000 ppm ethrel and 1000 ppm ethrel had a significant effect on the ratio of TSS/acid. They recorded 18.2, 18.5, 18.1 and 18.9, respectively, while the control recorded 15.7.

The results revealed that flower thinning advanced the fruit ripening by increasing the ratio of TSS/acid comparing to the control. This observation could be attributed to that the remained fruits after thinning were superior and most of them are of first quality. The study also indicated that ethrel alone or combined with GA₃ also enhanced ripening, while GA₃ had not any significant effect in this respect. The effect of ethrel on improving the fruit quality and enhancing maturity of fruit trees was mentioned in many papers. For instance, Karim *et al.* (1989) on cranberry found that it increased fruit quality and marketing grade. Also, Haitheme and Abu-Bakr (2003) on mango found that it advanced maturity and increased TSS% and decreased flesh firmness. On grape, Mohamed and Shaaban (2008) found that ethrel had a pronounced effect on berry chemical properties and advanced the ripening. Same effects were reported on lemon (Gill *et al.*, 1982), on

orange (Al-Mughrabi *et al.*, 1989), and on mango (Singh and Dwivedi, 2009).

The results of present study accordance with those reported by El-Kassas *et al.* (1989), El-Sese (1988b), Hussein *et al.* 1994b, Amin *et al.* (2000), Mohamed (2004), and El-Sese and Mohamed (2005). The study also showed that the percentage of TSS was higher in the first sampling date as compared with the second one. The later was accordance with that reported by Mahmoud (1989). He reported that the juice contents of TSS were significantly increased from the early stage of fruit development till October 1st and then it decreased till the harvest date (October 31).

From the previous results it could be concluded that spraying with GA₃ at any concentration greatly reduced fruit splitting and increased the average fruit weight. Moreover, deliverance approximately 10 % of total yield susceptible to split. The experiment also indicated that commercial fruits of Manfalouty pomegranate cultivar were produced from the first three waves of fruit set. The early fruit set times produced larger, first quality and earlier harvested fruits. While later fruit set times did not attain their maturity standards and gave inferior and non-commercial fruits. Such fruits are poor in quality because they are not able to ripen in appropriate time and are affected by low temperature during fruit ripening (El-Sese 1988b). Such fruits are rejecting in the markets and/or do not acceptable by the consumers. Accordingly, grading and sorting of the fruits during harvest according to the fruit set times are very important things and should be exercised for obtained a good price.

References:

- Ahmed, E.E.H. 2007. Effect of fruit thinning and spraying with some chelated element and calcium on yield and fruit quality of Manfalouty pomegranate. M.Sc. Thesis, Fac. of Agric., Assiut Univ., 95 p.
- Al-Mughrabi, M.A.; M.A. Bacha and A.O. Abdel-Rahman 1989. Influence of pre-harvest application of etrel and 2,4-D on fruit quality of Balady orange. J. King Saud Univ., Agric. Sci., [1, 2], 95-102.
- Amin, K.I., A.M. El-Salhy, H.A. Abdel-Galil and M.S. El-Kholy 2000. Effect of girdling, fruit thinning and uniconazole spraying on fruiting of Manfalouty pomegranate cultivar. Assiut J. of Agric. Sci. 31 (4): 177-189.
- Association of Official Agricultural Chemists. 1975. Official Methods of Analysis A.O.A.C. 12th Ed. Published by A.O.A.C., Washington D.C, U.S.A.
- Bruinsma, J. 1962. Chemical control of fruit crop growth and development. Netherlands J. Agric. Sci. 10 (5): 109-125.
- Cline, J.A. and M. Trough 2007. The effect of GA₃ on fruit cracking and quality of Bing and Sam Sweet cherries. Canadian J. of Plant Sci., 87: 545-550.
- Division of Agricultural Sciences. 1977. Growing Pomegranates in California. California University. Leaflet 2459.
- El-Kassas, Sh.E., H.M. Mahmoud and A.M. El-Salhy 1989. Effects of some growth regulators on fruit quality of Manfalouty pomegranate cultivar. Assiut J. Agric. Sci., 20 (2): 51-69.
- El-Kassas, Sh.E., H.M. Mahmoud, A.M. El-Salhy and S.A. Mohamed 1994. Effects of GA₃ and calcium treatments on the keeping quality and storability of Manfalouty pomegranate fruits. Assiut J. Agric. Sci. 26 (4): 217-230.
- El-Khawaga, A.S. 2003. Effect of paclobutrazol and zinc sulphate on splitting and fruit quality of Manfalouty pomegranate trees under Upper Egypt conditions. J. Agric. Sci., Mansoura Univ., 28 (8): 6289-6294.
- El-Khawaga, A.S. 2007. Reduction in fruit cracking in Manfalouty pomegranate following a foliar application with paclobutrazol and zinc sulphate. J. of Appl. Sci. Res. 3 (9): 837-840.
- El-Masry, S.M. 1995. Physiological studies to control pomegranate fruit disorders. M.Sc. Thesis, Fac. of Agric., Assiut Univ., Egypt. 152 p.
- El-Salhy, A.M. 1996. Performance of single and multiple Manfalouty pomegranate fruits in response to GA₃ application. Fourth Arabic Conf. for Horticultural Crops, El-Minia, Egypt, 757-767.
- El-Sese, A.M. 1998a. Effect of time of fruit setting on the quality of some pomegranate cultivars. Assiut J. Agric. Sci. 19 (3): 55-69.
- El-Sese, A.M. 1988b. Physiological studies on flowering and fruiting habits of some pomegranate cultivars under Assiut conditions. Assiut J. Agric. Sci. 19 (4): 320-336.
- El-Sese, A.M. and A.K.A. Mohamed 2005. Effect of flower thinning on yield, fruit splitting and quality of Manfalouty pomegranate cultivar. J.

