

# Impact of Chemical and Non-Chemical Thinning Treatments on Yield and Fruit Quality of Date Palm

Mohamed S. Al Saikhan<sup>1</sup> & Abdel-Kader A. Sallam<sup>2\*</sup>

<sup>1</sup> College of Agricultural and Food Sciences, King Faisal University, Kingdom of Saudi Arabia

<sup>2</sup> Date Palm Research Center of Excellence, King Faisal University, Kingdom of Saudi Arabia

\* Permanent address: College of Technology and Development, Zagazig University, Egypt

Correspondence: Mohammed S. Al Saikhan, College of Agricultural and Food Sciences, King Faisal University, Kingdom of Saudi Arabia. Tel: 966-135-895-809. E-mail: [msaikhan@kfu.edu.sa](mailto:msaikhan@kfu.edu.sa)

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## Abstract

The fruit thinning process is employed for the production of high quality large-sized fruits and prevent the production of compact bunches. It is also one way to reduce the alternate bearing habits in date palm. In this study, seven thinning treatments (i.e. without spraying water after pollination, spraying water at 3 minutes after 3, 4 and 5 h, spraying Ethephon at 0, 500 and 1000 ppm after ten days from pollination) are used for Khalas and Ruzeiz date palm cultivars. The factorial experiment in a randomized completely block design with three replicates was done. The results reveal that, spraying water after mechanical pollination has reduced fruit set% and increased fruit shees%. Most thinning treatments reduced fruit yield/palm in both Khalas and Ruzeiz. Spraying water after 5 h enhanced fruit quality compared with the other thinning treatments in besr and tamr stages. Spraying with ethephon at 1000 ppm gave the increased sugars content and TSS, whereas reduced the moisture content in besr stage. Spraying water after 5 h from mechanical pollination or Ethephon at 1000 ppm after 10 days are suitable for obtaining economic yield with best fruit quality.

**Keywords:** date palm, *Phoenix dactylifera*, thinning, Ethephon, fruit quality, yield

## 1. Introduction

Date palm (*Phoenix dactylifera* L.) is a major tree crops in arid regions of the Middle East and North Africa, having an important impact on the economy of many countries in these regions. In addition, it is the major fruit crop in the Kingdom of Saudi Arabia (74.5% of fruit trees). This tree crop is helpful in making Saudi Arabia's arid climate unique for the cultivation purpose. According to FAOSTAT, in Saudi Arabia, the annual dates production is around 1.05 million ton from 160000 hectare (FAOSTAT, 2012). There are many methods to remove their inflorescences or bunches or reduced part of bunch i.e. shorten or remove part of bunch or remove individual fruits or adjustment the ratio between bunch: leaves. In the date palm, the newly spraying with water after pollination or plant hormones such as ethephon is used. Generally, the time of application of those methods or application have important factor in mode of action about the desired effect of the thinning process. Hand thinning of fruit is not economically practical. It leads towards the failure as it results in attaining adequately thin small fruit and poor return bloom. The studies suggested that the chemical and physical traits of date palm fruits have increased due to bunch thinning El-Shazly (1999), Harhash (2000), Bamiftah (2000). Succary date palm cultivar was thinned by removing 15 and 30% of the total number of strands from the center of each bunch, while the control strands were used as reference. Although, thinning caused significant decrease in yield (based on both bunch and palm weight), significant improvements in fruit quality were observed Soliman and Harhash (2012). Methods of manual and chemical thinning were compared on the same Zaghoul palms by El-Kassas (1986). He found that, bunch-thinning treatments substantially decreased bunch weight and increased fruit weight, size, pulp percent, pulp/seed ratio, fruit dimensions, reduced total sugars and decreased sucrose.

