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EFFECT OF THINNING AND SOME GROWTH REGULATORS ON YIELD AND FRUIT QUALITY OF ZAGHLOUL DATE PALM

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ABSTRACT: The effects of bunch thinning methods [(removing 25% of the strands (R.S.) or cutting back 25% of the tips of strands (C.B.S.)], spraying ethephon (500, 1000 or 1500 ppm), NAA (100 or 200 ppm) and GA_3 (100 or 200 ppm) on yield and fruit quality of Zaghloul date palms have been investigated. Thinning by (R.S.) was better than by (C.B.S.) whereas (R.S.) did not affect the yield and enhanced fruit quality. Ethephon increased the yield and improved fruit quality. NAA drastically decreased the yield but enhanced fruit quality, while GA_3 at 200 ppm increased the yield and improved fruit quality.

INTRODUCTION

Alternate bearing is very pronounced in most date palm cultivars (AL-Bakr, 1972 and Wally *et al.*, 1979).

The successful orchard management is directed towards obtaining a suitable yield with high fruit quality, and one of the most important cultural practices in date palm orchards is fruit thinning. Several trials have been done to improve yield and fruit quality of date palms. EL-Shazly (1999) found that fruit thinning decreased the total yield, but enhanced quality of Nabtet Ali dates palm. Godara *et al.* (1990) stated that removing one-third of the bunch from the center had the best effect on fruit ripening and quality of Shamran dates.

Kamal (1995) reported that ethephon treatments advanced fruit ripening of Zaghloul and Samani dates, but GA_3 and NAA retarded it. All 3-growth regulators improved fruit quality, and 1500

ppm ethephon was regarded as the most promising treatment. EL-Hamady *et al.* (1992) reported that ethephon was effective as fruit thinner for date palms, and this effect seems to be influenced by the prevailing weather conditions especially temperature and relative humidity.

The present study was carried out on Zaghloul date palms to investigate the effect of ethephon, GA_3 and NAA on yield and fruit quality comparing with the manual bunch thinning under Ismailia Governorate weather conditions.

MATERIALS AND METHODS

This work has been carried out during 2000 and 2001 seasons on Zaghloul date palm cultivar (*Phoenix dactylifera* L.) grown in a commercial orchard, located at new reclaimed area in Wady Al-Mollak, Ismailia Governorate. All palms were 22-year-old and planted at 8x8 m apart in sandy soil. The 30 experimental trees were healthy, as uniform as possible in growth and vigour and were subjected to the same cultural practices commonly adopted in the orchard. The selected palms were pruned to leave the same number of functional leaves (45 leaves/palm). The number of bunches per palm was adjusted to 7 of nearly equal size, by removing excess from the latest and earliest small ones. Hence, the remaining bunches were uniform and chosen at different directions. Pollination was achieved by using pollen grains from the same parent in both seasons.

The treatments of this study were as the following:

1. Control (spraying the bunches using water + Masrol at 1 cm^3/l as wetting agent).
2. Removing 25% of the number of the strands from the center of each bunch.
3. Cutting back 25% of the strand tips of each bunch.
4. Ethephon spray at 500 ppm + wetting agent.
5. Ethephon spray at 1000 ppm + wetting agent.
6. Ethephon spray at 1500 ppm + wetting agent.
7. NAA spray at 100 ppm + wetting agent.
8. NAA spray at 200 ppm + wetting agent.
9. GA_3 spray at 100 ppm + wetting agent.
10. GA_3 spray at 200 ppm + wetting agent.

All treatments were applied 21 days after the hand pollination in both seasons, except the GA_3 treatments, which were carried out one week later.

The experiment was arranged in a complete randomized design with three replications (one palm tree for each). At picking time, all bunches from all treatments, in the same time, were harvested when the colour was developed. Total yield per palm in kg. was recorded and the average bunch weight was calculated.

Samples of 50 date fruits were taken at random from each palm for both fruit physical and chemical characteristics determinations. The physical characteristics of fruit, including fruit, pulp and seed weight (g), fruit dimensions (cm) and volume (cm^3) was determined. Also the fruit length/diameter (L/D) ratio and pulp percentage were calculated. Fruit colour was determined according to Hunter (1967), using a Minolta CR-10 Chromameter (Minolta Crop., Japan) measuring L, a, b coordinates (Francis, 1980). The colour index (CI) was calculated according to Jimenez-Cuesta *et al.* (1981), as follows:

$$CI = 1000 \times a / L \times b$$

Were:

L = lightness.

a = values on a green to red scale.

b = values on a blue to yellow scale.

Fruit firmness (kg/cm^2) was measured at two equatorial sites using fruit pressure tester FT327 fitted with a 0.80 cm convex tip. Chemical properties (moisture %, TSS and acidity) were determined according to A.O.A.C (1985). Tannin content was determined using the method of Indigo carmin indicator (A.O.A.C. 1985). In the dried fruit pulp, total sugars were determined according to Malik and Singh (1980).

