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Impact of Thinning Bunches and Spraying Calcium Nitrate and Gibberellic Acid on Set, Drop, Yield and Quality of Fruits in Hayany Date Palm

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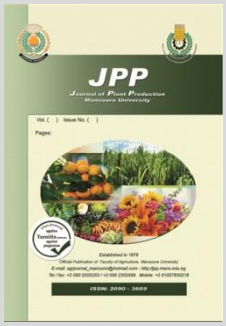

ABSTRACT

This research was conducted during 2015 and 2016 growing seasons on Hayany Cv. date palms growing on sandy soil in a private orchard in the governorate of Damietta, Egypt, to assess the effect of thinning bunch and spraying with calcium nitrate and gibberellic acid on fruit set, drop percentage, productivity and fruit quality. Bunch thinning was carried out by leaving 7, 9 and 11 bunch\palm and removing the overload. Each thinning treatment was then subjected to spraying 2500ppm calcium nitrate alone or combined with gibberellic acid at 150 ppm as well as without spraying (control). The results cleared that the thinning treatments by retaining 7, 9 and 11 bunch / palm with calcium nitrate spraying at 2500 ppm alone or followed by spraying with gibberellic acid at 150 ppm led to increasing the percentage of fruit set, yield / palm and decreasing the percentage of fruit drop compared to the control (Retention 7, 9 or 11 with water spray). Also the yield were increased with increasing number of bunches/palm from 7 to 11bunches/palm in the first season and the treatment of thinning at 11 bunch / palm with calcium nitrate and gibberellic acid spray gave the highest yield / palm compared to other treatments. While the thinning procedure by leaving 11 bunch / palm led to a decrease in palm yield in the second season compared to other thinning treatments. The palms subjected to combination treatment involved 7 bunch/palm and $Ca(No_3)_2 + GA_3$ gave the best physical properties parameters (fruit weight, flesh weight, fruit size, fruit length and fruit diameter) compared to other treatments. The date fruits of the same treatment got the best values in most chemical characters such as SSC%, total sugar and percentage of calcium, whilst the ratio of acidity and total tannins decreased significantly.

Keywords: Date palm, Calcium nitrate, bunch thinning, Gibberellic acid, fruit set, fruit drop, fruit quality and yield.

INTRODUCTION

Date palm is prevalent tree at dried zones of North Africa and the Middle East with a significant impact in economies of many countries in these places. Adaptation of the date palm to water stress makes it is one of the first fruit trees possible to spread and cultivate in Egyptian dry and semi-dry regions. (Bekheet, 2013). In Egypt, date palms cultivation covers a wide district from Damietta in the north to Aswan in the south as well as in the Oasises. Hayany date palm is the most important soft date cultivar in Damietta governorate. Egypt is ranked among one of the top ten producers of dates and yields 1590414tones (FAO STAT, 2017).

Damietta Governorate is considered one of the major producers of "Hayany" soft date where there are about 606814 female adult palms (Ministry of Agriculture, 2013). Fruit thinning is necessary to ensure adequate flowering and to overcome the alternate bearing during the successive years as well as to improving the of quality fruit (EI-Kassas, 1983; Moustafa, 1993 and El-Shazly, 1999).

Calcium plays a main role in protecting the structure and quality of the cell wall by preventing the germination of fungal spores and by blocking destructive enzymatic reactions, thus helping to fruit firmness (Biggs., 1999).Calcium is known as one of the most essential minerals that decide the quality of the fruit because it is needed for cell elongation and cell division (Rizzi and Abruzzese, 1990). Calcium functions have emerged as a cross-linkage of the middle lamella that connects cells next to each other. It's also necessary in enzymatic reactions, gives the equilibrium of both anions and cations in the plant and plays a main role in cell membrane stabilization (Stebbins *et al.*, 1972).

Plant growth regulators are organic compounds other than nutrients that are naturally produced in high plants, regulating growth or other physiological activities at a location distant from its production site and involved in minute amounts to changing plant physiology functions. The influence of GA_3 has at minimum three significant actions: 1) to increase the organ's capacity as a nutrient sink, 2) to strengthen the production of IAA in plant cells and 3) stimulating hydrolytic enzyme production (Addicott and Addicott, 1982).The present study aimed to evaluate the effect of bunch thinning and spraying calcium nitrate and gibberellic acid on fruit set, drop, yield and their quality of Hayany palm.

