


Improving Pollination Efficiencies of Certain Arab Date Palm Cultivars Grown under New Valley Conditions

Radwan, E.M.A.^{1*} ; El-Salhy, A.M.²; Yousef, S. Diab³ and Dalia, M.N. Mohamed¹

¹Horticulture Department, Faculty of Agri. New Valley University, El-Kharga, New Valley, Egypt

²Pomology Department, Faculty of Agriculture. Assiut University, Assiut, Egypt

³Date Palm Central Lab. Agric., Res. Center, Giza, Egypt.

* Corresponding author

Radwan, E.M.A.

Received: 06/02/2022

Revised: 10/03/2022

Accepted: 13/03/2022

Published: 12/07/2022

Abstract

Pollination is a critical process in date palm production lines that affects yield and fruit quality. This study aimed to evaluate the effect of sprayed pollen grain powder on yield and fruit quality of Madjool, Segae and Khodry date cultivars. This study was conducted in Dakhla Oasis, New Valley Governorate, Egypt during the 2019 and 2020 seasons. Results showed that the most beneficial treatment in this concern is spraying female spathes with 0.5 to 1 g pollen grains plus 10% sugar/L water which gave economical yield with good fruit quality. Moreover, it is distinguished to increase the pollination efficiency and save time, effort, labour and cost likewise more practical because it plays a promising in pollination technique in the future.

Keywords: Date Palm, pollen grain suspension, pollination, fruit quality.

Introduction

Phoenix dactylifera, commonly known as date or date palm, is a flowering plant species in the palm family, Arecaceae, cultivated for its edible sweet fruit. Although its exact place of origin is uncertain because of its long cultivation, it probably originated from the Fertile Crescent region straddling between Egypt and Mesopotamia (Krueger and Robert, 2018). Date palm is the most common fruit tree grown in semi-arid and arid regions. It plays an important role in protecting catch crop systems and stabilizing the ecosystem (Hasnaoui et al., 2011). The total annual world production of dates is 8.5 million tons, with the countries of the Middle East and North Africa being the largest producers. Egypt is the first top ten date producer (FAO, 2018). Many varieties of dates are available and marketed in different price ranges (Abdul-Hamida et al., 2020). Dates are one of the most important fruits for domestic consumption and export. Egypt is considered one of the top ten date producers. Zaghoul, Samany, Hayany are the most economically important date palm varieties grown in Egypt. Date palm is grown in Egypt both in the Nile valley and in desert areas. The total area and number of females reached 117073 feddan and 14379648 palms. The yield produced reached 1465030 tons Table (1), according to (M.A.L.R. 2019).

The date palm is an important and important fruit crop grown in the New Valley region, where high temperatures and poor soil quality are profound (El-Merghany and Zaen El-Daen, 2013). For this reason, the date palm is considered to be one of the suitable trees that could be cultivated in the reclaimed desert regions. Date palm fruits are one of the main export crops in Egypt, where they are harvested and marketed in three stages of development. The three stages are khalal (Bisr), Routab and Tamar (Kassem, 2012).

Since the date palm is a dioecious plant, pollination is by wind or insects, which in turn

results in inferior fruit. Therefore, in order to achieve commercial production, artificial pollination methods must be used (El-Salhy et al., 2010 and Shaaban et al. 2019). The most important yield of date development is a result of the high proportion of fruit set. Achieving this rate depends on a mix of a few variables; H. the quality of the pollen source, the pollination process, male-female compatibility, and environmental conditions, irrigation, soil and fertilization (El-Salhy et al., 2012 and Iqbal et al., 2012).

Building up a pollination procedure and changing from the traditional method of pollinator to strategy pollinated by pollen grain-water suspension spray prompted improve the fruit set is a perfect degree without thinning process has likewise to improve the fruit quality. The utilization of the technique to pollinate with pollen suspension with water reduces labor effort and costs of thinning process (Samauni-Mona et al., 2016; Shaaban et al., 2019; El-Sharabasy et al., 2020 and El-Salhy et al., 2021).