Recently, Awad (2006) reported that water sprays for 3 minutes after pollination decreased the fruit set percentage of 'Lulu' date palm cultivar. The percentage varies on the application time. Water spray is the most effective and efficient treatment after 4 hours of pollination. By using the treatment methods, the fruit set means of both season decreased significantly. The results depicted the fruit set percentage as forty-eight percentage,

which is compared to the control that is seventy-nine percentages. During these seasons, the water spray treatment increases the fruit quality characteristics. This includes fruit weight, flesh weight, fruit length and diameter. At the Tamr stage, when 4h pollination was applied, at that time, bunch weight and total yield per tree decreased by doing thinning with water. Ethephon is known as growth plan regulator. According to the Agrochemicals Handbook through ethylene liberation, the Ethephon's mode of action acts. This is absorbed by interferes and plant in the growth process (The Agrochemicals Handbook, 1983). El-Hamady et al. (1983) found that Ethephon was effective at all concentrations and excessive thinning occurred with 400 ppm. Early application was more effective than late application. Yield was lower in Ethephon-treated palms than controls. However, the biennial bearing habit of the treated palms was significantly reduced. Ripening in Ethephon-treated palms was comparatively earlier than in controls. Fruit weight and total soluble sugar content were significantly higher in fruits from Ethephon-treated palms than in control. In addition, El-Hamady et al. (1993) stated that, as a fruit thinner Ethephon was effective up to 200 ppm when applied it ten days after fruit set. Fruit quality attributes were improved in both Seleg and Meneify date palm cultivars. Hussein et al. (1992) observed that fruit ripening was hastened by 3-7 and 6-11 days by Ethephon at 250 and 500 ppm and by 3-5 and 5-9 days by moderate and heavy thinning respectively. Ethephon treatments had no significant effects on bunch weight, but fruit thinning reduced bunch weight and increased fruit weight and size. Fruit TSS and total sugars contents were highest with Ethephon at 500 ppm and heavy thinning. Mostafa and Seif (1993) found that, Ethrel (ethephon) treatments (0, 100, 300 or 400 ppm) reduced the average bunch yield in comparison to the untreated bunches; however, the differences were not significant. Spraying date fruits with Ethrel enhanced fruit quality for increasing total sugars, flesh weigh, fruit dimensions, TSS and fruit weight.

This research aims to find out the impact of thinning methods i.e. water sprays, Ethephon sprays on the yield, and fruit quality of Khalas and Ruzeiz date palm cultivars in Alahsa Oases, Saudi Arabia.

## 2. Materials and Methods

In orchards of National Date Palm Research Center, Alahsa, KSA during 2010 and 2011 seasons, the study was conducted on Ruseiz and Khalas date palm cultivars. Twenty-one date palm trees (10-years old) selected from each cultivar for the application of thinning treatments. The palms were received to the same horticultural practices. The number of spathes per palm was adjusted to eight for Khalas and six for Ruzeiz by removing excess earliest, latest and small inflorescence for each cultivar.

### 2.1 Experimental Design

By using three replicates, the factorial experiment was done in a randomized complete block design. Two cultivars Khalas and Ruzeiz are included in the first factor and in the second factor thinning treatments are included:

- Water spraying: These treatments received the mechanical pollination by handle machine (1 pollen grains: 7 flour), then spraying water 3 min duration after 3, 4 and 5 h from pollination, as well as, control (without spraying water).
- Ethephon spraying: mechanical pollination was done as previous description, and then after 10 days was spraying these bunches by 0, 500 and 1000-ppm ethephon.

Pollination was carried out by using the same pollen sources. After pollination and thinning treatments application immediately were wrapped with paper bags to prevent natural contamination by wind-borne pollen, bee pollination or by unwanted pollen. Thereafter, the bags were removed out after two or three weeks from pollination.

