

## IMPACT OF POLLINATION BY POLLEN-GRAIN-WATER SUSPENSION SPRAY ON YIELD AND FRUIT QUALITY OF SEGAE DATE PALM CULTIVAR (*PHOENIX DACTYLIFERA* L.)

SOLIMAN, S.S.<sup>1,2\*</sup>, A.I. ALEBIDI<sup>1</sup>, A.M. AL-SAIF<sup>1</sup>, R.S. AL-OBEED.<sup>1</sup> AND A.N. AL-BAHELLY<sup>1</sup>

<sup>1</sup>Plant Production Dept., College of Food & Agric. Sciences, King Saud University

<sup>2</sup>Department of Horticultural Crops Technology, National Research Centre, Cairo, Dokki, Egypt  
Box 2460, Riyadh 11451, Saudi Arabia

\*Corresponding author's email: said\_soliman@hotmail.com

### Abstract

This study was carried out for both successive seasons 2013-2014, 2014-2015 at Riyadh, Kingdom of Saudi Arabia. The impact of pollen grain-water suspension spray at different concentrations on fruit retained, bunch weight, yield and fruit quality were examined on Segae date palm cultivar. Spray pollination at 2 g pollen +3 g sugar/liter followed by spray pollination at 2 g pollen/liter gave higher physical properties and lower fruit retained. Spray pollination at 2 g pollen +3 g sugar/liter followed by traditional pollination (control) gave the highest bunch weight and yield compared to the application other treatments in both seasons. Spray pollination at 3 g pollen + 2 g sugar/liter followed by spray pollination at 2 g pollen/liter and spray pollination at 2 g pollen +3 g sugar/liter followed by spray pollination at 2 g pollen/liter treatments were significantly increase total sugar percentage compared to other treatments and control in the first and second seasons, respectively. Acidity percentages were significantly increased with spray pollination at 2 g pollen/liter followed by spray pollination at 3 g pollen/liter compared to other treatment and control in the second season. Moisture content percentages were significantly increased with traditional pollination (control) as compared to other treatments in both seasons. Spray pollination at 2 g pollen +3 g sugar/liter treatment produced highest fruit quality and could be considered as a recommended treatment in such experiment.

**Key words:** Date palm, Pollination, Pollen grain, Water, Fruit quality.

### Introduction

Date palm (*Phoenix dactylifera* L.) is one of the important fruit species grown in Kingdom of Saudi Arabia. Segae are of the best date palm cultivar and one of the most famous species that are eaten in the tamur stage in Kingdom of Saudi Arabia. Natural pollination in date palm may occur by wind and insects and pollination process is dependent on these two agents. Inadequate pollination cause access to the fruits of poor quality. Thinning and pollination are important processes that affect on yield production and fruit quality in date palm. Developing a pollination technique and change from the traditional method of pollinator to method pollinated by pollen grain-water suspension spray led to improve the fruit set is ideal degree without thinning process has also improved the quality of fruiting characteristics. The use of the method of pollinate by pollen suspension with water of the reduce labor effort and costs of thinning process, Awad (2010). Al-Wasfy (2014) found that the pollinated (suspension) by a mixture consisting of 1 g boric acid + 2 g ascorbic acid + 2m treacle + 4 g pollen grains/liter water caused increasing yield and fruit quality of Zaghlool cultivar. Pollinated (suspension) by 1.0 to 6.0 g pollen grains/ liter water better percentage of fruit set, percentage of fruit retained, bunch weight, yield, flesh, fruit weight compared to traditional pollination. Moreover, improved all chemical characteristics of the fruits except percentage of acidity. Awad (2011) recorded that the possibility of control fruit set in heavy bearing and compactness cultivars especially Lulu, Khenazy, Nabbut-Ali and Sabbaka by pollinate inflorescence female date palm to spray pollen grains and water suspension. Moreover, pollinate by suspension pollen improving fruit physical chemical properties. Iqbal *et al.* (2010) found that the placement

technique lead to get a percentage of a good fruit set, yield economic and improved fruit quality in Dhakki date palm cultivar. More recently, a liquid pollen grain suspension medium thickened with agar was also developed for kiwifruit, Yano *et al.* (2007).