MATERIALS AND METHODS

This research was carried out during two growing seasons 2015 and 2016 on 27 female date palms (*Phoenix dactylifera* L.) of Cultivar "Hayany" grown on sandy soil in OM-El-Reda Village in a private orchard 20 km west of Damietta Town. Female palms with symmetrical characters of vigor, length, pollen sources and age (40 years old) were selected and gotten traditional orchard maintenance and pollination as typically performed in Damietta Governorate. The date palms selected have been divided into 9 groups (treatments) each one includes 3 date palms and used to

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investigate the impact of bunch thinning and spraying calcium nitrate and gibberellic acid on fruit set and drop %, yield and fruit quality under the following treatments:

T_1: Thinning by adjusting the number of bunches to seven bunches/palm and spraying bunches and leaves with water only.

T_2: Thinning by adjusting the number of bunches to seven bunches/palm and then spraying the bunches and leaves with $Ca(NO_3)_2$ at 2500 ppm.

T_3: Thinning by adjusting the number of bunches to seven bunches/palm and then spraying the bunches and leaves with $Ca(NO_3)_2$ at 2500 ppm and GA_3 at 150 ppm.

T_4: Thinning by adjusting the number of bunches to nine bunches/palm and spraying bunches and leaves with water only.

T_5: Thinning by adjusting the number of bunches to nine bunches/palm and then spraying the bunches and leaves with $Ca(NO_3)_2$ at 2500 ppm.

T_6: Thinning by adjusting the number of bunches to nine bunches/palm and then spraying the bunches and leaves with $Ca(NO_3)_2$ at 2500 ppm and GA_3 at 150 ppm.

T_7: Thinning by adjusting the number of bunches to eleven bunches/palm and spraying bunches and leaves with water only.

T_8: Thinning by adjusting the number of bunches to eleven bunches/palm and then spraying the bunches and leaves with $Ca(NO_3)_2$ at 2500 ppm.

T_9: Thinning by adjusting the number of bunches to eleven bunches/palm and then spraying the bunches and leaves with $Ca(NO_3)_2$ at 2500 ppm and GA_3 at 150 ppm.

These treatments were applied at 30 days after hand pollination and followed by removal 15% of strands for all remained bunches in the same time. Each palm was sprayed with 3 liters of previous concentrations dissolved in water.

The following measurements were carried out

1. Fruit set %: Two bunches were selected on each palm. Ten strands on each bunch were chosen and the fruits setting were counted on them at one month after pollination in order to estimate the fruit setting percentage using the following equation:

$$\text{Fruit set \%} = \frac{\text{Total number of fruits setting/strand}}{\text{Total number of flowers/strand}} \times 100$$

2. Total fruit drop %: Two bunches were selected on each palm. Ten strands on each bunch were chosen, labeled and the fruits setting were counted on them at one month after pollination and at harvest time to estimate the total fruit drop percentage using the following equation:

$$\text{Total fruit drop} = \frac{\text{Total number of fruits setting/strand - retained fruit at harvest time}}{\text{Total number of fruits setting/strand}} \times 100$$

3. Yield /palm (Kg): At harvesting time during the first week of October in both seasons, bunches of dates were weighted and recorded to obtain the total yield/palm. The average yield and bunch weight were estimated by Kg.

4. Fruit characteristics: Fruit samples collected at full color stage (Khalal) during the first week of October in both seasons. Fifty fruits were taken at random from all bunches of each palm for the determination of physical and chemical characteristics.

A. Fruit physical characteristics

Ten fruits for each replicate were used to determine weight (g), length (cm), size (cm^3) and flesh percentage of the date fruit as well as shape index which was also calculated by dividing fruit length on fruit diameter values.

B. Fruit chemical characteristics

1. Total soluble sugars

It was determined in fruit flesh according to the method described by Dubois *et al.* (1956) in the methanol 70% extract using the phenol sulphoric acid method and the concentration was calculate as g/100g fresh weight.

