

## Effect of Some Pollen Carriers on Yield and Fruit Quality of Zaghloul and Samani Date Palm Cultivars

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**Abstract:** This study was carried out during two successive seasons (2006 and 2007) on Zaghloul and Samani date palm cultivars grown at EL- Mansouria, Giza governorate, Egypt. A spraying trail was conducted using pollen grains at 2g/L mixed with gibberellic acid (GA<sub>3</sub>) at 10, 20 and 30ppm or with sucrose solution at 5, 10 and 20% as activating media as well as traditional pollination as control plants. All spraying treatments improved yield, retained fruits and both fruit physical and chemicals characteristics i.e. Fruit weight, volume, dimensions, TSS %, reducing sugars, non- reducing sugars and total sugars contents compared with the control. On the other hand, total acidity % was not affected by different treatments. The promising effect was attributed to using pollen grains at 2g/L + GA<sub>3</sub> at 20 ppm. In addition, pollen grains at 2g/L +Sucrose solution at 10% gained also good results. From these results, the possibility of using 2g/L pollen grains in combination with GA<sub>3</sub> or sucrose solution as carrier of Zaghloul and Samani date palm was raised. Such practice gave satisfactory promotion on the yield and gave the best results with regard to fruit quality rather than the traditional pollination method (control). These results were beneficial when the amount of pollen grains is not sufficient to accomplish pollination efficiency.

**Key words:** Date palm • Pollination • GA<sub>3</sub> • Sucrose solution • Fruit quality

### INTRODUCTION

It is well recognized that date palm is a dioecious plant i.e. male and female flowers are borne on separate palms and the natural pollination may occur by wind and insects.

If the pollination process is dependent on these two agents, the palm cropping will be shy and the fruits may be inferior quality due to inadequate pollination. Therefore, artificial hand pollination becomes a necessary as a mean to ensure good yield.

The shortage of skilled labourers of pollinations and the limited quantity of pollen grains are the basis to justify the use of mechanical pollination by sprayers and dusters [1-5].

Mixing pollen grains with various carriers was beneficial in establishing mechanical pollination and obtaining an economical yield with good fruit quality. Also, it is responsible for enhancing pollination efficiency [6-9].

Therefore, this investigation was carried out to study the effect of spraying pollen grains suspended on

gibberellic acid (GA<sub>3</sub>) or sucrose solution as activating media on yield and fruit quality of Zaghloul and Samani date palm cultivars grown under sandy soil conditions at Mansoria, Giza governorate, Egypt.

### MATERIALS AND METHODS

This study was carried out during two successive seasons (2006 and 2007) on 18 year's old Zaghloul and Samani date palm cultivars spaced at 10 meters apart, grown in sandy soil at private orchard located in EL- Mansoria, Giza governorate, Egypt. Twenty one trees were selected for each cultivar and divided into 7 treatments in three replicates (each of one tree) and arranged in a randomized complete block design as the following.

1. Control (hand pollination using the traditional method).
2. Pollen grains at 2g/L + GA<sub>3</sub> at 10 ppm.
3. Pollen grains at 2g/L + GA<sub>3</sub> at 20 ppm.
4. Pollen grains at 2g/L + GA<sub>3</sub> at 30 ppm.

5. Pollen grains at 2g/L + sucrose at 5%.
6. Pollen grains at 2g/L + sucrose at 10%.
7. Pollen grains at 2g/L + sucrose at 20%.

The concentration of pollen grains for each treatment was 2 gram per litter for both Zaghloul and Samani cultivars.

Sprays of pollen suspension were thoroughly applied by hand sprayer (two litter capacity) at the amount of 200 ml/inflorescence. Suspension was shaken for few minutes then it used immediately [10]. Hand pollination was done by inserting 3 strands of the same selected male inflorescence into the female spathe.

Both traditional and spray pollination were carried out twice. The first one just after the female spathe opening and the second was carried 3 day's later. The used pollen grains were collected from the same selected male palm tree to avoid the effect of metaxinia . After pollination with the first and second sprays, the inflorescences were wrapped with newspaper bags to prevent natural contamination by wind-borne pollen, bee pollination or by unwanted pollen from surrounding males. Thereafter, the bags were removed out after three weeks from pollination.