### Materials and Methods

This study was conducted at the Agriculture Research and Experiment Station, Dirab, King Saud University, Riyadh during both successive seasons 2013- 2014 and 2013-2014 on Segae date palm cultivar. Fifteen date palm trees for of uniform vigorous, grown on sandy soil, 15 year-old, were selected according to their bearing of almost the same number of bunch and leaves. Only eight spathe were remained on each palm. Pollination was done by using pollen from the same male. Fifteen palm divided into five treatments in five replicates (each of one tree) and arranged in a randomized complete block design as the following:

Traditional pollination (control), spray pollination at 3 g pollen/liter, spray pollination at 3 g pollen + 2 g sugar / liter, spray pollination at 2 g pollen / liter and spray pollination at 2 g pollen +3 g sugar / liter.

All treatments is a suspension from pollen and were completely applied by small hand sprayer (three liter capacity). While treatment pollination (control) by manual pollination was achieved by five strands (male) inserted in the center of female flowers. After flowers pollination, the was covered by paper pages so as to block natural pollution by wind pollen from surrounding males. The bags were extracted out after a month from fruit set.

The yield of palms was crop during the August month. Average bunch weight and yield in kg/palm was registered. Samples of 20 date fruits were selected at random for the definition of fruit quality.

**A.** Average bunch weight and yield was predestined by kg.

**B.** Fruit retained percentage: the average fruit retained percentage was calculated at harvest using this equation:

$$\text{Fruit retained \%} = \frac{\text{Total number of retained fruits per bunch}}{\text{Total nodes number per bunch}}$$

**C-Fruit physical characteristics:** Samples were taken from five replicates, 10 fruits were taken randomly from each bunch (replicate) to determine fruit size and dimensions (length and diameter, in cm), fruit weight, fruit flesh weight and seed weight (in grams).

**D-Chemical characteristics:** Chemical properties of fruits (moisture content, total soluble solid TSS), fruit acidity and sugar content (reducing, non-reducing, and total sugar) were determined according to A.O.A.C., (1995).

**Statistical analysis:** Observations recorded were processed using Microsoft Excel (Microsoft, 2000). All statistical analysis and the simple correlation, as well as stepwise multiple regression analysis were carried out using the Statistica Program (Anon., 1995).

The objective of this study is to provide pollen, especially in the beginning of the season where some males in delayed open spathe, as well as procedure natural thinning of spathe because of compacted by traditional pollination and low fruit quality characteristics.

## Results

**Fruit retained:** Data in Table 1 the results of this study showed that spray of suspension at significantly increased retained fruits was significantly affected by all treatments and control in two seasons. In addition there was a favorable relevance amidst pollen concentration and retained fruits percentage in two seasons. Retention of fruit percentage is decreased by spray pollination at 2 g pollen +3 g sugar/liter,

spray pollination at 2 g pollen/liter followed by spray pollination at 3 g pollen + 2 g sugar/liter than the spray pollination at 3 g pollen/liter and application at traditional pollination (control). Improvement in fruit retained percentage could be demonstrate as a result of increase in pollen grains germination and pollen tube prolongation due to traditional pollination. The mentioned results are in contrary with those obtained by Awad (2010), how found that the fruit set percentage was significantly higher in the pollinate by suspension than in the conventional method.

**Bunch weight and Yield (kg):** Data in Table 1 clearly indicate that the average bunch weight and yield of Segae cultivar (Tamar stage). There are not significantly affected by any of the spray pollination treatments and traditional pollination in both seasons. Although the results are not significant, but it spray pollination at 2 g pollen +3 g sugar/liter followed treatment by traditional pollination gave the highest bunch weight and yield compared to the other spray treatments.