2. Tannins

It was determined according to the Folin-Denis method described by Schanderl (1970) as follow: Weigh 0.5 g of the fruit powder component was taken in a 100-mL of flask, to which was added 50 mL of water, then gently was heated the flask and boiled for 30 minutes. The contents were centrifuged at 4,000 rpm for 10 min. The supernatant was collected separately in a volumetric flask and made up the volume to 100 ml with distilled water. One ml of the sample extract was transferred to a volumetric flask and mixed with FolinCiacolate's reagent (2 ml), followed by the addition of saturated carbonate sodium solution (4 ml). The mixture was diluted with distilled water to 50 ml, shacked well for 30 min at room temperature, and then the absorbance was recorded at 700 nm. The standard tannic acid solution was prepared by dissolving 100 mg tannic acid in 100 ml of distilled water. Tannins content was calculated as mg tannic acid equivalent from a linear regression equation obtained from a calibration curve (R2 = 0.9944).

3. Soluble solid content (SSC %) was determined in fruit juice by using Carl-Zeiss hand refractometer according to A.O.A.C (1995).

4. Total acidity content (%) was determined by titrating 5 ml juice sample with 0.05 N sodium hydroxide (NaOH), using phenolphthalein as an indicator. The acidity was express as gram of malic acid in 100 ml juice according to the method described in A.O.A.C (1995).

5. Determination of calcium content

Calcium content was measured in dry fruit flesh using Perkins Elmer Atomic Absorption Spectrophotometer (Model, Sepectronic 21 D) as described by Jackson (1973).

Statistical Analysis

The studied treatments were designed in completely randomized blocks design according to method substantive by Gomez and Gomez (1984). The gained data of both seasons were subjected to analysis of variance (ANOVA) using Computer Software program called Co Stat. The treatment means were compared by using Duncan's multiple range tests at probability of 0.05 according to Duncan (1965).

RESULTS AND DISCUSSION

1. Effect of studied treatments on fruit set%, total fruit drop% and yield/palm

Data in Table (1) and Fig (1) showed the effect of interaction between bunch thinning and spraying $Ca(No_3)_2$ and GA_3 treatments on total fruit set%, total fruit drop% and yield on Hayany date palm fruits during 2015 and 2016 seasons.

Data in Table (1) and Fig (1) showed that the impact of water spraying only (control) with the number of bunches, it was found that the fruit set% decreased while the total fruit drop% in both seasons. In addition, yield/palm increase by increasing the number of bunches in first season while, in the second season the thinning at 11 bunch/palm gave the lowest

values in this regard. Spraying with calcium at 2500 ppm alone increased the fruit set% as well as a significant reduction in total fruit drop% compared to the control or combination of spray calcium and gibberellin. In addition interference in the spray between calcium and gibberellin led to a significant increase in yield/palm compared to control or spraying calcium alone at all thinning levels.

Our findings of thinning treatments are in line with those found by El-Assar and Refaat (2013), Al Saikhan and Sallam (2015), Radwan, (2017) and El-Badawy *et al*., (2018) on many date palm cultivars include Sewy, Khalas and Ruzeiz, Bent Aisha and Sewy, respectively. They revealed that treatments for thinning gave the highest values in fruit-set and the lowest value was given in fruit dropping % in comparison with control and reduced fruit yield/date palm compared to un-thinning treatment.

Table 1. Effect of interaction between thinning bunches and spraying $Ca(No_3)_2$ and GA_3 on fruit set% and yield of Hayany date palm during 2015 and 2016 seasons.