Mixing pollen grains with various carriers, nutrient minerals and ascorbic acid was beneficial to establish mechanical pollination and achieve an economic yield with good fruit quality. Also, it is responsible for improving pollination efficiency (Ahmed, 2014; Al-Wasfy, 2014; Samouni-Mona et al., 2016; Soliman et al., 2017; Shaaban et al., 2019; Abdel-Halim, 2020 and El -Sharabasy et al., 2020).

Therefore, the present study was conducted to evaluate different methods for pollination effects on fruiting of three Arabian date palm cultivars grown under New Valley conditions.

Materials and Methods

This investigation was carried out in Dakhla Oasis, New Valley Governorate; Egypt (latitude 25° and longitude 29°). The fieldwork of this study was conducted in 2019 and 2020 on three Arabian date palm cultivars selected

for their best fruiting qualities. All tested palm varieties belong to the group of semi-sweet dates and were in the production phase and planted in sandy soil. Five healthy palms for each variety with nearly similar vigour, were selected. Regular agricultural practices were carried out as usual. The leaf/cluster ratio was adjusted at the end of flowering to reach its 8:1 value. Artificial pollination was carried out uniformly in terms of source, date and method. The number of spathes per palm was set at 10 to achieve the following five treatments:

- 1- Hand pollination by inserting 8-10 strands/spathe (traditional hand)
- 2- Spraying pollen grain suspension 2 g pollen/L plus 10% sugar.
- 3- Spraying pollen grain suspension 1 g pollen/L plus 10% sugar.
- 4- Spraying pollen grain suspension 0.5 g pollen/L plus 10% sugar.
- 5- Spraying pollen grain suspension 0.25 g pollen/L plus 10% sugar.

These treatments were applied to the same palm. Pollination has been standardized in terms of source and method to avoid residues of *Metaxenia*. The experimental design was set up as a split randomized complete block with ten replicates, each with a spathe. The cultivars are used as the main plots while the pollination method is used as the secondary plots.

Both hand pollination and pollination treatment sprays were applied on the third day of spatula rupture. Sprays of the pollen suspension are thoroughly applied to the spatula using a small (liter capacity) hand sprayer at a rate of 50 ml/spatula. To prevent pollen contamination, after spraying the pollen grain suspension, each spathe was packed in paper bags, which are removed after four weeks.

Temperature (C) and relative humidity (%) data during the pollination periods and fruit growth of the present study are given in Table (1).

To evaluate the effects of different pollination methods on fruiting, the following parameters were determined.

Yield components and fruit quality:

Percentages of fruit retention were each assessed at harvest time. Five female strands per bundle were randomly selected from each replicate and then the percentages were calculated according to the following equation:
$$\text{Fruit retention (\%)} = \frac{\text{Number of retained fruits on the strand}}{\text{Number of retained fruit} + \text{Number of flowers scars}} \times 100$$

At harvest time, bunches of each palm were picked and weighed, and then the yield/palm (kg) was recorded.

Samples of 50 fruits were taken random from each replicate to determine some physical and chemical properties.

These characteristics included the determination of fruit weight, fruit dimension, flesh percentage and fruit moisture percentage as well as TSS, sugar content, tannins and total acidity as outlined in (A.O.A.C. 1995).

All data obtained were tabulated and analyzed according to (Gomez and Gomez 1984) and Snedecor and Cochran (1990) for proper statistical analysis. Differences between treatment mean were compared using least significant differences at a statistical probability of 5%.

Table (1): Monthly air temperature and relative humidity during the two seasons.

Year	2019			R.humidity	2020			R. humidity
	Temperature (°C)				Temperature (°C)			
Month	Max.	Min.	Mean		Max.	Min.	Mean	
March	26.8	10.6	17.8	29.1	28.4	11.6	19.0	34.3
April	33.6	15.4	23.2	24.2	33.1	15.2	23.0	26.3
May	38.9	21.0	29.3	14.1	37.8	19.6	27.4	21.3
Jun	40.4	24.0	31.8	19.4	39.8	22.4	30.4	19.2
July	40.6	25.0	32.4	20.7	39.2	23.4	31.0	21.1
Aug	40.8	24.7	32.1	21.1	40.2	23.9	31.4	21.9

According to the New Valley weather station.