**Physical characteristic:** Data in Table 2 indicated that fruit weight, flesh weight, fruit volume, seed weight and fruit dimensions was significantly affected by different treatments for Segae cultivar in two seasons of study. It was clearly noticed that there is a positive relationship between pollen grains, water and sugar concentrations and fruit weight, flesh weight, fruit volume and fruit dimensions. Spray pollination at 2 g pollen +3 g sugar/liter followed by spray pollination at 2 g pollen/liter gave the highest fruit weight, flesh weight, fruit volume and fruit dimensions during two seasons of study than those spray pollination at 3 g pollen/liter and application at traditional pollination (control). Meanwhile, spray pollination at 3 g pollen/liter gave the lowest value of physical properties in both seasons. Sugar helps adhesion pollen pistil of flower and accelerates the growth of pollen tube, and perhaps this helps in cell division and elongation early.

**Table 1. Effect of pollination method on fruit retained, bunch weight and yield.**

Treatment	Fruit retained (%)	Bunch weight (Kg)	Yield (Kg)
<b>2013-2014 seasons</b>			
Traditional pollination	34.2	9.2	92.0
Spray pollination at:			
3 g/liter	30.1	8.6	85.7
3 g + 2 g sugar/liter	27.5	7.9	79.0
2 g / liter	22.0	8.0	80.0
2 g +3 g sugar/liter	19.0	9.7	96.7
<b>LSD at 0.05</b>	<b>6.1</b>	<b>ns</b>	<b>ns</b>
<b>2014-2015 seasons</b>			
Traditional pollination	29.3	8.7	87.0
Spray pollination at:			
3 g/liter	35.8	8.5	85.0
3 g + 2 g sugar/liter	27.8	7.2	72.0
2 g / liter	25.3	7.4	73.7
2 g +3 g sugar/liter	21.7	8.8	87.7
<b>LSD at 0.05</b>	<b>7.4</b>	<b>ns</b>	<b>ns</b>

**Table 2. Effect of pollination method on fruit physical characteristics.**

Treatment	Fruit weight (g)	Flesh weight (g)	Seed weight (g)	Fruit volume (cm)	Fruit length (cm)	Fruit diameter (cm)
<b>2013-2014 seasons</b>						
Traditional pollination	11.41	10.40	1.00	11.67	4.17	2.37
Spray pollination at:						
3 g/liter	10.68	9.74	0.93	10.67	4.00	2.33
3 g + 2 g sugar/liter	12.93	11.91	1.02	12.67	4.20	2.40
2 g/liter	13.32	12.28	1.04	13.17	4.37	2.50
2 g +3 g sugar/liter	17.25	16.11	1.14	16.83	4.63	2.77
<b>LSD at 0.05</b>	<b>2.31</b>	<b>2.37</b>	<b>0.1</b>	<b>2.16</b>	<b>0.28</b>	<b>0.17</b>
<b>2014-2015 seasons</b>						
Traditional pollination	11.75	10.76	0.98	11.67	3.96	2.37
Spray pollination at:						
3 g/liter	11.62	10.72	0.90	10.72	3.97	2.37
3 g + 2 g sugar/liter	12.38	11.35	1.03	11.35	4.00	2.40
2 g/liter	12.47	11.47	1.00	11.47	4.17	2.40
2 g +3 g sugar/liter	13.11	12.14	0.98	12.14	4.20	2.47
<b>LSD at 0.05</b>	<b>1.1</b>	<b>0.8</b>	<b>0.11</b>	<b>0.7</b>	<b>0.5</b>	<b>0.4</b>