Treatments		Fruit set %		Yield (kg/palm)	
Bunches No. per palm	**Spraying**	**2015**	**2016**	**2015**	**2016**
	Control (water)	81.64f	82.84f	89.39f	92.47ab
	$Ca(No_3)_2$ *	93.82a	94.69a	90.09f	95.87ab
7	$Ca(No_3)_2 + GA_3$ **	91.6b	92.42b	94.36ef	101.80a
	Control (water)	78.04g	79.36g	101.64de	108.30a
	$Ca(No_3)_2$ *	91.72b	92.56b	103.56d	112.68a
9	$Ca(No_3)_2 + GA_3$ **	89.08c	89.99c	107.07cd	117.81a
	Control (water)	77.24g	78.62g	112.20bc	62.5c
	$Ca(No_3)_2$ *	87.64d	88.73d	114.95ab	70.33bc
11	$Ca(No_3)_2 + GA_3$ **	85.21e	86.30e	121.00a	75.00bc

***= Spraying $Ca(No_3)_2$ at 2500ppm, **= Spraying GA_3 at 150ppm**

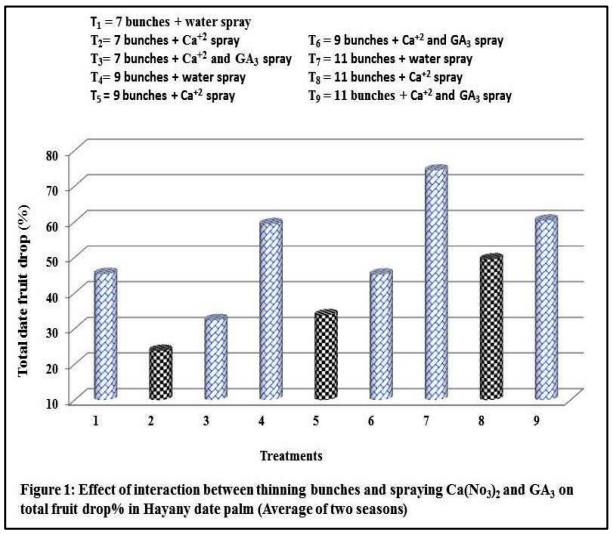

Figure 1: Effect of interaction between thinning bunches and spraying $Ca(No_3)_2$ and GA_3 on total fruit drop% in Hayany date palm (Average of two seasons)

Moreover, the present results of spraying with $Ca(NO_3)_2$ individual or in combination with GA_3 agreed with the results of several previous studies. El-Kosary (2009), Kassem *et al*., (2011), Awad and Al-Qurashi, (2012), and Khalil (2015) on Zaghloul and Samany date palm cultivars, found that the spraying GA_3 at rate of 150 ppm resulted in significant decrease of fruit drop% and significant increase in both fruit set% and fruit yield/palm when compared with untreated palms. In addition, Ashour (2018) on Barhee date palm suggested that spraying with the combination of 100 ppm GA_3 + 100 ppm BAP + 250 ppm Boric acid significantly increased fruit set compared to control. As for calcium application, El-Baz and El-Dengawy (2001) on date palm C.V Hayany and Badran (2015) on Zaghloul and Samany date palm noticed that spraying with calcium nitrate or calcium carbonate gave a significant decrease in fruit drop % and a substantial increase in yield compared to control (untreated date palms).

The increment in yield/palm can be attributed to the increase in number and length of growing leaves, consequently an increase will be expected in the photosynthetic assimilates (Harhash *et al*., 2007) that required for setting and development of date fruits. A tentative explanation for the increased fruit removal force, due to calcium sprays may be due to improving the formation of cellulose and lignin. These materials are required to build the structure of the plant or to prevent the formation of abscission layers and consequently to reduce the fruit drop in pre-harvest (Nijjar, 1985) and GA_3 is important growth regulator for the plant, since they is playing an important role in cell division and cell wall elongation and leads to the increase yield (Crosier *et al*., 2000).

2. Effect on fruit properties of Hayany date palm

1. Fruit physical properties

a. Fruit weight (g), flesh percentage and fruit size

The results in Table (2) indicated that the fruit weight (g), flesh percentage and fruit size decreased by increase the remained number of bunches per palm. Under tested 3 levels of bunches thinning, the combination treatment of spraying calcium nitrate and Gibberillic acid clarified a significant increase in fruit weight and size compared to the spraying calcium only or water (control). The highest values of flesh percentage were observed by thinning treatment of 7 bunches/palm received spraying $Ca(No_3)_2$ at 2500 ppm + GA_3 at 150 ppm in the first season, while the highest value in the second season recorded by treatment of 7 bunches/palm with spraying $Ca(No_3)_2$. The retention of an excess number of bunches on date palms (11 bunches/palm) results in the production of fruits with significantly lower weight, size and flesh values than other thinning treatments (7 or 9 bunches/palm).