Results

Yield components

The data presented in Tables (2 and 3) show the effect of spraying pollen grain suspension at various concentrations (0.25 to 2 g/l) with 10% sugar on fruit retention percentage and bunch weight of Madjool, Segae and Khodry Date Palm Varieties During the 2019 and 2020 Seasons. It is worth mentioning that fruit set, fruit retention and grape weight behaved almost similarly in the two seasons examined.

Percent fruit retention and bunch weight were significantly affected by different hand pollination methods during the two seasons studied. There are insignificant differences in fruit retention percentages due to pollination using either a 2 g pollen grain suspension plus 10% sugar compared to traditional hand pollination or using 1 or 0.5 g pollen grain suspension plus 10% sugar. On the other hand, pollination by pollen grain suspension at 1 to 0.25 g/L plus 10% sugar significantly reduced these traits compared to traditional hand pollination. There is a gradual decrease that occurs as the pollen grain in the spray suspension decreases.

In this regard, it seems that the reduction in fruit retention and bunch weight could be explained by the reduction in pollen grain concentration in the suspension. These results emphasized that there is a positive correlation between pollen grain count and initial fruit retention percentage. Furthermore, no significant differences in grape weights were found since the pollen grain suspension was sprayed at 2 or 0.5 g plus 10% sugar/L. compared to hand pollination (control). Whereas bundle weight decreased significantly in response to pollen grain suspension (0.25 g/L) plus 10% sugar compared to conventional hand pollination (control).

The fruit retention percentage obtained was (68.33, 66.02, 58.91, 58.12 & 53.28) and (67.04, 65.22, 59.57, 58.94 & 53.06%) due to traditional Pollination (T1), pollination by spraying a pollen grain suspension at 2 g pollen + 10% sugar (T2), 1 g pollen + 10% sugar (T3), 0.50 g pollen + 10% sugar (T4) or 0.25 g pollen + 10% sugar (T5). The corresponding bundle weights recorded were (7.800, 7.821, 7.477, 7.453 & 7.322) and (8.652, 8.42, 8.32, 8.248 & 7.811 k/palm), respectively.

Table 2: Effect of certain pollination methods on fruit retention of some date palm cultivars during 2019 and 2020 seasons.

Cultivars(A)	2019				2020			
	Madjool	Segae	Khodry	Mean	Madjool	Segae	Khodry	Mean
Treat (B)								
1	75.60	58.40	71.01	68.33	73.77	56.65	70.71	67.04
2	72.55	58.51	67.00	66.02	70.37	57.16	68.14	65.22
3	64.64	52.80	59.30	58.91	63.87	54.30	60.55	59.57
4	65.45	53.98	54.95	58.12	64.87	55.18	56.97	68.94
5	57.30	50.80	51.74	53.28	56.60	50.11	52.48	53.06
Mean	55.51	54.9	60.8		65.85	54.68	61.77	
LSD 5%	A= 2.48	B= 2.21	AB= 3.83		A= 3.10	B= 2.88	AB= 3.95	

Table 3: Effect of certain pollination methods on bunch weight of some date palm cultivars during 2019 and 2020 seasons.

Cultivars (A)	2019				2020			
	Madjool	Segae	Khodry	Mean	Madjool	Segae	Khodry	Mean
Treat (B)								
1	6.483	7.830	9.080	7.800	7.350	8.665	9.940	8.652
2	6.465	7.900	9.100	7.821	6.810	8.760	9.682	8.420
3	6.343	7.430	8.658	7.477	6.530	9.100	9.330	8.320
4	6.550	7.620	8.188	7.453	6.730	9.170	8.843	8.248
5	5.935	7.420	8.110	7.322	5.943	9.061	8.430	7.811
Mean	6.35	7.74	8.62		6.67	8.95	9.25	
LSD 5%	A= 0.42	B= 0.38	AB= 0.65		A= 0.32	B= 0.41	AB= 0.71	

Therefore, the percentage decrease in bundle weight due to pollination by pollen grain suspension versus traditional hand pollination was (0.0, 4.14, 4.45 & 6.13) and (2.68, 3.83, 4.67 & 9.72%) due to the use of T2, T3, T4 and T5 during the two seasons studied.