All data obtained during the course of the experiment were subjected to statistical analysis according to Steel and Torrie (1982).

The differences among treatment means were compared by Duncan's multiple range test at 0.05 level, using the MSTAT-C statistical package, according to Michigan State University (1990).

RESULTS AND DISCUSSION

The experimental data from this study are summarized in Tables 1, 2, 3 and 4 as follow:

1. Total Yield and Average Bunch Weight

Bunch weight was an indicator to the yield of palm trees because the number of bunches on the tree was constant. Data show that removing 25% of strands did not affect the yield per palm, but cutting back 25 % of strands significantly reduced it and the reduction percentages were 20.67% and 15.55% in the first and second seasons, respectively, as compared with the control. Khalifa *et al.* (1987) found that thinning-out 30% of the fruit did not reduce averages of the yield of Zaghloul cv. if it was carried out up to six weeks after pollination. However, other investigators reported that bunch weight was reduced in proportion to the amount of thinning [EL-Kassas, 1983b; Hussein *et al.* (1992a, b and c); El-Kassas *et al.*, 1995; and El-Shazly, 1999].

The data also indicated that ethephon at 500 and 1000 ppm significantly increased the total yield per palm in both seasons, since 500 ppm increased the yield by 6.52% and 9.84% in the two seasons, respectively, while the corresponding increases were 9.95% and 17.28% at 1000 ppm level. On the other side, ethephon at 1500 ppm significantly decreased the yield by 17.17% and 16.54% as compared with control in the two seasons, respectively. Hussein *et al.* (1992c) reported that there was no obvious effect of ethephon on bunch weight of Samany date palm, while Kamal (1995) mentioned that ethephon, GA_3 and NAA enhanced bunch weight of Zaghloul date palm. El-Hamady *et al.* (1992) reported that ethephon was effective as a fruit thinner, and this effect seems to be influenced by the prevailing weather conditions especially temperature and relative humidity, also El-Hamady *et al.* (1979) mentioned that ethephon became less effective as a fruit thinner at later dates of application.

The NAA treatments drastically decreased the yield. Such reductions were 62.46% and 66% in the first season and 53.25% and 61.40% in the second one compared to untreated control for 100 and 200 ppm NAA, respectively. This reduction could due to the thinning effect of NAA on date fruits. El-kassas, (1983b) reported that NAA at 50, 100 and 200 ppm reduced the bunch weight of Zaghloul date palm. Also, Shafaat and Shabana (1981) and

Table 1: Effect of thinning and some growth regulators treatments on yield and physical fruit characteristics of Zaghloul date palm during 2000 season.

Treatments	Yield kg/palm	Bunch wt. (kg)	Fruit wt. (g)	Fruit volume (cm^3)	Fruit Length (L) (cm)	Fruit diameter (D) (cm)	L/D ratio	Fruit colour (CI)	Fruit firmness $kg\backslash cm^2$	Seed wt. (g)	Pulp wt. (g)	Pulp wt. (%)
Control	71.36 d	10.19 d	26.15 d	27.00 e	5.35 e	2.56 d	2.10 a	102.5 d	3.96 e	1.88 a	24.28 d	92.82 e
Removing 25% of strands	70.96 d	10.14 d	28.54 bc	29.00 cd	5.72 d	3.10 b	1.85 cd	129.2 c	4.48 bc	1.79 b	26.75 bc	93.71 c
Cutting back 25% of strands	56.61 e	8.09 e	26.47 d	26.83 e	5.53 e	2.89 c	1.92 bc	105.4 d	4.26 cd	1.82 b	24.65 d	93.12 de
500 ppm ethephon	76.01 bc	10.86 bc	27.28 cd	28.17 cde	5.44 e	2.59 d	2.10 a	108.0 d	3.90 e	1.70 c	25.58 cd	93.76 c
1000 ppm ethephon	78.46 b	11.21 b	28.96 bc	29.33 bcd	5.78 d	2.90 c	2.00 ab	125.3 c	3.89 e	1.67 c	27.29 bc	94.24 b
1500 ppm ethephon	59.41 e	8.49 e	29.52 b	31.00 b	5.86 cd	2.94 bc	1.99 b	165.3 a	4.04 de	1.67 c	27.85 b	94.32 b
100 ppm NAA	26.79 f	3.83 f	37.76 a	37.83 a	6.13 ab	3.44 a	1.78 d	143.8 b	4.55 ab	1.66 c	36.10 a	95.60 a
200 ppm NAA	24.26 f	3.47 f	36.14 a	36.50 a	6.18 a	3.31 a	1.87 cd	90.0 e	4.79 a	1.69 c	34.45 a	95.32 a
100 ppm GA_3	72.68 cd	10.38 cd	27.48 cd	27.67 de	5.89 cd	3.05 bc	1.93 bc	100.3 de	4.53 abc	1.81 b	25.67 cd	93.41 cd
200 ppm GA_3	85.07 a	12.16 a	29.71 b	30.00 bc	6.00 bc	3.31 a	1.81 d	95.6 de	4.72 ab	1.66 c	28.05 b	94.39 b

Means having the same letter (s) in each column are insignificantly different at 5% level.