**Table 3. Effect of pollination method on fruit chemical characteristics.**

Treatment	TSS %	Reducing sugars %	Non-R. sugars %	Total sugars %	Acidity %	Moisture content %
<b>2013-2014 seasons</b>						
Traditional pollination	66.80	45.60	14.78	60.38	0.217	20.4
Spray pollination at:						
3 g / liter	64.80	42.88	17.62	60.50	0.204	16.6
3 g + 2 g sugar / liter	67.60	39.93	22.53	62.46	0.167	17.6
2 g / liter	68.40	42.49	19.17	61.66	0.205	18.0
2 g +3 g sugar / liter	63.20	38.45	16.97	55.42	0.205	17.1
<b>LSD at 0.05</b>	<b>ns</b>	<b>6.91</b>	<b>ns</b>	<b>6.10</b>	<b>ns</b>	<b>2.1</b>
<b>2014-2015 seasons</b>						
Traditional pollination	73.20	34.68	21.62	56.30	0.359	18.0
Spray pollination at:						
3 g / liter	70.00	32.77	27.85	60.62	0.269	14.9
3 g + 2 g sugar / liter	67.60	32.50	27.42	59.92	0.307	16.9
2 g / liter	70.40	33.39	27.53	60.92	0.371	17.1
2 g +3 g sugar / liter	68.00	33.16	31.46	64.62	0.307	16.2
<b>LSD at 0.05</b>	<b>5.0</b>	<b>ns</b>	<b>10.2</b>	<b>6.12</b>	<b>0.01</b>	<b>3.4</b>

**Chemical characteristic**

**3. Fruit chemical constituents:** Table 3 shows the effect of pollination treatments on fruit chemical constituents of Segae date cultivar. It is quite clear from these tables that fruit chemical constituents took similar trend during the two studied seasons almost. All treatments affected significantly total soluble solids, reducing sugar, non-reducing sugar, total sugar and moisture content percentage. Application at traditional pollination (control) followed by spray pollination at 2 g pollen / liter treatments were significantly increase in total soluble solids in the second season compared to other treatments. Application at traditional pollination (control) followed by spray pollination at 3 g pollen / liter gave the highest

reducing sugar compared to other treatments in the first season. Non-reducing sugar increased with spray pollination at 2 g pollen +3 g sugar/liter followed by spray pollination at 3 g pollen/liter treatments than those other treatments and control in the second season. Spray pollination at 3 g pollen + 2 g sugar/liter followed by spray pollination at 2 g pollen/liter and spray pollination at 2 g pollen +3 g sugar/liter followed by spray pollination at 2 g pollen/liter treatments were significantly increase total sugar percentage compared to other treatments and control in the first and second seasons, respectively. Acidity percentage were significantly increased with spray pollination at 2 g pollen/liter followed by spray pollination at 3 g pollen/liter compared to other treatment and control in the second season. The

total soluble solids, non-reducing sugar and acidity percentage in the first season. and reducing sugar were not significantly affected by any of the pollination treatments in the second season.