These results were strengthened with those results reported by Moustafa, (1998) on "Seewy" date palm, Al-Saikhan (2008) on Ruzeiz date palm and Bashir *et al*., (2014) on Kur date palm. They revealed that thinning treatment of bunch and strand improved fruit weight, size and flesh weight as compared to the control treatment (Unthinned date palm). Similar observations were found by El-Badawy *et al*., (2018) on Sewi' date palm, they indicated that fruit weight

& fruit pulp increased when the rates of thinning increase. The increase in fruit weight and flesh weight in thinning treatments may be attributed to an internal adjustment mechanism that makes the remaining fruits capable to efficiently use assimilates, due to change in source (leaves No.) to sink (fruits) ratio and thus improve chemical and physical qualities of fruits (Nixon and Carpenter, 1978 and Pallas *et al*., 2013). Moreover, spraying with calcium nitrate on Hayany date palm (El-Baz and El-Dengawy, 2001) or calcium carbonate on Zaghloul date palm (Aly and El Agamey, 2018) gave a significant increase in fruit weight as compared with untreated palm. El-Kosary, (2009), Ghazzawy (2013) and Ashour *et al*., (2018) on different cultivars of date palm found that spraying GA_3 at 50 – 150ppm to date palm significantly increased fruit weight compared to un-spraying ones.

Table 2. Effect of interaction between thinning bunches and spraying $Ca(No_3)_2$ and GA_3 on fruit weight, size and flesh% of Hayany date palm during 2015 and 2016 seasons.

Treatments		Fruit weight (g)		Fruit flesh%		Fruit size (cm^3)	
Bunches No. per palm	Spraying	2015	2016	2015	2016	2015	2016
7	Control (water)	17.62c	21.11b	85.01bc	87.34ab	18.70b	21.00b
	$Ca(No_3)_2$ *	18.84b	22.18a	85.66ab	87.77a	19.30b	21.85b
	$Ca(No_3)_2$ + GA_3 **	20.50a	22.97a	86.24a	87.59ab	22.00a	23.17a
9	Control (water)	15.18ef	18.50d	84.05d	86.75c	15.87cd	18.87c
	$Ca(No_3)_2$ *	16.19de	19.95c	84.67cd	87.47ab	16.35c	19.23c
	$Ca(No_3)_2$ + GA_3 **	16.89cd	20.35bc	84.72cd	87.26b	18.00b	20.70b
11	Control (water)	12.10g	14.17g	81.79f	84.25f	13.27e	15.30e
	$Ca(No_3)_2$ *	13.10g	15.22f	82.87e	85.08e	14.50de	16.80d
	$Ca(No_3)_2$ + GA_3 **	14.70f	17.00e	84.00d	86.05d	15.33cd	18.17c

***= Spraying Ca $(No_3)_2$ at 2500ppm, **= Spraying GA_3 at 150ppm**

b. Fruit length and fruit shape index

Concerning the effect of spraying with water alone (control) with thinning to the different numbers (7, 9 and 11) of bunches/palm (Table 3), it was revealed that the fruit length increased by decreasing the number of bunches, while interference in the spray between $Ca(No_3)_2$ at 2500ppm and GA_3 at 150ppm increased the fruit length compared with control and spraying with calcium nitrate only. Also, the retention of an excess number of bunches on date palm (11 bunches/palm) gave the highest values in fruit shape index compared with other treatments.