### 2.2 Data Recorded

#### 2.2.1 After Thinning Application

After two months from application treatments, 10 strands were selected from each bunch. Strands were labeled and determined the following characters: By using the below mentioned equation, the fruit set was recorded:

$$\text{Fruit set \%} = \frac{\text{Total number of fruit set}}{\text{Total nodes number}} * 100$$

- Fruit shees (failed to set i.e. more than one carpel was grown) was estimated by following equation:

$$\text{Fruit shees \%} = \frac{\text{Total number of fruit shees}}{\text{Total nodes number}} * 100$$

- Fruits dropping % was calculated using the following equation:

$$\text{Fruit dropping \%} = \frac{\text{Total number node don't borne fruits}}{\text{Total nodes number}} * 100$$

### 2.2.2 At Harvest Time

At the Besr (yellow at full mature) and Tamr stages (full ripening) measured the following observation:

#### 2.2.2.1 Dates Yield

- Fruit retained percentage was calculated (10 strands from each bunch) using the following equation:

$$\text{Fruit retained \%} = \frac{\text{Total number retained fruits}}{\text{Total nodes number}} * 100$$

- Bunch weight (kg).
- Yield/tree (kg) i.e. No. of bunches x bunch weight.

#### 2.2.2.2 Fruit Characteristics

From each bunch, three replicates (each has 25 fruits) are used in this study.

##### a. Fruit Physical Characters

- Fruit weight (g)
- Fruit length and diameter (mm)
- Pulp weight (g)
- Seed weight (g)
- Pulp to seed ratio

##### b. Fruit Chemical Characters

- Fruit moisture percentage.
- Total soluble solids (TSS)
- Sugars content as following:

With a HITACHI HPLC equipped with a model L-2130 solvent delivery system and L-2200 autosampler, the Chromatographic analyses of sugar in dates were carried out (HITACHI VWR). Three detectors, a PDA detector HITACHI and L-2490 RI were used for detection. Nucleo-Sil carbohydrate column was used with an acetonitrile–water (75:25) mobile phase for isocratic elution. The flow rate was 1.5 mL/min. RI was performed at ambient temperature (Yuan & Chen, 1999).

### 2.3 Statistical Analysis

In this study, the ANOVA is used to statistically analyze the data according to Gomez and Gomez (1984). The treatment means were compared by using at least significant difference (LSD) test using statistical analysis systems software (SAS, 2001).

## 3. Results and Discussions

The section discusses the results and findings of the study. The section discusses the effect of thinning treatments and their interactions. The effect of those treatments on date palm cultivars is not scope due to genetic differences between them.

### 3.1 Fruit–Set, Shees and Dropping Percentages

Effect of thinning treatments on the fruit set, shees and dropping percentages is shown in Table 1. The results demonstrated significant effect in the previous characters. Mechanical pollination without spraying water treatment gave the highest value in fruit-set percentage (68.9) in comparison to the other thinning treatments. In addition, spraying water after 5h and Ethephon treatments came in the second rank without any significant differences between them. On the other hand, the spraying water after 3 and 4h gave the lowest value (54.5 and 58.3, respectively). On the contrary, the shees % reversed the rank of fruit-set%. Regarding the effect of thinning treatments on fruit dropping %, the spraying water after 4 and 5h gave the lowest value, whereas, the spraying water after pollination (3 hrs) recorded the highest value (32.8%). Almost, Ruzeiz cultivar produced the highest values in fruit-set percentage with all thinning treatment especially when both the treatment methods were not used. However, in the shees percentage and dropping percentage, Khalas cultivar usually produce the highest values under the same treatments.

Table 1. Effect of thinning treatments on fruit-set, shees and dropping percentages of Khalas and Ruzeiz cultivars after 2 months (over 2010 and 2011 seasons)