Table 2: Effect of thinning and some growth regulators treatments on yield and physical fruit characteristics of Zaghloul date palm during 2001 season.

Treatments	Yield kg/palm	Bunch wt. (kg)	Fruit wt. (g)	Fruit volume (cm^3)	Fruit Length (L) (cm)	Fruit diameter (D) (cm)	L/D ratio	Fruit colour (CI)	Fruit firmness $kg\backslash cm^2$	Seed wt. (g)	Pulp wt. (g)	Pulp wt. (%)
Control	81.03 d	11.58 d	24.62 f	25.00 e	5.44 e	2.41 c	2.27 a	94.8 ef	4.21 cd	1.97 ab	22.66 e	92.01 f
Removing 25% of strands	79.42 d	11.35 d	27.65 e	28.33 d	5.82 c	2.89 b	2.03 bcd	127.8 b	4.63 b	1.96 ab	25.69 d	92.91 e
Cutting back 25% of strands	68.43 e	9.78 e	27.06 e	27.33 d	5.78 c	2.79 b	2.08 abcd	111.1 cd	4.29 c	1.94 ab	25.13 d	92.84 e
500 ppm ethephon	89.00 c	12.71 c	27.25 e	28.17 d	5.65 d	2.47 c	2.21 a	103.0 de	4.02 de	1.72 c	25.53 d	93.64 d
1000 ppm ethephon	95.03 b	13.58 b	27.16 e	28.00 d	5.87 c	2.78 b	2.12 abc	132.8 b	3.85 e	1.98 ab	25.18 d	92.70 e
1500 ppm ethephon	67.63 e	9.66 e	32.82 c	34.00 b	5.83 c	2.60 bc	2.25 ab	164.3 a	4.03 de	2.03 a	30.78 c	93.80 cd
100 ppm NAA	37.88 f	5.41 f	37.35 a	37.66 a	6.16 b	3.30 a	1.87 d	122.9 bc	4.98 a	1.91 b	35.44 a	94.89 a
200 ppm NAA	31.28 g	4.47 g	35.48 b	35.5 a	6.28 ab	3.19 a	1.97 cd	130.0 b	4.96 a	1.90 b	33.58 b	94.66 ab
100 ppm GA_3	88.66 c	12.67 c	28.21 e	28.67 d	6.19 ab	3.27 a	1.90 cd	88.9 f	4.30 c	1.95 ab	26.26 d	93.07 e
200 ppm GA_3	101.38 a	14.48 a	30.90 d	31.00 c	6.31 a	3.28 a	1.92 cd	84.9 f	4.84 ab	1.77 c	29.13 c	94.26 bc

Means having the same letter (s) in each column are insignificantly different at 5% level.

Moughieth and Hassaballa (1979) reported similar findings.

The GA_3 at 200 ppm significantly increased the yield per palm (19.21% and 25.11% over the control, in the first and second seasons, respectively). Such increase could be attributed to the increase in fruit weight. Meanwhile, GA_3 at 100 ppm increased the yield by 9.42% over the control in the second season only; the differences were insignificant in the first season. These results are in agreement with El-Kassas (1983a) on Zaghloul cv., who mentioned that maximum increase in bunch weight, was obtained by GA_3 at 200 ppm. Also Hussein *et al.* (1992b) reported that increasing the concentration of GA_3 significantly increased weight of bunch.

II. Fruit Quality

A. Fruit Physical Characteristics

1. Fruit weight

Removing 25% of strands significantly increased fruit fresh weight (9.13% and 12.31% over the control in the first and second seasons, respectively), while cutting back 25% of strands increased it by 9.91% over the control, in the second season only. The differences between both thinning methods were not significant in the second season.

El-kassas (1983b) reported that slight increase in fresh weight per fruit was obtained when center strands were removed or when strands tips were removed; this means that some other factors than the number of fruits per bunch was involved. Similar results were found by Hussein *et al.* (1977), Khalifa *et al.* (1987), Hussein *et al.* (1992a), Hussein *et al.* (1992c), El-kassas *et al.* (1995) and EL-Shazly (1999). They indicated that reducing the number of fruits per bunch could increase weight and quality of date fruits. These effects might be due to more accumulation of carbohydrates and other substances in bunches that treated with thinning (Hussein *et al.*, 1992b).

Ethephon treatments significantly increased the average fruit weight. Highest fruit weight was that of the 1500 ppm ethephon treatment during both seasons (12.89% and 33.31% over the control). Meanwhile, there were no significant differences between the control and 500 ppm ethephon treatment in the first season; the 1000 ppm ethephon treatment gave significantly higher fruit weight

than the control in both seasons (9.71% and 10.32% over the control). No significant differences between 500 and 1000 ppm ethephon treatments were detected in both seasons in this respect. The increase in fruit weight in response to ethephon treatment was reported by El-Hamady *et al.* (1979) and Kamal (1995), while Hussein *et al.* (1992c) reported that there was no clear effect of 250 and 500 ppm ethephon treatments on fruit weight of Samany dates.