These results confirmed with those obtained on various date palm cultivars by Harhash and Abdel-Nasser (2007), Al-Wasfy *et al*., (2008), Radwan (2017) and El-Badawy *et al*., (2018) who mentioned that all methods of thinning by fruits or bunches gave a substantial increase in fruit length and fruit shape index as compared to un-thinning palms (control). In addition, Sarkar and Ghosh (2005) and Ashour *et al*., (2018) mentioned that spraying GA_3 on different date palm cultivars increased fruit volume, fruit length and fruit shape index compared to un-spraying ones. The improvement in the physical fruit quality (weight, length and size) obtained by thinning may be due to a reduction in the compactness of the fruits, which prevents its accumulation within the bunch. Consequently, such fruits take the opportunity of good natural growth. Also, fruit thinning effectively lowered the competition occurred between fruits and consequently raised total soluble solids and sugar contents for each fruit (Al-Wasfy and Mostafa, 2008). The increase in fruit quality due to calcium could be attributable to its effects on formation and changes of carbohydrates and carbohydrate enzymes, other reasons could be the reduction of abscission and the role of calcium in the maintenance of the middle lamella cells (Wahdan *et al*., 2011) and bio-regulators result in better quality and fruit yields by improving the internal physiology (better water supply, nutrients and other compounds vital to their proper growth) of fruit development (Pandey., 1999).

Table 3. Effect of interaction between thinning bunches and spraying $Ca(No_3)_2$ and GA_3 on fruit length and shape index of Hayany date palm during 2015 and 2016 seasons.

Treatments		Fruit length (cm)		Fruit shape index	
Bunches No. per palm	Spraying	2015	2016	2015	2016
7	Control (water)	5.10bc	5.32bc	1.96e	2.02d
	$Ca(No_3)_2$ *	5.23b	5.43b	1.98de	2.026d
	$Ca(No_3)_2$ + GA_3 **	5.50a	5.70a	2.003bcd	2.036cd
9	Control (water)	4.84e	4.98de	2.023abc	2.00e
	$Ca(No_3)_2$ *	4.90de	5.05d	2.00cd	2.07a
	$Ca(No_3)_2$ + GA_3 **	5.03cd	5.25c	1.973de	2.02d
11	Control (water)	4.60f	4.73f	2.043a	2.066a
	$Ca(No_3)_2$ *	4.65f	4.81ef	2.033ab	2.063ab
	$Ca(No_3)_2$ + GA_3 **	4.81e	4.95de	2.02abc	2.046bc

***= Spraying Ca$(No_3)_2$ at 2500ppm, **= Spraying GA_3 at 150ppm**

2. Fruit chemical properties

a. SSC% and Acidity percentage

Data in Table (4) showed that the concentration of SSC% in fruit increased, while the percentage of acidity in fruit juice decreased by decreasing the number of bunches on palm. Also spraying with 2500ppm $Ca(NO_3)_2$ increased the SSC% compared to the control and the combination treatment of spraying $Ca(NO_3)_2$ and GA_3. The contrary trend was true for the percentage of acidity in fruit juice.

b. Total sugar, tannins and calcium in fruits

Data in Table (5) and fig (2) showed the effect of interaction between bunches thinning and spraying treatments on content of total sugar, tannins and calcium in fruits. As for the effect of spraying with water only (control)

with thinning to the different numbers (7, 9 and 11) of bunches/palm (Table 5) and (fig2), it was found that the concentration of calcium and total sugars in fruit decreased while the total tannins increased by increasing the number of bunches/palm. In addition, spraying with $Ca(No_3)_2$ at 2500ppm increased the total sugars percentage as well as significantly reduced fruit content of tannin's compared to the control or interaction spray of $Ca(No_3)_2$ at 2500ppm and GA_3 at 150ppm, and the opposite trend was observed for calcium content in date fruit.

Table 4. Effect of interaction between thinning bunches and spraying $Ca(No_3)_2$ and GA_3 on SSC% and Acidity% of Hayany date palm fruits during 2015 and 2016 seasons