The palms were subjected to the same horticultural practices and pruning was performed to maintain bunch/mature leaves ratio to (1:8). The number of spathes per palm was adjusted to 8 bunches by removing earliest, latest and smallest inflorescences for each female palm of each cv.

All bunches were harvested at the peak of color development and the following determinations were carried out:

1. Fruit retained percentage was calculated at harvest date using this equation.

$$\text{Fruit retained \%} = \frac{\text{Total number retained fruit per bunch}}{\text{Total fruits number per bunch}} \times 100$$

2. The average bunch weight was estimated by kg.
3. Yield (kg/tree) was estimated as followed: number of bunches/tree × bunch weight (kg).
4. Fruit physical properties: Sample of three replicates (each of 40 fruits) was taken randomly from each bunch to determine fruit dimensions (length and diameter in cm), fruit weight (g) and volume (cm).
5. Fruit chemical properties:

- Total soluble solids (%) using hand refractometer.
- Acidity (%) was determined as malic acid.
- Total soluble sugars: It was determined according to Smith *et al.* [11], in the methanolic extract using the phenol sulphoric acid method and the percentage was calculated on dry weight basis.
- Reducing sugars content: It was determined in the methanolic extract according to A.O.A.C. [12].

Non-reducing sugars content, it was determined by differentiate between total and reducing sugars.

All obtained data were subjected to the analysis of variance as the usual technique of analysis of variance.

The treatment means were presented and compared using the last significant difference (L.S.D) as mentioned by Gomez and Gomez [13].

## RESULTS AND DISCUSSION

**Fruit Retained Percentage:** Data presented in Table 1 clearly indicated that percentage of retained fruits was significantly affected by different pollination treatments for the two cultivars in both seasons. However, the traditional pollination method (control) gave the lowest percentage. It is also noticed that GA<sub>3</sub> spray treatments significantly increased fruit retained % compared with the control. The best results were obtained from treatment of pollen grains + GA<sub>3</sub> at 20 ppm in the two cultivars under study in both seasons.

The previous results are in harmony with those obtained by Mostafa *et al.* [14] who found that spraying Le-Cont pear trees with GA<sub>3</sub> at 25 ppm increased number of fruits/tree.

As for sucrose spray treatments, the results presented in the previous table indicate that the treatments significantly increased percentage retained fruits for the two cultivars in both seasons. In this respect, sucrose spray at concentration of 5% + pollen grains gave the best results for Zaghloul cultivar. While, pollen grains + sucrose spray at 10% gave the best results for Samani cultivar in both seasons. The obtained results are in agreement with those obtained by Mostafa [8] who found that sucrose spray significantly increased the fruit retained percentage than control for Zaghloul and Samani dates and Ragab *et al.* [15] on Sewy cv.

**Bunch Weight:** It is clear from Table 1 that all applied treatments significantly increased bunch weight in the two cultivars during the two seasons of the study as compared with control. Treatment of pollen grains + GA<sub>3</sub>

Table 1: Effect of some pollen carriers on fruit retained %, bunch weight and yield of Zaghoul and Samani date palm