It could be concluded that there is a reduction in grape weight by reducing pollen grain suspension concentration, where a reduction in fruit retention was associated with a reduction in pollen grain suspension. Regardless of the pollination methods, the data presented in the previous tables showed that the cultivars studied varied significantly in terms of their fruit set, fruit retention and bunch

weight. The fruit retention percentage was (55.51, 54.90 & 60.80) and (65.85, 54.68 & 61.77%), respectively, for Madjool, Segae and Khodry date varieties during two seasons studied. The corresponding bundle weights were (6.35, 7.74 & 8.62) and (6.67, 8.95 & 9.25 kg/palm). Hence the bundle weight could be arranged in descending order as follows, Khodry, Segae and Madjool, respectively.

The interaction between the two factors examined, Tables (2, 3 & 4), showed that all combinations of Madjool cultivars gave the highest fruit retention compared to either Segae or Khodry cultivars. In contrast, all combinations of Khodry cultivars recorded the heaviest bunch weight compared to other

cultivars studied. The heaviest bunch weight was found on the Khodry date palm, pollination by hand traditional pollination or spraying with 2g pollen suspension plus 10% sugar.

Fruit quality

1- Physical fruit properties

The data presented in Tables (4, 5 and 6) show the effect of spraying pollen grain suspension at various concentrations with 10% sugar on fruit physical characteristics of Madjool, Segae and Khodry date cultivars during the 2019 and 2020 seasons. It is evident that the results took a similar trend during the two seasons examined. It has been clearly established that there is a positive relationship between both improving the physical characteristics of the fruit in terms of increasing fruit weight and flesh percentage and reducing fruit moisture content on the one hand and pollination using a diluted pollen grain suspension on the other side compared with traditional hand pollination (control). The improvement in these properties was associated with a reduction in the concentration of the pollen grain suspension used from 2 g/l to 0.25 g/l plus 10% sugars.

In addition, an increase in fruit weight was recorded by reducing the applied pollen grain suspension concentration. This increase was significantly increased when using pollen grain suspension at a concentration of 1, 0.5 or 0.25 g/l compared to the control. The heaviest fruit was detected on palms pollinated with a pollen grain suspension concentration of 0.25 g/l plus 10% sugar. The fruit weights recorded were (15.26, 16.75, 18.48, 18.83 & 19.32) and (15.24, 16.59, 18.40, 18.59 & 19.10 g), respectively from T1 to T5 during the two seasons studied. Therefore, the percent increase in fruit weight due to the use of pollen grain

suspension over the control was achieved (9.76, 21.10, 23.39 & 26.61) and (8.86, 20.47, 21.39 & 25.33 %) due to T2 to T5 compared to T1 during the two seasons studied, respectively. Also, the fruit moisture content recorded was (28.83, 27.27, 26.81, 26.64 & 26.59) and (28.26, 26.51, 26.49, 26.47 & 26.46%, respectively) due to T1 to T5 during the two seasons studied.

Therefore, the percentages of decreases in fruit moisture due to the use of pollen grain suspension versus the control were achieved (5.41, 7.01, 7.59 & 7.77) and (6.19, 6.26, 6.33 & 6.37%, respectively) based on T2 to T5 compared to T1 (control) during the two seasons studied. Due to the concentration of the pollen grain suspension of 1, 0.5 or 0.25 g pollen grains/l, no significant differences in fruit weight and fruit moisture content were observed.