The NAA at 100 or 200 ppm significantly increased fresh weight in both seasons. The increases were 44.40% and 51.71% for 100 ppm NAA and 38.20% and 44.11% for 200 ppm NAA over the control in the 1st and 2nd seasons, respectively. Such data proved the superiority of NAA at 100 - 200 ppm in increasing fresh weight over all other studied treatments, due to the effect of this growth regulator in lowering bunch weight. El-Kassas (1983b) and Kamal (1995) found similar results.

Increasing the concentration of GA_3 significantly increased the fruit fresh weight. These results might be attributed to the effect of GA_3 on growth as it stimulates both cell division and cell enlargement. This result is supported by the findings of El-Kassas (1983a); Hussein *et al.* (1992b) and Kamal (1995).

2. Fruit volume

Fruit volume reacted similarly to the fruit weight. Manual bunch thinning and all tested growth regulators significantly increased fruit volume in the two seasons, except fruit thinning by cutting back strands by 25%, 500 ppm ethephon and 100 ppm GA_3 in the first season. Hussein *et al.* (1977); El-Kassas (1983b); Al-Maghrabi *et al.* (1992); Hussein *et al.* (1992a, b and c) reported that fruit volume of thinned date palms was larger than unthinned ones. Also the obtained results are in agreement with the findings of El-Hamady *et al.* (1992) and Kamal (1995) on ethephon treatment; El-Kassas (1983b) and Kamal (1995) on NAA treatment and El-Kassas (1983a); Hussein *et al.* (1992b) and Kamal (1995) on GA_3 treatment.

3. Fruit dimensions

The obtained data showed that fruit length was significantly increased by both manual fruit thinning methods in the two seasons of study as compared with

control, except cutting back method in the first season. These results agree with those previously reported by Hussein *et al.* (1992b and c) and El-Shazly (1999).

For growth regulators, all ethephon, NAA and GA_3 treatments increased fruit length, over the control. GA_3 was the most effective in this respect, followed by both NAA and ethephon.

Fruit diameter was significantly increased by both fruit thinning methods as compared with control in the two seasons of study. Similar results were reported by Al-Maghrabi *et al.* (1992); Hussein *et al.* (1992b and c), El-kassas *et al.* (1995) and EL-Shazly (1999).

Regarding the effect of growth regulators on fruit diameter, GA_3 at 100 and 200 ppm, NAA at 100 and 200 ppm and ethephon at 1000 ppm significantly increased it as compared with control, in both seasons. Ethephon at 1500 ppm, significantly increased fruit diameter compared to the control, in the first season only, but ethephon at 500 ppm did not show any significant effect on fruit diameter as compared with the control in both seasons. These results are in agreement with the findings of El-Nabawy *et al.* (1977) on GA and ethephon; Hussein *et al.* (1992b) on GA_3; El-Hamady *et al.* (1992) on ethephon and Kamal (1995) on GA_3, NAA and ethephon. On the other hand, Hussein *et al.* (1992c) mentioned that ethephon failed to show clear effect on fruit dimensions of Samany cv. El-Kassas (1983b) reported that NAA increased fruit length of Zaghloul cv. but failed to increase fruit width.

It was also found that L/D ratio was significantly decreased by both manual fruit thinning methods in both seasons; however cutting back treatment failed to revealed such significant effect in the second season. These results agree with those reported by Al-Maghrabi *et al.* (1992).

The NAA and GA_3 significantly decreased L/D ratio in both seasons, while ethephon did not significantly affect L/D ratio as compared with the control in both seasons, except 1500 ppm concentration in the first season only. In other words, ethephon treatment increased fruit size without affecting fruit shape. El-Hamady *et al.* (1992) reported analogical results concerning ethephon effect.

4. Fruit colour

Data revealed that colour index (CI) was significantly increased by both fruit thinning methods as compared to control in both seasons, except cutting back method in the first season only, which did not show significant effect.

Ethephon treatments at 1000 and 1500 ppm significantly increased the CI of fruits in the two seasons of study, and this effect was directly proportional to the concentration; as such ethephon at 500 ppm insignificantly enhanced fruit colour as compared with control, in both seasons.

NAA at 100 ppm significantly increased CI as compared with control in the two seasons, but there was no clear effect of NAA at 200 ppm, so it decreased CI in the first season and increased it in the second one.

GA_3 slightly decreased CI of fruit as compared with control during both seasons. El-Nabawy *et al.* (1977) mentioned that GA treatment retarded fruit coloration, while ethephon enhanced the colour development. Also, Sharma and Singh (1985) stated that ethephon at 1000 ppm improved fruit colour development, while Kamal (1995), reported that ethephon, GA_3 and NAA failed to affected fruit colour of Zaghloul dates.