Treatments	Fruit-set %	Fruit shees %	Fruit dropping %	
<b>A: Cultivars:</b>				
Khalas	48.7	15.0	36.2	
Ruzeiz	79.0	0.24	20.7	
F-test	**	**	**	
<b>B: Thinning treatments:</b>				
Without spraying water	68.9	3.30	27.8	
After 3 hours	54.5	16.7	32.8	
After 4 hours	58.3	16.9	24.8	
After 5 hours	64.2	11.4	24.4	
0 ppm Ethephon	65.9	3.66	30.4	
500 ppm Ethephon	66.5	2.55	30.9	
1000 ppm Ethephon	68.8	2.97	28.3	
F-test	**	*	**	
LSD at 5%	4.2	4.07	3.78	
<b>C: Interaction AxB:</b>				
Khalas	Without spraying water	52.0	6.17	41.8
	After 3 hours	44.4	25.4	30.1
	After 4 hours	39.2	33.8	27.0
	After 5 hours	46.9	22.5	30.5
	0 ppm Ethephon	53.1	6.90	40.0
	500 ppm Ethephon	49.7	4.73	45.5
	1000 ppm Ethephon	55.7	5.74	38.6
Ruzeiz	Without spraying water	85.7	0.43	13.8
	After 3 hours	64.5	0.00	35.5
	After 4 hours	77.5	0.00	22.5
	After 5 hours	81.5	0.23	18.3
	0 ppm Ethephon	78.7	0.43	20.8
	500 ppm Ethephon	83.3	0.37	16.3
	1000 ppm Ethephon	81.9	0.20	17.9
F-test	**	*	**	
LSD at 5%	5.83	5.75	5.35	

The outcomes of the study depicted that pollen grains have different sensitivities during pollen tube growth on stigmas. The water spray effect after pollination on reducing fruit-set might be due to washing out stigmas then prevent pollen grain to growth and reached to ovary. The humidity around the inflorescences may increase after water spray which is simulation of rainfall. This also increases the blow out of pollen (Zaid & de Wet, 1999). These results are in harmony with this obtained by Awad (2006) on Lulo date palm cultivar.

### 3.2 Retained Fruit Percentage, Bunch Weight and Yield/Palm

Data in Table 2 revealed that the retained fruit percentage, bunch weight and yield/palm were significantly affected by the thinning treatments. The use of 500 ppm Ethephon or without water spraying treatment, recorded the highest values (70.5% and 66.2, respectively). On the other hand, using spraying water treatment method after 3 and 4 hours produced the lowest values of retained percentage (47.0 and 49.7, respectively). Spraying

water after three, 4 and 5 hours from pollination reduced the retained fruit in Khalas cultivar (42.1, 38.2 and 37.9%, respectively) in comparison to the other treatments. Whereas, in Ruzeiz all thinning treatments depicted that the high values. As for bunch weight in kg results indicated, that palms without water spray treatments achieved significant greatest bunch weight i.e., 8.15 kg. On the other hand, water-spraying treatment after three hrs or Ethephon at 1000 ppm gained the lowest bunch weight. The interaction effect date palm cultivars and thinning treatments on bunch weight is shown in the attached Table 2. Data depicted that, without using water spraying treatment method and sprayed at 500 ppm Ethephon treatments produced the heaviest bunch weight in Khalas cultivar (10.0 and 10.25, resp.) without significant difference between them.

Table 2. Effect of thinning treatments on retained fruit percentage, bunch weight and yield/palm of Khalas and Ruzeiz cultivars (over 2010 and 2011 seasons)

Treatments	Retained fruit %	Bunch weight (kg)	Yield/palm* (kg)	
<b>A: Cultivars:</b>				
Khalas	48.8	8.73	66.57	
Ruzeiz	65.5	5.70	34.22	
F-test	**	**	**	
<b>B: Thinning treatments:</b>				
Without spraying water	66.2	8.15	58.90	
After 3 hours	47.0	6.50	43.80	
After 4 hours	49.7	7.13	47.12	
After 5 hours	54.3	7.75	50.09	
0 ppm Ethephon	58.6	7.31	52.87	
500 ppm Ethephon	70.5	7.56	55.62	
1000 ppm Ethephon	53.7	6.13	44.37	
F-test	**	**	**	
LSD at 5%	5.18	0.62	4.43	
<b>C: Interaction AxB:</b>				
Khalas	Without spraying water	58.7	10.0	80.00
	After 3 hours	42.1	7.63	55.35
	After 4 hours	38.2	8.00	56.74
	After 5 hours	37.9	8.63	58.94
	0 ppm Ethephon	55.9	9.00	72.00
	500 ppm Ethephon	63.9	10.25	82.00
	1000 ppm Ethephon	44.9	7.63	61.00
Ruzeiz	Without spraying water	73.7	6.30	37.80
	After 3 hours	51.8	5.38	32.25
	After 4 hours	61.3	6.25	37.50
	After 5 hours	70.7	6.88	41.25
	0 ppm Ethephon	61.2	5.63	33.75
	500 ppm Ethephon	77.1	4.88	29.25
	1000 ppm Ethephon	62.5	4.63	27.75
F-test	**	**	**	
LSD at 5%	7.32	0.87	6.26	