Regardless of pollination methods, the data presented in the previous tables showed that the varieties studied differed in terms of their physical fruit characteristics, i.e., Fruit weight, flesh percentage and fruit moisture content, differed significantly. Fruit weights were (20.59, 16.00 & 16.61) and (19.38, 16.38 & 17.00 g) for Madjool, Segae and Khodry date varieties, respectively, during two seasons studied. The corresponding flesh percentage was (94.15, 91.83 & 93.14) and (94.01, 91.78 & 93.25%) and the fruit moisture content was (23.51, 25.95 & 32.06) and (22.34, 25.92 & 31.26%), respectively.

The interaction between the two factors examined, Tables (4, 5 & 6), showed that all combinations of the Madjool cultivar. gave the highest fruit weight and flesh percentage compared to Segae or Khodry cultivars. In contrast, all combinations of Khodry cultivars

recorded the highest fruit moisture content compared to other cultivars studied. The heaviest fruit weight (21.97 & 20.76 g) was recorded on Madjool dates sprayed with 0.25 g pollen suspension plus 10% sugar during each

of the two seasons studied. Also, the highest fruit moisture content (33.41 & 32.78%) was recorded on Khodry dates pollinated by traditional hand pollination during each of the two seasons studied.

Table 4: Effect of certain pollination methods on fruit weight of some date palm cultivars during 2019 and 2020 seasons.

Cultivars (A) Treat (B)	2019				2020			
	Madjool	Segae	Khodry	Mean	Madjool	Segae	Khodry	Mean
1	17.55	14.14	14.10	15.26	17.28	13.87	14.58	15.24
2	19.40	15.20	15.65	16.75	18.56	15.26	15.95	16.59
3	21.82	16.30	17.32	18.48	20.14	17.15	17.90	18.40
4	22.20	16.60	17.68	18.83	20.16	17.35	18.25	18.59
5	21.97	17.70	18.28	19.32	20.76	18.25	18.26	19.10
Mean	20.59	16.00	16.61		19.38	16.38	17.00	
LSD 5%	A= 0.82	B= 0.89	AB= 1.54		A=0.73	B= 0.76	AB= 1.31	

Table 5: Effect of certain pollination methods on flesh percentage of some date palm cultivars during 2019 and 2020 seasons.

Cultivars (A) Treat (B)	2019				2020			
	Madjool	Segae	Khodry	Mean	Madjool	Segae	Khodry	Mean
1	92.65	90.95	91.86	91.82	92.51	90.68	92.51	91.9
2	93.80	91.52	92.83	92.72	93.61	91.30	93.36	92.76
3	94.35	91.75	93.25	93.12	94.10	92.00	93.50	93.18
4	94.85	92.21	93.91	93.66	94.97	92.34	93.19	93.47
5	95.10	92.72	93.86	93.87	94.90	92.70	93.63	93.74
Mean	94.15	91.83	93.14		94.01	91.78	93.25	
LSD 5%	A= 1.82	B= 1.78	AB= 3.08		A= 1.68	B= 1.83	AB= 3.18	

Table 6: Effect of certain pollination methods on fruit moisture of some date palm cultivars during 2019 and 2020 seasons.

Cultivars (A) Treat (B)	2019				2020			
	Madjool	Segae	Khodry	Mean	Madjool	Segae	Khodry	Mean
1	25.13	27.95	33.41	28.03	23.26	28.75	32.78	28.26
2	23.32	26.17	32.33	27.27	22.19	26.25	31.10	26.51
3	23.18	25.41	31.85	26.81	22.13	26.37	30.95	26.49
4	22.98	25.22	31.71	26.64	21.98	26.51	30.93	26.47
5	23.22	25.28	31.28	26.59	22.15	26.71	30.51	26.46
Mean	23.51	25.95	32.06		22.34	25.92	31.26	
LSD 5%	A= 0.71	B= 0.65	AB= 1.12		A= 0.50	B= 0.61	AB= 1.06	

2- Fruit chemical constituents:

It is evident from data in tables (7, 8 & 9) that the pollination by dilution pollen grain suspension concentrations at 2 to 0.25 g/L significantly improved the fruit chemical constituents in terms of increasing the total soluble solids and reducing, tannins content compared to pollination by traditional hand pollination. The improvement of these fruit traits was associated with the reduction of pollen grain suspension concentrations from 2 to 0.25 g/L plus 10% sugar. Using dilution pollen grain suspension under 2 g/L significantly increased total soluble solids and total sugars compared to traditional hand pollination.