Treatments		SSC%		Acidity%	
Bunches No. per palm	**Spraying**	**2015**	**2016**	**2015**	**2016**
7	Control (water)	29.00a	31.00ab	0.111de	0.133e
	$Ca(No_3)_2$ *	30.00a	32.50a	0.089e	0.111e
	$Ca(No_3)_2 + GA_3$ **	28.50a	30.50bc	0.133cde	0.150de
9	Control (water)	25.5bc	29.00cd	0.156bcd	0.194bc
	$Ca(No_3)_2$ *	26.5b	29.50bcd	0.150bcd	0.174cd
	$Ca(No_3)_2 + GA_3$ **	25.00bc	28.00de	0.181bc	0.201bc
11	Control (water)	23.00d	26.50ef	0.234a	0.234ab
	$Ca(No_3)_2$ *	24.00cd	27.00ef	0.201ab	0.223ab
	$Ca(No_3)_2 + GA_3$ **	22.50d	26.00f	0.240a	0.252a

***= Spraying $Ca(No_3)_2$ at 2500ppm, **= Spraying GA_3 at 150ppm**

Table 5. Effect of interaction between thinning bunches and spraying $Ca(No_3)_2$ and GA_3 on total sugars and tannins content in fruits of Hayany date palm during 2015 and 2016 seasons.

Treatments		Total sugars %		Tannins (mg/100 gm flesh)	
Bunches No. per palm	**Spraying**	**2015**	**2016**	**2015**	**2016**
7	Control (water)	40.00b	45.73b	207.00e	212.20e
	$Ca(No_3)_2$ *	41.50a	47.80a	190.00f	198.50f
	$Ca(No_3)_2 + GA_3$ **	39.60b	43.80c	194.00f	200.80f
9	Control (water)	36.33cd	38.33e	227.30c	236.80c
	$Ca(No_3)_2$ *	37.00c	39.60d	211.30de	217.60e
	$Ca(No_3)_2 + GA_3$ **	35.00d	36.30f	217.10d	224.15d
11	Control (water)	30.46f	32.43h	247.00a	270.30a
	$Ca(No_3)_2$ *	32.55e	34.15g	230.00bc	240.80c
	$Ca(No_3)_2 + GA_3$ **	28.70g	30.50i	236.50b	247.90b

***= Spraying $Ca(No_3)_2$ at 2500ppm, **= Spraying GA_3 at 150ppm**

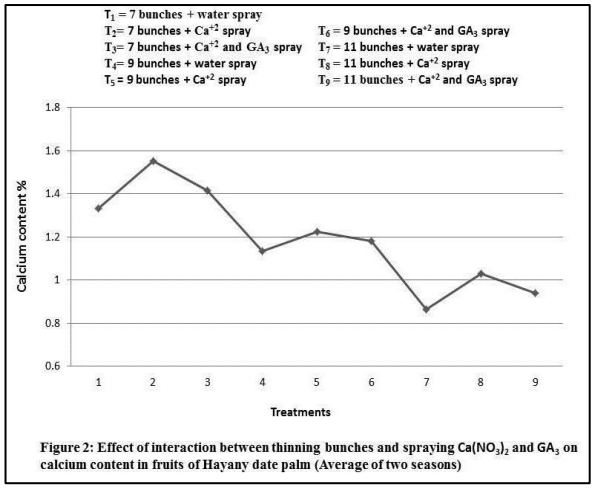

Figure 2: Effect of interaction between thinning bunches and spraying $Ca(NO_3)_2$ and GA_3 on calcium content in fruits of Hayany date palm (Average of two seasons)

The results are in agreement those of Mostafa and El Akkad (2011), Badran, (2015) and Radwan (2017) on various date palm cultivars (Bent Aisha, Sewy, Zaghloul and Haiany) who found that, fruit thinning gave a significantly increased in SSC% and total sugars compared to the un-thinning palms. Spraying with calcium nitrate or calcium carbonate on date palm gave a substantial increase in TSS% and total sugars content % compared with control (untreated date palms). However a significant decrease in soluble tannin % was observed as compared with control Badran, (2015) & (Aly and El Agamey, 2018). An explanation noticed that an increase in fruit weight, flesh weight and sugar content in the treatment of strand removal and thinning tips can be due to an internal adjustment mechanism that enables the remaining fruits to use assimilates efficiently and enhance their chemical and physical quality in reduced competitive environments (Ali-Dinar *et al*.,2002 and Hammam *et al*., 2002). This reduction of acidity content might be due to the change of acid into sugars under enzyme invertase influence during storage period. GA_3 induced reduction in acidity, may be linked with hormonal stimulation of assimilates translocation. Similar changes have been recorded by Monica *et al.*, (2013).