Treatments	Zaghoul cv.				Samani cv.			
	Fruit retained (%)	Bunch weight (kg)	Yield/tree (kg)	Increasing % over control	Fruit retained (%)	Bunch weight (kg)	Yield/tree (kg)	Increasing % over control
<b>First season (2006)</b>								
Control (traditional method)	29.8	15.3	109.0	-	34.5	16.1	117.7	-
Pollen grains +GA <sub>3</sub> at 10 ppm	30.7	15.9	112.3	3.2	43.5	16.5	120.0	1.9
Pollen grains +GA <sub>3</sub> at 20 ppm	34.7	16.4	114.3	4.9	43.7	17.0	122.0	3.7
Pollen grains +GA <sub>3</sub> at 30 ppm	32.4	15.8	113.0	3.7	44.5	16.5	123.0	4.5
Pollen grains +sucrose at 5%	56.8	16.4	117.0	7.3	44.5	17.0	128.0	8.8
Pollen grains +sucrose at 10%	35.9	17.0	119.3	9.4	48.9	18.0	129.7	10.2
Pollen grains +sucrose at 20%	45.6	17.7	121.0	11.0	37.3	18.7	135.7	15.3
L.S.D at 5%	6.73	0.30	0.84	-	10.04	0.21	1.05	-
<b>Second season (2007)</b>								
Control (traditional method)	29.3	15.7	109.7	-	34.7	16.2	119.3	-
Pollen grains +GA <sub>3</sub> at 10 ppm	33.3	16.2	113.0	3.0	43.0	16.6	121.3	1.7
Pollen grains +GA <sub>3</sub> at 20 ppm	35.7	16.6	115.3	5.1	44.7	17.1	122.0	2.3
Pollen grains +GA <sub>3</sub> at 30 ppm	34.7	16.0	115.0	4.8	45.0	16.8	123.3	3.4
Pollen grains +sucrose at 5%	56.7	16.7	117.7	7.3	46.3	17.1	129.7	8.7
Pollen grains +sucrose at 10%	37.9	17.2	120.3	9.7	48.7	18.1	132.0	10.6
Pollen grains +sucrose at 20%	45.3	17.9	122.0	11.2	38.0	19.1	136.7	14.6
L.S.D at 5%	5.48	0.28	0.60	-	8.07	0.25	1.67	-

at 20 ppm gave heavier bunch weight than other the concentrations for the two cultivars under this study in both seasons. As for sucrose sprays, treatment of pollen grains + 20% sucrose gave the best results in this respect, for the two cultivars in both seasons. The obtained results are in agreement with those obtained by Mostafa [8] on Zaghoul and Samani cultivars and Ragab *et al.* [15] on Sewy cv.

**Yield:** Concerning the average yield/tree, Table 1 indicated that different pollination treatments significantly affected the yield in both seasons for the two cultivars under the study compared with the control. As for GA<sub>3</sub> treatments, the best results were obtained from treatment of pollen grains + GA<sub>3</sub> at 20 ppm for Zaghoul cv during the two seasons of the study. While, for Samani cultivar the best results obtained from pollen grains treatment + GA<sub>3</sub> spray at 30 ppm. The average of increment was 3.2, 4.9 and 3.7%, also 3.0, 5.1 and 4.8% for the three concentrations of GA<sub>3</sub> in the first and second seasons, respectively for Zaghoul cultivar. The average of increment was 1.9, 3.7 and 4.5%, also 1.7, 2.3 and 3.4 % for the three concentrations of GA<sub>3</sub> in the first and second seasons, respectively for Samani cultivar.

As for sucrose treatments, there was a positive relationship between sucrose concentration and yield in the two cultivars under study in both seasons.

The average of increment was 7.3, 9.4 and 11.0%, also 7.3, 9.7 and 11.2% for sucrose concentrations in the first

and second season, respectively for Zaghoul cultivar. The average of increment was 8.8, 10.2 and 15.3, also 8.7, 10.6 and 14.6% for sucrose treatments than the control for Samani cultivar in the first and second seasons, respectively.

The obtained results are in line with those reported by Mostafa [8] on Zaghoul and Smani cultivars and Ragab *et al.* [15] on Sewy cv.

## FRUIT QUALITY

### Physical Characteristics

**Fruit Length:** Data in Table 2 clearly indicated that fruit length was significantly affected by pollination treatments for Zaghoul and Samani cultivars in both seasons of the study. In this respect, the best results were obtained by spraying pollen grains + GA<sub>3</sub> at 10 ppm for the two cultivars under study. As for sucrose treatments, best results were obtained by spraying 2g pollen grains/L suspended with sucrose at 5% for the two cultivars under investigation during the two seasons. The traditional pollination method gave the shortest fruits. The above results are agree with those obtained by Mostafa [8] who found that average fruit length of Zaghoul and Samani was increased as a result of sugar cane spray applications mixed with pollen grain. Also, Mostafa *et al.* [14] found that spraying different combinations of sucrose and GA<sub>3</sub> significantly increased fruit length of Le-Cont pear.