The recorded total soluble solids were (64.63, 67.25, 68.49, 68.62 & 69.09) and (65.02, 67.99, 68.03, 68.40 & 68.55%) due to T₁ to T₅ during the two studied seasons, respectively. Hence the increment percentage of total soluble solids attained (4.05, 5.97, 6.17 & 6.90) and (4.56, 4.62, 5.20 & 3.83%) due to T₂ to T₅ compared to T₁ during the two studied seasons, respectively.

On the other hand, data in table (9) showed that using dilution pollen grain suspension at 2, 1 or 0.25 g/L significantly reduced the tannins contents compared to using traditional hand pollination.

The improvement in these fruit traits was associated with the reduction in pollen grain suspension concentration from 2 to 0.25 g/L. Using a pollen grain suspension containing 0.25 g plus 10% sugars gave the highest values for total soluble solids and total sugars and the lowest values for tannin content, while using traditional hand pollination gave the minimum values for total soluble solids and total sugars and the highest Tannin values revealed content. Regardless of pollination methods, the data presented in the previous tables showed that the varieties studied differed significantly in terms of their fruit chemical components. The TSS obtained were (70.03, 66.52 & 66.03) and (71.3, 65.3 & 66.2%) respectively for Madjool, Segae and Khodry date varieties during two seasons studied. The corresponding total sugars were (67.49, 63.44 & 62.48) and (68.10, 62.19 & 63.11%), respectively.

Table 7: Effect of certain pollination methods on TSS% of some date palm cultivars during 2019 and 2020 seasons.

Cultivars (A) Treat (B)	2019				2020			
	Madjool	Segae	Khodry	Mean	Madjool	Segae	Khodry	Mean
1	67.37	62.37	64.16	64.63	70.64	61.11	63.30	65.02
2	70.55	65.81	65.38	67.25	72.11	66.74	65.10	67.99
3	70.80	67.95	66.71	68.49	71.00	66.55	66.55	68.03
4	70.80	68.11	66.95	68.62	72.11	65.74	67.37	68.4
5	70.62	68.35	68.31	69.09	70.62	66.37	68.66	68.55
Mean	70.03	66.52	66.03		71.3	65.3	66.2	
LSD 5%	A= 1.85	B= 1.43	AB= 2.47		A= 1.68	B= 1.31	AB= 2.27	

Table 8: Effect of certain pollination methods on total sugar of some date palm cultivars during 2019 and 2020 seasons.

Cultivars (A)	2019				2020			
	Madjool	Segae	Khodry	Mean	Madjool	Segae	Khodry	Mean
Treat (B)								
1	65.18	59.63	60.38	61.73	67.45	59.12	61.41	62.66
2	68.76	62.75	61.76	64.42	68.73	63.55	62.35	64.88
3	67.63	64.83	62.80	65.08	68.22	62.48	62.36	64.35
4	67.98	64.81	63.16	65.31	67.87	62.63	64.25	64.92
5	67.88	65.19	64.28	65.78	68.23	63.15	65.18	65.52
Mean	67.49	63.44	62.48		68.1	62.19	63.11	
LSD 5%	A= 1.83	B= 1.54	AB= 2.66		A= 1.32	B= 1.28	AB= 2.21	

Table 9: Effect of certain pollination methods on tannins of some date palm cultivars during 2019 and 2020 seasons.