5. Fruit firmness

Fruit firmness was significantly increased by both fruit thinning methods as compared with control and this effect was evident in the two seasons of this study, except cutting back method in the second season.

Ethephon at all tested concentrations did not significantly affect fruit firmness in both seasons, while NAA and GA_3 treatments significantly increased fruit firmness over the control in both seasons, except GA_3 at 100 ppm in the second season which showed no significant effect. Kamal (1995) stated that ethephon, GA_3 and NAA failed to affected fruit firmness significantly.

6. Seed fresh weight

In the first season, fruit thinning and growth regulators treatments significantly decreased the fresh weight of seeds. In the second season, these treatments failed to affect this parameter, except GA_3 at 200 ppm and

ethephon at 500 ppm, which significantly decreased it.

These results are in line with those obtained by El-Kassas (1983b), who reported that the fresh weight of seed was significantly decreased in proportion to the amount of bunch thinning as compared with control in one of the tested seasons only. Also fluctuated effect of GA_3 on fresh weight of seed was reported by El-Kassas (1983a). Al-Maghrabi *et al.* (1992) and El-Shazly (1999) mentioned that fruit thinning did not affect seed weight; the same result on ethephon treatment was reported by El-Hamady *et al.* (1992).

7. Pulp weight and percentage

The obtained results indicated that both fruit thinning methods significantly increased pulp weight over the control in both seasons, except cutting back method in the second season only, which did not show significant effect.

The calculated pulp % also showed the same trend of the pulp weight in both seasons. El-Kassas (1983b), Al-Maghrabi *et al.* (1992), El-Kassas *et al.* (1995) and El-Shazly (1999) also reported similar findings.

Regarding the effect of growth regulators on pulp weight and pulp percentage, the data presented in Tables 1 and 2 show that all tested growth regulators at all used concentrations significantly increased both weight and percentage of pulp over the control in both seasons, except ethephon at 500 ppm and GA_3 at 100 ppm on pulp weight in the first season only, which did not show significant differences. The results were in line with those obtained by El-Kassas (1983a) on GA_3 and El-Hamady *et al.* (1992) on ethephon for pulp weight but not for pulp percentage, while El-Kassas (1983b) reported that NAA at any concentration did not affect flesh percentage of Zaghloul dates.

B. Fruit Chemical Properties

1. Moisture content percentage

Data in Tables 3 and 4 reveal that, in both seasons, fruits produced from thinned date palms had significantly lower moisture content than the control. In this respect removing 25% of strands and cutting back 25% of strands tips did not significantly differ. These results might be due to the effect of thinning on improving the quality of fruit and increasing the total soluble solids percentage and

Table 3: Effect of thinning and some growth regulators treatments on fruit chemical properties of Zaghloul date palm during 2000 season.

Treatments	Moisture (%)	Pulp dry wt. (%)	TSS (%)	Acidity (%)	TSS/acid (ratio)	Total sugars (% of dry wt.)	Tannins (%)
Control	76.38 a	23.62 c	24.50 cd	0.052 c	471.5 d	63.61 d	0.16 a
Removing 25% of strands	70.70 c	29.30 a	26.33 bc	0.049 d	537.4 c	70.32 ab	0.12 e
Cutting back 25% of strands	68.88 c	31.12 a	27.25 ab	0.054 b	501.6 cd	67.77 bc	0.15 b
500 ppm ethephon	73.95 b	26.05 b	25.00 c	0.047 e	535.9 c	64.48 d	0.14 c
1000 ppm ethephon	73.83 b	26.17 b	27.50 ab	0.044 f	625.6 b	65.49 cd	0.13 d
1500 ppm ethephon	71.12 c	28.88 a	28.00 ab	0.042 g	666.7 a	69.71 ab	0.11 f
100 ppm NAA	73.98 b	26.02 b	22.50 de	0.048 de	471.8 d	66.43 cd	0.11 f
200 ppm NAA	69.31 c	30.69 a	21.83 e	0.046 e	470.9 d	67.89 bc	0.13 d
100 ppm GA_3	71.23 c	28.77 a	28.33 ab	0.053 bc	534.6 c	71.39 a	0.15 b
200 ppm GA_3	73.73 b	26.27 b	29.50 a	0.056 a	523.6 c	64.95 cd	0.12 ef

Means having the same letter (s) in each column are insignificantly different at 5% level.

Table 4: Effect of thinning and some growth regulators treatments on fruit chemical properties of Zaghloul date palm during 2001 season.