### Discussion

The main objective of fruit thinning is to obtain increase bunch weight, fruit weight and fruit size. Pollinator by pollen suspension spray led to improve the fruit set is ideal degree without thinning process has also improved the quality of fruiting characteristics. The use of the method of pollinate by pollen suspension with water of the reduce labor effort and costs of thinning process, Awad (2010). The retained percentage of the fruits varied depending on the concentration of pollen in the water. The results of this study appeared that spray of pollen suspension at different concentration significantly lower fruit retained, yield and bunch weight per palm. Spray pollination at 2 g pollen +3 g sugar/liter followed by spray pollination at 2 g pollen/liter decreased fruit retained percentage and bunch fruit but had a significant positive effect on most physical properties of fruit in two seasons (Table 1). The highest fruit retained percentage was obtained by traditional pollination (control) treatment compared to the treatments. That may be to see the weather conditions and normal agricultural operations. Shabana & Al-Sunbol (2007) reported that the palm cultivars growing at Yemen (Tuhama region) the shortage of fruit retained and/or abnormal flowering. May be warm winter (abnormal) and inadequate cold. Awad (2010) Found that the Lulu cultivar with profuse bearing and compactness bunches of pollinated by liquid grain suspension (0.5 g/l) led to a reduction the percentage of fruit set and improved fruit quality without a thinning process compared with the control and organized bearing palm. This technique can be used when storing pollen with early flowering cultivars, providing a large proportion of pollen. Awad (2010). The results are in agreement with those achieved by Hussein *et al.* (1993) on Samany dates; Moustafa (1998) on Seewy dates and Al-Khateeb *et al.* (1993) on Khalas dates. They reported that decreased fruit bearing increased fruit volume, fruit weight and sugar percentage but reduce total yield per palm. Moustafa (1998) reported that the efficiency of spray pollination vigor be increased by adjustment of suspension medium such as the addendum of sucrose solution at 10%. Also, Yano & Matsumoto (2007), the use of liquid grain suspension medium thickened with agar was developed for kiwifruit. Sakamoto *et al.* (2009) found that the significant effect was observed for the addition of sucrose at 3g / to suspension media of the pollen grains was successful for Japanese pear pollination. The mentioned results are in agreement with those obtained by Ashour *et al.* (2004), Attala *et al.* (2007) and Desouky *et al.* (2007) on date palm, they found that the all boron spraying treatments improved yield, retained fruits and physical & chemical characteristics, Soliman *et al.* (2010), Iqbal *et al.* (2010), Soliman & Al-Obeed (2011) and Al-Obeed & Soliman (2011) who found that the application spray pollination and spray liquid sugar increased fruit retained on different cultivars of date palm. The bunch weight and yield of Segae cultivar (Tamar stage) there are not significantly affected by any of the spray pollination treatments and traditional pollination in both seasons. These results are in contrary with those published by Awad

(2010), found that the total yield per palm were significantly higher in suspension pollination treatments compared to in conventional pollination. The total soluble solids, non-reducing sugar and acidity percentage in the first season Awad (2006) reported that the fruit load had no declared effect on fruit physical and chemical quality. However, reducing sugar percentage, total sugar percentage and moisture content in the first season and total soluble solids, non-reducing sugar, total sugar percentage, total acidity percentage and moisture content percentage were significantly increased in second season.

In conclusion, results of the present study suggest that method of spray pollination at 2 g pollen +3 g sugar / liter reduce the labor and duration pollination as well as provision pollen grains. Furthermore, the method of pollination obtained two aims, the pollination and thinning at the same time. In addition is very important and useful pollination process, positive effect the physical and chemical characteristics of fruits, improve the fruit quality of date palm and could be considered as a recommended treatment in such experiment.

### Acknowledgment

This research was supported by the King Saud University, Deanship of Scientific Research, College of Food and Agricultural Sciences Research Center.

### References

- Al-Khateeb, A.A., O.A. Al-Tahir and A.S. Al-Ghamdi.1993. Thinning stage effects on fruit size, yield and quality of date palm (*Phoenix dactylifera* L.) cv Segae. *Proceedings of the Third International Symposium on the Date Palm*, King Faisal Univ., Al-Hassa, pp. 231- 237.
- AL-Obeed, R.S. and S.S. Soliman. 2011. Effect of delaying pollination on bunch weight and fruit quality of barhy date palm cultivar under riyadh condition. *American-Eurasian J. Agric. & Environ. Sci.*, 10 (1): 65-69, 2011.
- Al-Wasfy. M.M.M. 2014. Yield and fruit quality of Zaghloul date palm nin relation to using new technique of pollination. *Stem. Cell.*, 5(1): 14-17
- Anonymous. 1995. StatSoft, INC: STATISTICA for Windows. StatSoft, Inc.,Tulsa,ok.
- 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.
- Association of Official Agricultural Chemists. 1995. Official methods of Analysis. A.O.A.C. 15<sup>th</sup> Ed. Published by A.O.A.C. Washington, D.C. (U.S.D).
- Attalla, A.M., A.A. Etman, A.M. El-Kobbia and S.M. El-Nawam. 2007. Influence of flower Boron spray and soil application with some Micronutrients in Calcareous Soil on: II-Yield, Quality and Mineral content of Zaghloul dates in Egypt. *The Fourth Symposium on date palm in Saudi Arabia*, Date Palm Research Center, King Faisal University, pp: 73 –Al Hassa, 5-8 May.
- Awad, M.A. 2006. Water spray as a potential thinning agent for date palm flowers (*Phoenix dactylifera* L.) cv. Lulu. *Sci. Hortic.*, 111: 44-48.
- Awad, M.A. 2010. Pollination of date palm (*Phoenix dactylifera* L.) cv. Lulu with pollen grains-water suspension. In: *The Abstract book of Oral Presentations of the 4th International Date Palm Conference*, United Arab Emirates Univ., Abu Dhabi, p. 102.