Cultivars (A)	2019				2020			
	Madjool	Segae	Khodry	Mean	Madjool	Segae	Khodry	Mean
Treat (B)								
1	0.176	0.218	0.168	0.187	0.154	0.198	0.173	0.175
2	0.165	0.202	0.161	0.176	0.143	0.182	0.164	0.163
3	0.160	0.198	0.158	0.172	0.139	0.176	0.163	0.159
4	0.160	0.194	0.160	0.171	0.139	0.182	0.164	0.162
5	0.166	0.199	0.158	0.174	0.135	0.173	0.162	0.157
0.157	0.166	0.202	0.161		0.142	0.182	0.165	
LSD 5%	A= 0.005	B= 0.006	AB= 0.010		A= 0.004	B= 0.005	AB= 0.009	

The interaction between the two factors examined, Table (7, 8 & 9) showed that all combinations of Madjool cultivars gave the highest TSS and sugar levels compared to Segae and Khodry cultivars. In contrast, all combinations of Segae dates recorded the highest tannin content compared to other varieties studied. The highest TSS (70.80 & 72.11%) was measured in the Madjool date palm pollinated by spraying with 0.5g of pollen suspension plus 10% sugar.

Discussion

Pollination is considered the most important difficult and expensive practice to ensure a good yield in date palms. The limited

amounts of pollen grains are the basis to justify the use of mechanical pollination by sprayers and pollinators. The beneficial effect of using pollen with carriers on yield and fruit quality has been attributed primarily to its significant role in increasing the efficiency of pollination and fertilization. Mechanical pollination requires mixing the pollen grains with a bulky material to minimize the amount of pollen grains needed. This bulky material must be available, cheap and of a specific gravity close to that of the pollen grains in order to obtain a homogeneous mixture (Abdalla et al., 2011; Awad, 2011 and El-Salhy et al., 2021).

There was an improvement in the quality of the dates as fruit weight, fruit size and

sugar content increased, and fruit moisture and tannin content decreased due to a reduction in the concentration of pollen grain suspension used. These findings could be due to the reduction in fruit set percentage since using the diluted pollen grain suspension. Such a reduction in fruit set was effectively reduced, the competition that occurred between fruits resulted in sufficient carbohydrates and other essential nutrients for the remaining ones, and consequently increased fruit weight and improved fruit ripeness and improved their soluble solids and sugar content. Such effects were similar to fruit thinning effects in improving fruit physical attributes. So, it could be easy to identify the initial fruit set that gave the reasonable yield with good fruit quality, using either different pollination methods or fruit thinning. So, it could be said that using pollen grain suspensions to dilute the fruit has similar effects on improving fruit quality. In addition, increasing fruit weight and its sugar content, and decreasing fruit tannin and moisture content are very necessary for improving the quality of such a variety and resulted in an increase in packable yield.

These results will complement the results of (Abdalla et al., 2011 and El-Salhy et al., 2012) who recommended the use of pollen grain suspension to achieve an economical yield with good fruit quality and to improve the efficiency of the pollination process. In relation to the above results, the use of Madjool, Segae and Khodry date varieties for pollination can be recommended. Pollen grain suspension concentrations (0.5 to 1.0 g plus 10% sugar) were sufficient to produce a high yield with good achieve fruit quality. These results are important from an economic and horticultural point of view. While the amount of pollen

grains used in traditional hand pollination (8 to 10 strands/spade) is around 1g. This quantity is sufficient to dust 20 spatulas with a spray pollen grain suspension in an amount of 50 ml/spatula. Therefore, using traditional hand pollination is equivalent to 20 times using it as a spray suspension. Therefore, using the spray method reduces the amount of pollen to 0.05 over the amount used with the traditional method. Pollination as a pollen grain suspension leads to an increase in pollination efficiency, less consumption of pollen grains, and a reduction in human effort and pollination costs. Also, improve fruit quality and increase product yield. These results were supported by the results (El-Salhy et al., 2010; Samouni-Mona et al., 2016; and El-Salhy et al., 2021) that pre-tried the use of the combining pollen grains suspension as a Spray for pollination of date palms. Such a method of pollination increased yield and improved the physical and chemical properties of the fruit.

Conclusion

Based on the results obtained so far, it could be concluded that the use of a pollen grain suspension with 1 to 0.5 g/L plus 10% sugar leads to a considerable yield with good fruit quality and an increase in pollination efficiency.

Conflict of interest statement

This manuscript has no conflicts of interest.

Data availability statement:

All data sets collected and analyzed during the current study are available from the corresponding author on reasonable request.