Mean fruit yield/palm weight became highest (58.9 kg/palm) when water spray treatment method was not used but if Ethephon 500 ppm treatment was applied came in the second order. Whereas spraying water after three hrs (43.8/palm) showed the significantly least fruit weight over two seasons. The influence of thinning treatment and cultivars on the yield /palm presented in Table 2. The results showed that the all-thinning treatments recorded the highest values with Khalas in comparison to Ruzeiz cultivar. Without spraying water (no thinning) and sprayed at 500 ppm ethephon treatments produced the heaviest yield weight in Khalas cultivar (80.0 and 82.0, resp.) without significant difference between them.

Thinning treatment significantly decreased the fruit yield because of using bunch-thinning treatment. This might be due to the reducing fruits set percentage and retained percentage compared with un-thinned bunches. The outcomes of the present study were attained by the previous outcomes Mostafa and Seif (1993) on Sweey, Harhash and Abdel-Nasser (2007) on Zaghoul, Awad (2006) on Lulu and Soliman et al. (2010) on Khalas. They stated that fruit thinning reduced the yield of the studied date varieties.

### 3.3 Fruit Physical Characteristics in Besr and Tamr Stages

Effect of thinning treatments on the physical characteristics is shown in Tables 3 and 4. The results demonstrated significant impact in fruit weight, length, diameter, pulp weight, seed weight and pulp /seed ratio because of applying the thinning treatments. All spraying water treatments after mechanical pollination caused values increased in all physical characters except seed weight comparison with the other treatments or without spraying (control). Spraying water after 5 h produced the highest values in comparison to the rest treatments in both besr and tamr stages. Fruit physical parameters as affected by interaction between thinning treatments and date palm cultivars are presented in Tables 3 and 4 over two seasons. The data indicated that spraying water after pollination gave the highest values for both cultivars.

The increment in fruit physical characteristics may be due to the present small number of fruits/bunch as a result of reducing fruit-set percentage also, save the net of photosynthesis processing to remained fruits. Similar trend and findings were reported by El-Kassas (1986), Hussein et al. (1992), Mostafa and Seif (1993) and Awad (2006). They found that averages of fruit physical characters improvement by thinning treatments.

### 3.4 Fruit Chemical Proprieties (Besr and Tamr Stages)

Regarding the influence of thinning treatments on the tested chemical characteristics, the results presented in Tables 5 and 6 clearly showed that the ethephon application was associated with significant decrease moisture % and increase in TSS over both growing seasons in Besr stage but, in Tamr it is not clear. Fruit chemical proprieties are presented in Tables 5 and 6 as affected by interaction between thinning treatments and cultivars. The results reveal that treated with ethephon was significantly decreased the moisture % in Ruzeiz fruits compared with treatment without spraying water (74.4%) in Besr. On the other hand, the total soluble solids values were increased in Khalas with ethephone treated.