Table 2: Effect of some pollen carriers on some physical characteristics of Zaghloul and Samani date palm

Treatments	Zaghloul cv.			Samani cv.				
	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruit volume (cm)	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruit volume (cm)
<b>First season (2006)</b>								
Control (traditional method)	4.72	2.73	16.9	17.2	4.53	2.87	19.7	19.8
Pollen grains +GA <sub>3</sub> at 10 ppm	5.93	2.93	25.2	30.0	5.54	3.33	20.6	22.5
Pollen grains +GA <sub>3</sub> at 20 ppm	5.23	2.60	18.9	23.8	5.15	3.13	24.6	27.9
Pollen grains +GA <sub>3</sub> at 30 ppm	5.62	3.13	26.5	30.8	4.86	3.00	29.4	33.4
Pollen grains +sucrose at 5%	5.61	3.13	17.3	20.4	5.07	3.50	16.4	15.9
Pollen grains +sucrose at 10%	4.84	2.70	17.1	20.0	5.03	3.07	22.9	25.8
Pollen grains +sucrose at 20%	5.07	2.63	28.1	31.7	4.57	2.80	30.5	33.4
L.S.D at 5%	0.17	0.07	1.61	1.73	0.33	0.08	1.71	1.72
<b>Second season (2007)</b>								
Control (traditional method)	4.80	2.70	17.5	16.8	4.77	3.00	18.5	20.7
Pollen grains +GA <sub>3</sub> at 10 ppm	5.96	2.97	25.0	29.1	5.36	3.23	19.5	22.8
Pollen grains +GA <sub>3</sub> at 20 ppm	5.48	2.63	18.9	23.2	5.04	3.10	24.5	27.9
Pollen grains +GA <sub>3</sub> at 30 ppm	5.31	3.00	26.2	30.3	4.92	3.00	29.5	33.1
Pollen grains +sucrose at 5%	5.63	3.03	17.2	20.7	5.34	3.47	16.2	16.4
Pollen grains +sucrose at 10%	4.82	2.77	16.7	20.3	5.33	3.10	23.0	26.7
Pollen grains +sucrose at 20%	4.91	2.73	28.1	32.5	4.50	2.83	30.0	33.7
L.S.D at 5%	0.49	0.19	1.52	1.42	0.44	0.18	1.02	1.55

**Fruit Diameter:** Data in Table 2 indicated that all the studied pollination treatments significantly affected the average fruit diameter for Zaghloul and Samani cultivars during both studied seasons. The best results were obtained from treatment of pollen grains + GA<sub>3</sub> at 10 ppm for the two cultivars under the study. As for the sucrose treatments, best result was obtained from treatment of pollen grains + sucrose at 5% when compared with the other treatments including the control in two seasons of the study for the two cultivars.

**Fruit Weight and Volume:** Data in Table 2 clearly indicated that fruit weight of Zaghloul and Samani cultivars were significantly affected by different pollination treatments in both seasons of study.

It was clearly noticed that, a positive relationship between GA<sub>3</sub> or sucrose concentrations and fruit weight was detected. The treatment of pollen grains + GA<sub>3</sub> at 30 ppm also treatment of pollen grains + sucrose at 20% gave the higher fruit weight during both seasons of the study for the two cultivars. Meanwhile, the traditional pollination method gave the least fruit weight for both cultivars.

Regarding fruit volume, the results in the same Table show that fruit volume took a similar trend as fruit weight

and it was significantly increased as GA<sub>3</sub> and sucrose concentrations increased in both seasons of the study.

#### Chemical Characteristics

**Total Soluble Solids (TSS) Percentage:** Data presented in Table 3 showed that pollen grain spray treatments increased total soluble solids percentage in dates of both Zaghloul and Samani cultivars in comparison with the traditional method in both seasons of the study. In this respect, the best results were obtained from treatment of pollen grains + GA<sub>3</sub> at 20 ppm and treatment of pollen grains + Sucrose at 10 % in both seasons of the study for the two cultivars. These results are in line with those obtained by Ragab *et al.* [15] who found that using mixture of pollen grains + sucrose improved total soluble solids in Sewy cultivar.