- Agric. Sci. Mansoura Univ., 30 (1): 501-511.
- Gill, D.S., S. Bajwan, R. Singh and W.S. Brar 1982. Regional fruit research station, Abohar India. Effect of ethrel spraying on lemon fruit development (*Citrus lemonoides* L.). Science and Culture, 48 (11):
- HaitHEME, M. and Abu-Bakra Abu-Goukh 2003. Effect of ethrel in aqueous solution and ethylene released from ethrel on mango fruit ripening. J. of Hort. Sci. & Biotech. 78 (4): 568-573.
- Hussein, M.A., A.M. El-Sese, T.K. El-Mahdy and B. Abd El-Sabour 1994a. Physiological studies on thinning effects on the yield and fruit quality of Manfalouty Pomegranate. A-Flowering behaviour and sevin, NAA and hand thinning effects on fruit thinning, yield and certain fruit characteristics. Assiut J. Agric. Sci. 25 (3): 27-40.
- Hussein, M.A., A.M. El-Sese, T.K. El-Mahdy and B. Abd El-Sabour 1994b. Physiological studies on thinning effects on the yield and fruit quality of Manfalouty pomegranate. B-Sevin, NAA and hand thinning influences on some fruit physical and chemical properties. Assiut J. Agric. Sci. 25 (3): 41-51.
- Karim M. Farag, Jiwani P. Paita and Eiden J. Stang 1989. Field application of new ethrel formulations for early colour enhancement in cranberry (*Vaccinium macrocarpon* Ait.) fruit. Acta Hort. 241: 373-377.
- Mahmoud, H. 1989. Effect of 2,4,5-T on fruit quality of some Manfalouty pomegranate cultivar. Assiut J. Agric. Sci., 20 (3): 43-59.
- Mohamed, A.K.A. 2004. Effect of gibberellic acid (GA_3) and benzyladenine (BA) on splitting and quality of Manfalouty pomegranate fruits. Assiut J. Agric. Sci., 35 (3): 11-21.
- Mohamed, A.K.A. and M.M. Shaaban 2008. Improvements in berry quality of Ruby Seedless and Beauty Seedless grapes. Assiut J. Agric. Sci. 39(5):81-91.
- Mustafa, F.M.A. 1998. Physiological effects of Glutathione spray on development of fruit growth, yield and fruit cracking of Manfalouty pomegranate variety. Assiut J. Agric. Sci., 29 (3): 201-214.
- Sepahi, A. 1986. GA_3 concentrations for controlling fruit cracking in pomegranates. Iran Agric. Res. 5 (2): 93-99.
- Sharifi, H. and A. Sepahi 1984. Effect of gibberellic acid on fruit cracking in Meykholsh pomegranate. Iran Agric. Res. 3 (2): 145-155. (C.F. Hort. Abst. 55 (8): 6482, 1985).
- Singh, D.B.; B.D. Sharma and R. Bhargava 2003. Effect of boron and GA_3 to control fruit cracking in pomegranate. Current Agric., 27 (1/2): 125-127.
- Singh, R. and U.N. Dwivedi 2008. Effect of ethrel and 1-methyl cyclopropene (1-mcp) on antioxidants in Mango during ripening. Food Chemistry, 111 (4): 951-956.
- Snedecor, G.W. and W.G. Cochran. 1972. Statistical Methods. 6th. Ed. The Iowa State University Press, Ames, Iowa, U.S.A.

تأثير خف الأزهار والرش بحامض الجبريليك والأيثيفون على المحصول وجودة الثمار في صنف الرمان المنفلوطي

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يعتبر الرمان من أهم محاصيل الفاكهة في محافظة أسيوط حيث تعتبر هي المحافظة الرائدة في زراعة وإنتاج الرمان على مستوى جمهورية مصر العربية لما تتميز به من جو مثالي لنمو وإثمار أشجار الرمان من حيث الجو الجاف والصيف الطويل الحار . حتى سنوات قريبة كانت مساحات الرمان قليلة مقارنة بأهمية هذا المحصول . ولقد تضاعفت هذه المساحة عدة مرات في السنوات الأخيرة وذلك لزيادة الطلبات الإستيرادية لثمار هذا المحصول الهام خاصة من دول الخليج العربي . ويستلزم لتصدير ثمار الرمان مواصفات خاصة تتمثل في تحسين جودة الثمار وتقليل تشققها لتقليل الفاقد في المحصول ومحاولة رفع نسبة الثمار التجارية القابلة للتصدير أو لكي تباع محلياً بأسعار عالية . ولتحقيق هذا الهدف تم عمل هذه الدراسة والتي كانت تهدف بالدرجة الأولى إلى رفع نسبة الثمار التجارية مع تحسين خصائص جودة الثمار .
الطرق والمواد :