Sugars content in fruits are presented in Tables 5 and 6 as affected by thinning treatments. The results reveal that spraying bunches after 10 day with ethephon at 1000 ppm gave the highest values in fructose, glucose, maltose and sucrose (24.3, 28.4, 1.1 and 1.9 respectively) in besr stage whereas spraying water after 5 h came in the second rank. In tamr case, spraying with water after 5 h and both ethephon concentration recorded the highest values in sugars content without significant difference among them compared with the others. Without spraying water treatment gave the lowest values in this side. With respect to the interaction between the two factors under this study the data reveal significant effects in Besr stage whereas in Tamr do not reach significantly. In addition, Khalas fruits have the highest sugars content under the all-thinning treatments especially treated with ethephon in besr stage and tamr. Bunch thinning treatments significantly increased the T.S.S., sugars contents (fructose, glucose, maltose and sucrose) and fruit moisture content. These results may be due to the highly providing rate of adequate carbohydrates and other metabolites to the fruits. The past results were attained by these studies El-Kassas (1986), Hussein et al. (1992), El-Hamady et al. (1983), Mostafa and Seif (1993), Bamiftah (2000), Harhash (2000) and Al-Saikhan (2008).

Table 3. Effect of thinning treatments on fruit physical properties at Besr stage of Khalas and Ruzeiz cultivars (over 2010 and 2011 seasons)

Treatments	Fruit weight (g)	Fruit length (mm)	Fruit width (mm)	Pulp weight (g)	Seed weight (g)	Pulp/ seed ratio	
<b>A: Cultivars:</b>							
Khalas	14.89	38.8	25.3	13.72	1.17	11.7	
Ruzeiz	10.35	30.7	23.8	9.25	1.10	8.41	
F-test	**	**	**	**	**	**	
<b>B: Thinning treatments:</b>							
Without spraying water	11.05	33.2	23.8	9.94	1.11	8.99	
After 3 hours	13.07	35.4	24.9	11.92	1.15	10.3	
After 4 hours	13.40	36.7	24.6	12.30	1.01	11.1	
After 5 hours	14.22	35.9	25.5	13.08	1.14	11.4	
0 ppm Ethephon	12.07	33.9	24.6	10.91	1.16	9.43	
500 ppm Ethephon	11.56	33.3	23.7	10.46	1.10	9.45	
1000 ppm Ethephon	13.00	35.1	25.0	11.79	1.21	9.64	
F-test	**	**	**	**	**	**	
LSD at 5%	0.53	1.1	0.43	0.50	0.05	0.41	
<b>C: Interaction AxB:</b>							
Khalas	Without spraying water	12.53	36.4	23.9	11.42	1.11	10.3
	After 3 hours	15.53	39.4	25.8	14.34	1.19	12.0
	After 4 hours	16.60	42.0	26.0	15.46	1.14	13.6
	After 5 hours	17.30	40.6	26.8	16.10	1.20	13.5
	0 ppm Ethephon	12.40	36.3	23.7	11.24	1.16	9.65
	500 ppm Ethephon	14.37	38.0	24.7	13.24	1.13	11.75
	1000 ppm Ethephon	15.53	39.1	25.9	14.25	1.28	11.15
Ruzeiz	Without spraying water	9.57	30.0	23.6	8.47	1.10	7.73
	After 3 hours	10.60	31.4	23.9	9.50	1.10	8.64
	After 4 hours	10.19	31.4	23.3	9.14	1.06	8.65
	After 5 hours	11.13	31.3	24.1	10.06	1.07	9.37
	0 ppm Ethephon	11.73	31.4	25.4	10.58	1.15	9.21
	500 ppm Ethephon	8.75	28.6	22.7	7.68	1.07	7.16
	1000 ppm Ethephon	10.47	31.0	24.0	9.32	1.15	8.13
F-test	**	**	**	**	NS	**	
LSD at 5%	0.75	1.54	0.61	0.71	---	0.58	

Table 4. Effect of thinning treatments on fruit physical properties at Tamar stage of Khalas and Ruzeiz cultivars (over 2010 and 2011 seasons)