Treatments	Moisture (%)	Pulp dry wt. (%)	TSS (%)	Acidity (%)	TSS/acid (ratio)	Total sugars (% of dry wt.)	Tannins (%)
Control	73.13 a	26.87 e	23.83 d	0.058 c	410.8 f	67.50 d	0.32 a
Removing 25% of strands	67.88 c	32.12 c	26.67 c	0.050 d	531.1 cd	73.81 ab	0.17 cd
Cutting back 25% of strands	66.82 c	33.18 c	26.50 c	0.058 c	457.0 ef	72.60 bc	0.23 bc
500 ppm ethephon	68.44 bc	31.56 cd	27.83 bc	0.048 f	579.8 bc	68.90 cd	0.20 bcd
1000 ppm ethephon	66.28 cd	33.72 bc	28.67 bc	0.046 g	628.0 b	70.59 bcd	0.18 cd
1500 ppm ethephon	63.39 e	36.61 a	29.27 ab	0.042 h	696.8 a	77.41 a	0.16 d
100 ppm NAA	70.42 b	29.58 d	22.72 de	0.048 f	470.0 def	72.47 bc	0.15 d
200 ppm NAA	64.52 de	35.48 ab	21.33 e	0.049 e	433.6 f	71.76 bc	0.20 bcd
100 ppm GA_3	68.52 bc	31.48 cd	27.83 bc	0.065 a	429.0 f	73.27 b	0.21 bcd
200 ppm GA_3	68.48 bc	31.52 cd	31.33 a	0.063 b	499.3 de	74.61 ab	0.25 b

Means having the same letter (s) in each column are insignificantly different at 5% level.

sugars contents. These results are in harmony with those reported by Hussein *et al.* (1977) and Hussein *et al.* (1992a, 1992b and 1992c). They mentioned that all treatments of fruit thinning decreased moisture contents, and this decrease might be due to the accumulation of carbohydrates, which increased dry matter content.

Concerning the effect of growth regulators, it is clear that ethephon, NAA and GA_3 significantly decreased the moisture content as compared with the control in both seasons of this study. Hussein *et al.* (1992c) reported that moisture content in fruit flesh of Samany date palms was significantly decreased due to ethephon treatment; this might be due to the effect of ethephon in enhancing fruit ripening which could in turn accumulate sugar rapidly during the period of fruit maturity and ripening. On the other hand, Hussein *et al.* (1992b) found that moisture percentage significantly increased by increasing the concentration of GA_3.

2. Pulp dry weight percentage

Data showed that pulp dry weight revealed the opposite trend of the moisture content, whereas both manual-thinning methods significantly increased pulp dry weight percentage as compared with control in the two seasons of this study. No significant difference was detected between the two methods of manual thinning of Zaghloul dates in this respect. These results are in the line with those obtained by Hussein *et al.* (1977) on Barhi dates and Hussein *et al.* (1992b) on Samany dates.

Regarding the effect of growth regulators, all tested concentrations of ethephon, NAA and GA_3 significantly increased pulp dry weight percentage over the control in the two seasons.

3. Total soluble solids (TSS)

In both seasons, fruits produced from date palms subjected to removing 25% of strands and cutting back 25% of strands tips had significantly higher TSS than those of control, except for the treatment of removing 25% of strands in the first season only, which slightly increased it. On the other hand, no significant difference was found between the two thinning methods. Such results might be due to the pronounced effects of bunch

thinning in increasing the supply of carbohydrates and other nutrients from leaves to the fewer number of fruits per bunch. The previous results are in accordance with those found by Hussein *et al.* (1977), Hussein *et al.* (1992a, b and c), Al-Maghrabi *et al.* (1992), El- Kassas *et al.* (1995) and El-Shazly (1999). They reported that fruit thinning increased the total soluble solids of Barhi, Zaghloul, Samany, Seleg and Meneify, Zaghloul and Nabtet Ali dates.

Concerning the effect of growth regulators in this regard, TSS content was significantly increased by all ethephon treatments in both seasons as compared with control, except the 500 ppm treatment in the first season only. In addition, NAA at 200 ppm significantly decreased TSS in both seasons as compared with the control, but NAA at 100 ppm failed to show significant difference in both seasons. Moreover, GA_3 treatments at 100 ppm dramatically increased TSS in the tow seasons of this study as compared with the control. GA_3 at 200 ppm showed the highest TSS values (29.50 and 31.33 in the first and second seasons, respectively).

Ethephon treatment was reported to increase fruit TSS {El-Hamady *et al.* (1992) and Hussein *et al.* (19992c)}. Also, Kamal (1995) stated that ethephon, GA_3 and NAA dramatically increased TSS of Zaghloul dates, while Hussein *et al.* (1992b) reported that GA_3 caused a slight reduction in TSS of Samany dates.

4. Total acidity

Data presented in Tables 3 and 4 show that fruit thinning by removing 25% of strands significantly decreased fruit acidity content in both seasons as compared with control. Meanwhile, cutting back 25% of strands tips significantly increased acidity percentage in first season only, and did not affect it in the second one. Godara *et al.* (1990), Al-Maghrabi *et al.* (1992) and El-Shazly (1999) reported that fruit thinning did not significantly affect fruit acidity content of Shamran, Seleg, Meneify and Nabtet Ali date fruits.