Mostafa [8] reported that the traditional pollination method gave the lowest value of TSS percentage than all pollination methods used in Zaghloul and Samani cultivars.

**Total Acidity:** Regarding total acidity, data in Table 3 indicated that no constants trend was detected among the treatments in both seasons. It is obvious that spraying treatments individually gave more or less similar

Table 3: Effect of some pollen carriers on some chemical characteristics of Zaghloul and Samani date palm

Treatments	Zaghloul cv.						Samani cv.					
	TSS (%)	Acidity acid	TSS/ ratio	Reducing sugars	Non reducing sugars	Total sugars	TSS %	Acidity %	TSS/ acid ratio	Reducing sugars	Non reducing sugars	Total sugars
<b>First season (2006)</b>												
Control (traditional method)	20.2	0.300	67.3	57.7	6.67	64.37	19.3	0.30	65.2	65.5	7.28	72.78
Pollen grains +GA <sub>3</sub> at 10 ppm	20.8	0.313	66.4	61.8	8.27	70.07	20.5	0.34	61.7	69.7	7.81	77.51
Pollen grains +GA <sub>3</sub> at 20 ppm	22.5	0.29	77.8	64.6	8.38	72.98	21.2	0.32	64.7	72.0	7.02	79.02
Pollen grains +GA <sub>3</sub> at 30 ppm	22.3	0.28	78.6	61.0	7.69	68.69	20.5	0.28	72.5	70.0	6.89	78.89
Pollen grains +sucrose at 5%	23.2	0.31	80.1	64.8	7.90	72.70	22.0	0.30	75.8	73.8	7.43	81.23
Pollen grains +sucrose at 10%	25.1	0.30	77.1	67.5	7.01	74.51	23.0	0.30	72.6	70.5	7.30	77.80
Pollen grains +sucrose at 20%	23.5	0.30	77.6	68.9	7.40	76.30	22.5	0.30	79.1	71.7	7.36	79.06
L.S.D at 5%	0.53	0.011	2.43	0.78	0.06	0.68	0.55	0.012	1.43	0.49	0.10	0.53
<b>Second season (2007)</b>												
Control (traditional method)	20.5	0.32	64.8	59.5	6.78	66.28	19.8	0.35	57.1	67.9	7.38	75.28
Pollen grains +GA <sub>3</sub> at 10 ppm	21.2	0.30	69.9	63.4	8.34	71.74	21.5	0.34	62.6	70.9	7.86	78.76
Pollen grains +GA <sub>3</sub> at 20 ppm	23.2	0.28	82.1	66.3	8.40	74.70	23.7	0.30	70.5	72.3	7.09	79.39
Pollen grains +GA <sub>3</sub> at 30 ppm	23.0	0.30	78.1	63.1	7.76	70.86	20.7	0.32	74.7	71.2	6.97	78.17
Pollen grains +sucrose at 5%	23.6	0.34	69.3	66.4	8.00	74.40	23.5	0.29	83.4	74.4	7.50	81.90
Pollen grains +sucrose at 10%	24.5	0.33	74.2	68.3	6.99	75.29	24.6	0.30	77.8	71.4	7.32	78.72
Pollen grains +sucrose at 20%	23.8	0.29	83.0	70.2	7.47	77.67	23.9	0.29	82.3	73.3	7.41	80.71
L.S.D at 5%	0.41	0.011	2.14	0.82	0.06	0.87	0.40	0.011	1.34	0.43	0.11	0.61

values to those obtained by traditional pollination method (control).

Regarding TSS/acid ratio, it was significantly affected by different treatments for the two cultivars during the two seasons of the study.

**Sugar Contents:** Data presented in Table 3 indicated that reducing sugars were significantly affected by different pollination treatments for the two cultivars in both seasons of study. So, spraying treatments increased reducing sugars percentage in the two cultivars compared with the traditional method (control).

As for non-reducing sugars, data in Table 3 showed that spraying treatments in the two seasons of the study for the two cultivars significantly enhanced fruit content of non-reducing sugars.