Treatments	Fruit weight (g)	Fruit length (mm)	Fruit width (mm)	Pulp weight (g)	Seed weight (g)	Pulp/ seed ratio	
<b>A: Cultivars:</b>							
Khalas	9.12	33.1	20.1	8.32	0.80	10.4	
Ruzeiz	6.57	28.3	20.0	5.86	0.72	8.17	
F-test	**	**	NS	**	**	**	
<b>B: Thinning treatments:</b>							
Without spraying water	7.39	27.0	20.8	6.64	0.75	8.77	
After 3 hours	8.19	32.6	20.6	7.43	0.76	9.70	
After 4 hours	7.86	31.7	20.1	7.15	0.72	9.84	
After 5 hours	8.54	32.7	20.4	7.75	0.79	9.79	
0 ppm Ethephon	7.71	27.8	18.7	6.94	0.77	8.99	
500 ppm Ethephon	7.52	31.4	20.0	6.79	0.73	9.30	
1000 ppm Ethephon	7.70	31.8	19.8	6.90	0.80	8.61	
F-test	**	**	**	**	**	**	
LSD at 5%	0.29	0.72	0.63	0.28	0.04	0.50	
<b>C: Interaction AxB:</b>							
Khalas	Without spraying water	8.63	26.8	21.1	7.83	0.79	9.88
	After 3 hours	9.78	36.4	21.0	8.97	0.81	11.13
	After 4 hours	9.70	36.1	20.8	8.92	0.78	11.49
	After 5 hours	9.99	36.2	20.5	9.15	0.84	10.94
	0 ppm Ethephon	8.32	26.5	16.9	7.54	0.78	9.64
	500 ppm Ethephon	8.81	34.7	19.9	8.05	0.75	10.70
	1000 ppm Ethephon	8.60	34.7	20.3	7.74	0.86	9.02
Ruzeiz	Without spraying water	6.15	27.2	20.6	5.44	0.71	7.67
	After 3 hours	6.61	28.7	20.2	5.90	0.71	8.27
	After 4 hours	6.03	27.3	19.3	5.37	0.66	8.19
	After 5 hours	7.08	29.2	20.2	6.35	0.74	8.64
	0 ppm Ethephon	7.10	29.0	20.6	6.34	0.76	8.35
	500 ppm Ethephon	6.22	28.0	20.1	5.52	0.70	7.89
	1000 ppm Ethephon	6.80	28.8	19.4	6.06	0.74	8.21
F-test	**	**	**	**	NS	**	
LSD at 5%	0.41	1.01	0.89	0.39	---	0.70	

Table 5. Effect of thinning treatments on fruit chemical properties at Besr stage of Khalas and Ruzeiz cultivars (over 2010 and 2011 seasons)

Treatments	Moisture %	TSS (°Brix)	Sugars %				
			Fructose	Glucose	Maltose	Sucrose	
<b>A: Cultivars:</b>							
Khalas	63.8	34.2	22.8	26.6	0.82	1.5	
Ruzeiz	65.7	31.6	17.8	23.8	1.09	1.9	
F-test	*	**	**	**	**	**	
<b>B: Thinning treatments:</b>							
Without spraying water	68.2	30.2	19.3	24.2	0.7	1.4	
After 3 hours	64.5	32.2	19.9	24.5	0.8	1.6	
After 4 hours	64.9	32.8	20.5	24.7	0.7	1.7	
After 5 hours	68.3	31.2	20.9	24.8	1.1	1.8	
0 ppm Ethephon	62.6	34.8	19.8	24.1	1.1	1.9	
500 ppm Ethephon	63.2	34.2	17.6	25.8	1.2	1.8	
1000 ppm Ethephon	61.8	35.2	24.3	28.4	1.1	1.9	
F-test	**	**	**	**	**	**	
LSD at 5%	3.40	1.38	1.2	0.7	0.15	0.1	
<b>C: Interaction AxB:</b>							
Khalas	Without spraying water	62.1	31.1	20.7	24.5	0.6	0.9
	After 3 hours	66.1	32.4	21.2	24.8	0.8	1.4
	After 4 hours	59.9	33.7	21.6	25.7	0.6	1.5
	After 5 hours	67.4	33.7	22.3	26.1	0.9	1.7
	0 ppm Ethephon	64.3	36.9	20.7	24.7	0.9	1.7
	500 ppm Ethephon	65.7	36.0	24.5	28.1	1.0	1.6
	1000 ppm Ethephon	61.6	35.7	29.0	32.9	1.1	1.8
Ruzeiz	Without spraying water	74.4	29.3	17.9	24.0	0.8	1.9
	After 3 hours	63.0	31.9	18.6	24.3	0.8	1.9
	After 4 hours	70.0	32.0	19.4	23.7	0.9	1.9
	After 5 hours	69.2	28.7	19.5	23.6	1.3	2.0
	0 ppm Ethephon	60.9	32.6	18.9	23.4	1.3	2.1
	500 ppm Ethephon	60.8	32.4	10.8	23.5	1.4	2.1
	1000 ppm Ethephon	62.0	34.7	19.6	24.0	1.2	2.0
F-test	**	*	**	**	*	**	
LSD at 5%	4.80	1.95	1.7	1.0	0.21	0.2	