CONCLUSION

It is recommended to thinning date palm through 7 and 9 bunches\palm and spraying with calcium nitrate and gibberellic acid as it gives the best yield from where quantity as well as improve the physical and chemical properties of the fruits and reduce the drop.

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تأثير خف السوباطات ورش نترات الكالسيوم وحمض الجبريليك على العقد والتساقط والمحصول وجودة الثمار في نخيل البلح الحيانى

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تم إجراء هذا البحث خلال عامى ٢٠١٥-٢٠١٦ على نخيل البلح صنف الحيانى والنامية فى تربة رملية فى بستان خاص بنخيل التمر وذلك فى محافظة دمياط-مصر. لتقييم تأثير إزالة السوباطات مع الرش بنترات الكالسيوم وحمض الجبريليك على عقد الثمار والتساقط والأنتاجية وجودة الثمار. تم اختيار ٢٧ نخلة متشابهة النمو والحمل تلقت ٩ معاملات كل منها ٣ مكررات. حيث تم إجراء ٣ معدلات خف للسوباطات من خلال ترك ٧و ٩ و ١١ سوباطة للنخلة وإزالة الزائد. وتلى ذلك رش كل معدل خف بالماء (كنترول) أو بنترات الكالسيوم بمعدل ٢٥٠٠ جزء فى المليون بمفرده أومتبوعا بالرش بحمض الجبريليك بمعدل ١٥٠ جزء فى المليون. أوضحت النتائج ان معاملات الخف باستبقاء ٧ أو ٩ أو ١١ سوباطة / نخلة مع الرش بنترات الكالسيوم بمعدل ٢٥٠٠ جزء فى المليون بمفرده أو متبوعا بالرش بحمض الجبريليك بمعدل ١٥٠ جزء فى المليون، أدت الى زيادة النسبة المئوية للعقد والمحصول/نخلة وخفض النسبة المئوية للتساقط مقارنة بالكنترول (أستبقاء ٧ أو ٩ أو ١١ سوباطة/نخلة مع الرش بالماء). وايضا زاد المحصول بزيادة عدد السوباطات للنخلة من ٧ إلى ١١ سوباطة/نخلة فى الموسم الاول، وأعطت معاملة الخف عند ١١ سوباطة/ نخلة مع الرش بنترات الكالسيوم وحمض الجبريليك أعلى محصول/نخلة بالمقارنة بالمعاملات الاخرى. بينما إجراء الخف بترك ١١ سوباطة/نخلة أدى إلى نقص محصول النخلة فى الموسم الثانى مقارنة بمعاملات الخف الأخرى (٧ أو ٩ سوباطة/نخلة).أشجار النخيل التى خضعت للمعاملة المشتملة على الخف الى ٧ سوباطات /نخلة مع الرش بنترات الكالسيوم وحمض الجبريليك، اعطت افضل المعايير فى الصفات الفيزيائية (وزن الثمرة-النسبة المئوية للحم - حجم الثمرة -طول الثمرة ومؤشر شكل الثمرة) بالمقارنة مع غيرها من المعاملات. فى حين ان افضل القيم فى معظم الصفات الكيميائية للثمار مثل (النسبة المئوية للمواد الصلبة الذائبة الكلية- النسبة المئوية للسكريات الكلية- النسبة المئوية للكالسيوم فى الثمار) تم الحصول عليها عن طريق المعاملة (٧ سوباطة /نخلة مع الرش بنترات الكالسيوم) بينما اعطت انخفاض كبير فى النسبة المئوية للحموضة فى عصير الثمار وكذلك فى النسبة المئوية للتانينات الكلية. نوصى بخف نخيل البلح ب ٧ و٩ سوباطات/للنخلة والرش بنترات الكالسيوم وحمض الجبريليك، حيث أنها تعطى المحصول الأفضل من حيث الكمية وكذلك تحسن الصفات الفيزيائية والكيميائية للثمار وتقلل التساقط.