Regarding the effect of growth regulators on fruit acidity, ethephon and NAA at all used concentrations significantly reduced it as compared with control in both seasons. However, GA_3 treatments significantly increased fruit acidity over the control in the two seasons of this

study, except the treatment of 100 ppm in the first season only. Kamal (1995) on Zaghloul date palm, reported that no clear effect of growth regulators (ethephon, GA_3 and NAA) was noticed on fruit acidity. Also, El-Hamady *et al.* (1992) stated that fruit acidity of Seleg and Meneify date palms was not significantly affected by any of the tested ethephon treatments.

5. TSS/acid ratio

The TSS/acidity ratio is a very important parameter of fruit quality. It was noticed that thinning by removing 25% of strands significantly increased the TSS/acid ratio in both seasons over the control. However, the treatment of thinning by cutting back 25% of strands tips, although increased TSS/acid ratio in both seasons, but the differences were not significant as compared with control.

Ethephon treatments significantly increased TSS/acid ratio in both seasons as compared with the control and this effect was directly proportional to the used concentration. These results agree with those reported by Maximos *et al.* (1980), Sharma and Singh (1985) and Kamal (1995).

The NAA treatments did not show significant effect on the TSS/acid ratio in both seasons. While GA_3 treatments significantly increased it over the control in both seasons, except the treatment of 100 ppm in the second season only. These results are in partial agreement with those reported by Kamal (1995), who found that NAA and GA_3 treatments increased TSS/acid ratio of Zaghloul dates.

6. Total sugars

The data listed in Tables 3 and 4 show that both manual-thinning methods significantly increased total sugars content as compared with the control in both seasons. However, the differences between both thinning treatments were not significant. These results may be due to the higher rate of carbohydrates and other metabolites supply to the retained fruits. Similar findings were reported by Hussein *et al.* (1977) on Barhi cv., El-Kassas (1983b) on Zaghloul cv., Hussein *et al.* (1992a) on Zaghloul cv., Hussein *et al.* (1992b) on Samany cv., Hussein *et al.* (1992c) on Samany cv., El-Kassas *et al.* (1995) on Zaghloul cv. and El-Shazly (1999) on Nabtet Ali cv.

Concerning the effect of the growth regulators on the total sugars content, ethephon at 1500 ppm significantly increased it in both seasons of study as compared with control. While ethephon at 500 or 1000 ppm failed to give similar effect in both seasons. These results are in partial agreement with those obtained by El-Nabway *et al.* (1977), El-*Hamady et al.* (1979), Hussein *et al.* (1992c) and Kamal (1995), who stated that increasing ethephon concentration significantly increased total sugars.

The NAA treatments significantly increased the total sugars content over the control in both seasons, except 100 ppm treatment in the first season only. These results are in accordance with those obtained by El-Kassas (1983b) and Kamal (1995), who noticed that NAA treatments increased total sugars content in Zaghloul date fruits.

Also GA_3 treatments significantly increased total sugars content over the control. This effect was evident in the two seasons of this study, except 200 ppm concentration in the first season only, which show no significant effect. These findings are in accordance with that published by Kamal (1995). However, El-Nabawy *et al.* (1977), El-Kassas (1983a) and Hussein *et al.* (1992b) reported that GA_3 treatments tended to reduce the total soluble sugars content in date fruits.

*7. **Tannin content***

The data listed in Tables 3 and 4 generally, show that tannin content in the second season was higher than that in the first one. In addition, tannin content in date fruits was significantly reduced by both manual-thinning methods as compared with control. This trend was evident in both seasons of this study, and removing 25% of strands was more effective than the cutting back 25% of strands tips, especially in the first season. In the second season, however, no significant difference between both thinning methods was detected.

Concerning the effect of growth regulators on tannin content, the data showed that ethephon treatments significantly reduced tannin content in date fruits in both seasons in comparison with the control. The magnitude of this reduction was proportional to the used ethephon concentration; however, differences between these

concentrations were insignificant in the second season only. El-Nabawy *et al.* (1977), El-Hamady *et al.* (1979) and El-Kassas (1995) reported similar findings.

NAA and GA_3 treatments also significantly reduced the tannin percentage, in both seasons as compared with the control. These results are in agreement with those of Kamal (1995) on Zaghloul date palm. However, El-Nabawy *et al.* (1977) reported that GA treatments had no clear effect on tannin content of Samany date fruits.

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تأثير بعض معاملات خف الثمار ومنظمات النمو على المحصول وصفات جودة الثمار فى البلح الزغلول

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أجريت هذه الدراسة خلال موسمى ٢٠٠٠ و ٢٠٠١ على نخيل البلح صنف الزغلول النامى فى ارض رملية حديثة الاستصلاح بمنطقة وادى الملاك بمحافظة الإسماعيلية فى محاولة لإلقاء مزيد من الضوء على تأثير الخف اليدوى وبعض منظمات النمو بتركيزات مختلفة تحت الظروف المناخية لتلك المنطقة على محصول وخصائص ثمار هذا الصنف الذى يعد من أهم الأصناف الرطبة المنزرعة فى مصر.