Table 6. Effect of thinning treatments on fruit chemical properties at Tamr stage of Khalas and Ruzeiz cultivars (over 2010 and 2011 seasons)

Treatments	Moisture %	TSS (°Brix)	Sugars %				
			Fructose	Glucose	Maltose	Sucrose	
<b>A: Cultivars:</b>							
Khalas	16.0	70.9	33.38	26.7	1.94	2.8	
Ruzeiz	18.5	68.7	25.42	25.4	1.35	2.2	
F-test	**	**	**	**	**	**	
<b>B: Thinning treatments:</b>							
Without spraying water	17.8	71.4	28.5	26.6	1.4	2.4	
After 3 hours	17.1	69.9	28.8	26.2	1.5	2.4	
After 4 hours	16.0	66.6	29.1	25.6	1.6	2.4	
After 5 hours	18.7	70.3	30.4	26.1	1.6	2.5	
0 ppm Ethephon	16.6	70.9	29.5	26.4	1.7	2.4	
500 ppm Ethephon	17.1	71.0	29.7	25.3	1.8	2.7	
1000 ppm Ethephon	17.4	68.6	29.4	26.3	1.9	2.6	
F-test	**	**	*	NS	*	NS	
LSD at 5%	<b>0.59</b>	<b>0.61</b>	<b>1.2</b>	--	<b>0.3</b>	--	
<b>C: Interaction AxB:</b>							
Khalas	Without spraying water	16.5	72.2	31.9	26.6	1.7	2.9
	After 3 hours	15.8	72.2	32.6	26.8	1.9	2.8
	After 4 hours	14.7	68.0	32.9	26.3	1.9	2.8
	After 5 hours	17.5	71.3	35.1	27.1	1.9	2.8
	0 ppm Ethephon	15.4	72.5	34.4	27.5	2.0	2.6
	500 ppm Ethephon	15.8	71.6	33.7	25.2	2.0	3.0
	1000 ppm Ethephon	16.2	68.6	33.1	27.4	2.2	2.8
Ruzeiz	Without spraying water	19.0	70.6	25.0	26.5	1.1	2.0
	After 3 hours	18.3	67.6	25.0	25.5	1.1	2.0
	After 4 hours	17.2	65.3	25.4	25.0	1.2	2.0
	After 5 hours	20.0	69.3	25.7	25.1	1.4	2.1
	0 ppm Ethephon	17.9	69.4	25.5	25.3	1.5	2.3
	500 ppm Ethephon	18.3	70.4	25.7	25.3	1.6	2.4
	1000 ppm Ethephon	18.7	68.5	25.8	25.2	1.7	2.5
F-test	NS	**	NS	NS	NS	NS	
LSD at 5%	---	<b>0.86</b>	--	--	--	--	

#### 4. Conclusion

It can be concluded from our findings that spraying water after 5 h from mechanical pollination on flowering bunches or Ethephon application at 1000 ppm after 10 days improved fruit quality (physical and chemical properties) due to reducing fruit number/bunch although, this treatment reduce yield/palm of Khalas and Ruzeiz cultivars. Water spraying as a physical or non-chemical thinning methods need more studies to know which suitable time to apply.

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