- Awad, M.A. 2011. Pollination of date palm (*Phoenix dactylifera* L. Lulu) with pollen grains water suspension. *Met., Env. & Arid Land Agric. Sci.*, 22(1): 91-99.
- Desouky, I.M., A. El-Hamady and A. Abdel-Hamid. 2007. Effect of spraying Barhee flowers with Potassium Sulphate and Boric Acid on fruit set, productivity and date properties. *The Fourth Symposium on date palm in Saudi Arabia*, Date Palm Research Center, King Faisal University, pp: 76. Al Hassa, 5-8 May.
- Dowson, V.H.W. 1982. Date Production and Protection with Special Reference to North Africa and the Near East. FAO Tech. Bullet. No. 35, 294 p.
- Hussein, M.A., S.Z. El-Agamy, K.I.A. Amin and S. Galal. 1993. Physiological studies for prolonging harvest date of Samany dates under Assiut Governorate conditions. II. Effect of ethephon and fruit thinning. *Proceeding of the Third International Symposium on the Date Palm*, King Faisal Univ., Al-Hassa, January, pp. 435-444.
- Iqbal. M., M.Q. Khan., M. Munir, S.U. Rehman, H.U. Rehman and M. Niamatullah. 2010. Effect of different pollination techniques on fruit set, pomological characters and yield of Dhakki date (*Phoenix dactylifera* L.) in Dera Ismail Khan, KP. *Sarhad J. Agric.*, 26(4): 515-518.
- Mawlood., E.A. 1980. Physiological studies on fruits development of Samani and Zaghlool date palm cultivars. Ph.D. Fac. Agric. Cairo. Univ.
- Moustafa, A. 1998. Studies on fruit thinning of date palms. *Proceedings of the First International Conference on Date Palms*, United Arab Emirates Univ., Al-Ain, pp. 354-364.
- Sakamoto, D., H. Hayama, A. Ito, Y. Kashimura, T. Moriguchi and Y. Nakamura. 2009. Spray pollination as a labor-saving pollination system in Japanese pear (*Pyrus pyrifolia* (Burm.f.) Nakai): Development of the suspension medium. *Sci. Hortic.* 119: 280-285.
- Shabana, H. and A. Al-Sunbol. 2007. Date palm flowering and fruit setting as affected by low temperatures preceding the flowering season. *Acta Hortic.*, 736: 193-198.
- Soliman, S.S., R.S. Al-Obeed and M.M. Harhash. 2010. Effects of thinning on bunch yield and fruit quality of Segae date palm cultivar. *Proceedings of the 4<sup>th</sup> international conference on date palm in U.A. E.* 15-17 March.
- Soliman, S.S. and R.S. Obeed. 2011. Effect of boron and sugar spray on fruit retention and quality of date palm. *American-Eurasian J. Agric. & Environ. Sci.*, 10(3): 404-409.
- Yano, T., N. Miyata and H. Matsumoto. 2007. The use of liquid pollen extender thickened with polysaccharides for artificial pollination of kiwifruit. *Acta Hortic.*, 753: 415-424.

(Received for publication 8 January 2016)