وقد اشتملت التجربة على تسعة معاملات بالإضافة إلى معاملة الكنترول هى:

- إزالة ٢٥% من عدد الشماريخ الزهرية من مركز السوباطة.
- تقصير ٢٥% من قمم الشماريخ الزهرية.
- الرش بالاثيفون بتركيز (٥٠٠ - ١٠٠٠ أو ١٥٠٠ جزء فى المليون).
- الرش بنفثالين حمض الخليك (NAA) بتركيز (١٠٠ أو ٢٠٠ جزء فى المليون).
- الرش بحامض الجبريليك (GA_3) بتركيز (١٠٠ أو ٢٠٠ جزء فى المليون).
- مقارنة بدون معاملة.

وقد أجريت المعاملات بعد ٣ أسابيع من إجراء التلقيح اليدوى، ما عدا معاملة الرش بحامض الجبريليك فقد أجريت بعد ذلك بأسبوع.

وقد أوضحت هذه الدراسة النتائج التالية:

١- أدت معاملات الرش بالاثيفون بتركيزات ٥٠٠ و ١٠٠٠ جزء فى المليون والجبريلين بكلا التركيزين (١٠٠ أو ٢٠٠ جزء فى المليون) إلى زيادة معنوية فى المحصول الكلى

للنخلة. ولم يكن لمعاملة الخف بإزالة ٢٥% من الشماريخ الزهرية تأثير معنوى فى هذا الشأن. بينما أدت معاملات الرش بنفثالين حمض الخليك بكلا التركيزين (١٠٠ أو ٢٠٠ جزء فى المليون) والاثيفون بتركيز ١٥٠٠ جزء فى المليون وكذلك معاملة تقصير ٢٥% من الشماريخ الزهرية إلى نقص معنوى فى المحصول.

٢- أدت جميع المعاملات إلى زيادة كل من وزن وحجم وطول وقطر الثمرة وكذلك وزن اللب ، فيما عدا معاملات تقصير ٢٥% من الشماريخ وكلا من الاثيفون بتركيز ٥٠٠ جزء فى المليون والجبريلين بالتركيز ١٠٠ جزء فى المليون التي لم يكن لها اتجاه واضح.

٣- أدت جميع المعاملات إلى زيادة النسبة المئوية للب. أما وزن البذرة فقد انخفض معنويا بتأثير معاملات الرش بالاثيفون بتركيز ٥٠٠ جزء فى المليون والجبريلين بالتركيز ٢٠٠ جزء فى المليون.

٤- أدت معاملات الرش بالاثيفون بتركيز ١٠٠٠ و ١٥٠٠ جزء فى المليون ونفثالين حمض الخليك بتركيز ١٠٠ جزء فى المليون وكذلك معاملة الخف بإزالة ٢٥% من الشماريخ إلى زيادة معنوية فى لون الثمار. أما صلابة الثمار فقد زادت فى جميع المعاملات فيما عدا معاملات الرش بالاثيفون.

٥- أدت معاملات كلا من الخف اليدوى والرش بمنظمات النمو الى انخفاض نسبة الرطوبة وزيادة نسبه المادة الجافة بالثمار. أما المواد الصلبة الذائبة الكلية فقد زادت بالرش بالاثيفون خاصة بالتركيزات العالية والجبريلين بكلا التركيزين. إلا أن الرش بنفثالين حمض الخليك قد أدى إلى انخفاضها. أما النسبة المئوية للحموضة فقد انخفضت بجميع المعاملات فيما عدا الرش بالجبريلين فقد أدى إلى زيادتها.

٦- أدت كلا من معاملتى الخف اليدوى الى زيادة معنوية فى محتوى الثمار من السكريات الكلية. أيضا أظهر الرش بالجبريلين بتركيز ١٠٠ جزء فى المليون والاثيفون بتركيز ١٥٠٠ جزء فى المليون ونفثالين حمض الخليك بتركيز ٢٠٠ جزء فى المليون زيادة معنوية فى محتوى الثمار من السكريات الكلية. أما التركيزات المنخفضة لكل من الاثيفون ونفثالين حمض الخليك لم يكن لها تأثير معنوى فى هذا الشأن.

٧- أدت معاملات كلا من الخف اليدوى والرش بمنظمات النمو الى انخفاض معنوى فى محتوى الثمار من التانينات.

مما سبق يتضح ان الخف بإزالة ٢٥% من الشماريخ الزهرية كان الأفضل من الخف بتقصيرها حيث لم تؤدى المعاملة الأولى ألي نقص فى المحصول مع تحسين جودة الثمار. كما وأن الرش بنفثالين حمض الخليك بالتركيزات المستخدمة رغم أنه حسن جودة الثمار إلا أنه أدى إلى انخفاض شديد فى المحصول. أما معاملات الرش بالإثيفون فكانت إيجابية خاصة بالتركيزات العالية.