As for total sugar contents, results in Table 3 indicated that fruit content of total sugars was significantly affected by different pollination treatments. However, spraying treatments increased total sugars percentage in both seasons of the study for the two cultivars. The lowest sugars percentage was obtained in the traditional method (control). These results are in line with Mostafa [8] on Zaghloul and Samani date palm,

Ragab *et al.* [15] on Sewy cv. and Mostafa *et al.* [14] on Le-Cont pear.

Form the abovementioned results, it could be concluded that combining pollen grains either with gibberellic acid (GA<sub>3</sub>) at 20ppm or sucrose solution at 20% as spraying suspension is the promising. Where, any of them increased yield and improved physical and chemical properties for Zaghloul and Samani cultivars.

#### REFERENCES

1. Preston, R.W., 1964. Pollinating date by airplane date growers. Inst. Rep., 41: 24.
2. Burkner, P.F. and R.M. Perkins, 1976. Mechanical extraction of date pollens. Rep. of the Annual Date Growers Inst. Hort. Abst., 46: 10733.
3. Brown, G.K., 1982. Date production mechanization in the USA. Proc. 1<sup>st</sup> Symp. on the date palm in Sudi Arabia March 23-25. King Faissal Univ. Al-Hassa, 1: 2-13.
4. Shabana, H.R. and M. Shafaat, 1982. Mechanization of date production. Date palm and date section. Scientific Res. Council. Baghdad, Iraq Proc.1<sup>st</sup> Symp. on Date palm in Saudi Arabia, 1: 712-714.

5. El-Kassas, Sh.E., 1983b. The effect of some growth regulators on the yield and fruit quality of Zaghloul date palm. *Assiut J. Agric. Sci.* 14 (2) 181-191.
6. Khalil, A.R. and A.M. Al-Shawaan, 1983. Wheat flour and sugar solution media as carriers of date palm pollen grains. Proceeding of the first Symposium on the date palm in Saudi Arabia. Al- Hassa, Saudi Arabia, King Faisal University, pp: 68-71.
7. El-Kassas, Sh.E. and H.M. Mahmoud, 1984. The possibility of pollination by diluted date palm pollen grains. *Assiut. J. Agric. Sci.*, 15 (1): 113-120.
8. Mostafa, R.A.A., 1994. Effect of different pollination methods on improving productivity of certain date palm (*Phoenix dactylifera* L.) cultivars under Assiut conditions. p. 109. Ph.D. Thesis, Fac. Agric. Assiut Univ., Assiut, Egypt.
9. Ashour, N.E., H.S.A. Hassan and E.A.M. Mostafa, 2004. Yield and Fruit quality of Zaghloul and Samani date palm (*Phoenix dactylifera* L) as affected by pollination methods. *Annals Agric. Sci.*, Ain Shams Univ., Cairo, 49 (2): 631-642.
10. Hussain, F.A., S.M. Bader and S.S. AL-Atear, 1985. Effect of different pollination methods on quality and quantity of date palm (*Phoenix dactylifera* L) Fruits. *J. Agric. Water Resources Res.*, 4(1): 265-282.
11. Smith, F., M.A. Gilles, J.K. Haniltun and P.A. Godees, 1956. Colorimetric methods for determination of sugars related substances. *Anal. Chem.*, pp: 28-35.
12. A.O.A.C. (Association of Official Agriculture Chemists), 1995. Official methods of analysis 15<sup>th</sup> Edn. Published by A.O.A.C., Washington, DC., USA.
13. Gomez, K.A. and A.A. Gomes, 1984. Statistical procedures for agricultural research. John Wiley and Sons. Inc., New York, pp: 680.
14. Mostafa, E.A.M., M.M.S. Saleh and M.M.M. Abd El-Migeed, 2001. Improving Le-Cont pear productivity by spraying GA<sub>3</sub> and sucrose. *Arab Univ. J. Agric. Sci. Ain Shams Univ.*, Cairo, 9 (1): 373-385.
15. Ragab, M.A., A.A. Gobara and A.Y. Mohamed, 2004. Effect of some pollen carriers on yield and fruit quality of Sewy date palms. *J. Agric. Sci. Mansoura Univ.*, 29 (9): 5201-5208.