أجريت هذه الدراسة خلال موسمي النمو 2006 ، 2007 على شجيرات الرمان صنف المنفلوطي مزروعة في المزرعة البحثية لقسم الفاكهة بكلية الزراعة - جامعة أسيوط - كان عمر الشجيرات عند بداية التجربة 32 عاماً ومزروعة على مسافات 5×5 متر . تم انتخاب 50 شجيرة متماثلة قسمت إلى 10 معاملات مشتملة على الكنترول . وكانت المعاملات كالتالي :

خف جميع الأزهار التي تخرج على الشجيرات خلال الأسبوع الأخير من مايو وحتى إنتهاء موسم التزهير ، رش الثمار بحامض الجبريليك بتركيز 50 ، 100 ، 150 جزء في المليون ، خف الأزهار + الرش بحامض الجبريليك بتركيز 100 جزء في المليون ، رش الثمار بالايثريل بتركيز 1000 جزء في المليون ، رش الثمار بالايثريل بتركيز 1000 جزء في المليون + حامض الجبريليك بتركيز 50 ، 100 ، 150 جزء في المليون ، الكنترول (تم الرش بالماء) . عند الجمع كان يتم فرز الثمار واستبعاد الثمار المتشقة حيث كان يتم حساب وزنها وعددها . ثم تدريج الثمار إلى ثلاثة درجات طبقاً لأوزانها التقريبية.

تم جمع عينتين ممثلين في مواعدين من كل عام من كل شجرة - اشتملت العينة على 5 ثمار - أخذت العينة الأولى في شهر سبتمبر والثانية في شهر أكتوبر من كل عام . لتقدير الصفات التالية:

متوسط وزن الثمرة ، متوسط وزن القشرة ، متوسط وزن الحبوب ومنها حسبت النسبة المئوية لمتوسط وزن الحبوب ، النسبة المئوية للمواد الصلبة الذائبة الكلية قدرت باستخدام الرافراكتوميتر اليدوي ، النسبة المئوية للحموضة محسوبة على أساس حامض الستريك ، نسبة المواد الصلبة الذائبة الكلية على الحموضة .

صممت التجربة كتجربة كاملة العشوائية - اشتملت على عشرة معاملات كل معاملة أحتوت على خمسة مكررات . تم اختبار معنوية الاختلافات بين المعاملات باستخدام طريقة أقل فرق معنوى عند درجة احتمالية 5% .

كانت أهم النتائج المتحصل عليها من التجربة :

1- أدت المعاملات وبالأخص خف الأزهار أو خف الأزهار + الرش بحامض الجبريليك إلى أعلى عدد ووزن من ثمار الدرجة الأولى وأقل عدد ووزن من ثمار الدرجة الثانية والثالثة ..

2- كان تأثير المعاملات غير معنوى على وزن المحصول الكلى خلال الموسم الأول بينما أعطت معاملتى الرش بحامض الجبريليك بتركيزى 150 ، 50 جزء فى المليون فى الموسم الثانى تأثيراً معنوياً بينما كان تأثير بقية المعاملات غير معنوى.

3- كان تأثير المعاملات معنوياً فى معظم الأحوال على تقليل النسبة المئوية للثمار المتشقة المحسوبة عدداً أو وزناً

4- أدت كل المعاملات إلى حدوث زيادة فى متوسط وزن الثمرة ووزن الحبوب.

5- أدت معظم المعاملات وبالأخص المحتوية على الايثريل إلى حدوث تحسن فى الصفات الكيماوية للثمار وأدت إلى تكبير النضج معبراً عنه بالنسبة بين المواد الصلبة الذائبة للحموضة ولكن كانت الفروق بين المعاملات والكنترول فى معظم الحالات غير معنوية .

تنصح الدراسة بخف جميع الأزهار التى تخرج على شجيرات الرمان المنفلوطى بداية من الأسبوع الأخير من مايو وحتى نهاية موسم التزهير وذلك للحصول على ثمار تجارية صالحة للتصدير أو بيعها بأسعار عالية فى الأسواق المحلية . تنصح كذلك الدراسة برش الثمار بحامض الجبريليك حيث أنها وسيلة فعالة لتقليل نسبة تشقق الثمار . كما أن الرش بالايثريل منفرداً أو مخلوطاً بحامض الجبريليك أدى لتحسين خصائص جودة الثمار وبكر من النضج وقلل من نسبة تشقق الثمار .