References

- Abdalla, M., El-Salhy, A., & Mostafa, R. (2011). Effect of some pollination treatments on fruiting of Zaghoul date palm cultivar under Assiut climatic condition. *Assiut J. of Agric. Sci*, 42, 350-362.
- Abd Elhalim, S. A. E. M. (2020). Physiological studies on flowering, setting, productivity and fruit quality of barhee date palm (Doctoral Dissertation, Benha University).
- Abdul-Hamid, N. A., Mustaffer, N. H., Maulidiani, M., Mediani, A., (2018). Quality evaluation of the physical properties, phytochemicals, biological activities and proximate analysis of nine Saudi date palm fruit varieties. *Journal of the Saudi Society of Agricultural Sciences* Available online 27 August 2018.
- Ahmed, E. (2014). Increasing pollination efficiency in Saily date palms using starch carrier along with pollens suspension. *Proceeding of the 5th International Date Palm Conference*, Abu Dhabi, UAE, March.
- Al-Wasfy, M. (2014). Yield and fruit quality of Zaghoul date palm in relation to using new technique of pollination. *Stem Cell*, 5(1), 14-17.
- A.O.A.C. (1995). *Association of Official Agricultural Chemists. Official Methods of Analysis*. 4th ed. pp. 495-510. Benjamin Franklin Station, Washington. D.C., U.S.A.
- Awad, M. A. (2011). Pollination of Date Palm (*Phoenix dactylifera* L.) cv.'Lulu'with Pollen Grains-Water Suspension. *Meteorology, Environment and Arid Land Agriculture*, 22(1), 91-101.
- El-Salhy, A., El-Bana, A., Abdel-Galil, H., & Ahmed, E. (2010). Effect of Pollen Grains Suspensions Spraying on Yield and Fruit Quality of'Saily'Date Palm. *IV International Date Palm Conference* 882,
- El-Salhy, A., Masoud, A., El-Kassas, D. S., Gadalla, E. G., & Hassan, H. K. (2021). Effect of pollination methods on yield and fruit quality of Barhy date palm under Aswan conditions. *Assiut Journal of Agricultural Sciences*, 52(2), 60-69.
- El-Salhy, A., Mostafa, R., El-Banna, A., & Diab, Y. (2012). Effect of pollination methods and pollen grains dilution on bunch weight and fruit quality of sewy Date palm cultivar. *Assiut University Journal of Agriculture Sciences*, Assiut Univ.
- El-Sharabasy, S., Saber, T., & Ghazzawy, H. (2020). Response of barhee date palm cultivar to different pollination methods. *Plant Archives Volume 20* No. 2, 4001-4006.
- El-Merghany, S., & Zaen El-Daen, E. (2013). Evaluation of some date palm cultivars grown under toshky conditions. *Journal of Plant Production*, 4(8), 1207-1218.
- FAO (2018) *Food and Agriculture Organization of the United Nations. Production Year Book*, Rome
- Gomez, K. A., & Gomez, A. A. (1984). *Statistical procedures for agricultural research*. John Wiley & Sons.
- Hasnaoui, A., Elhoumaizi, A., Hakkou, A., Wathélet, B., & Sindic, M. (2011). Physico-chemical characterization, classification and quality evaluation of date palm fruits of some Moroccan cultivars. *Journal of Scientific Research*, 3(1), 139-149.
- Iqbal, M., Niamatullah, M., & Munir, M. (2012). Effect of various Dactylifera males pollinizer on pomological traits and economical yield index of CV's Shakri, Zahidi and Dhakki date palm (*Phoenix dactylifera* L.). *The Journal of Animal & Plant Sciences*, 22(2), 376-383.
- Kassem, H. (2012). The response of date palm to calcareous soil fertilisation. *Journal of soil science and plant nutrition*, 12(1), 45-58.
- Krueger, R. R. (2018). *Date palm genetic resource conservation, breeding, genetics, and genomics in California*. The Conference Exchange Retrieved,
- M.A.L.R. (2019). *Ministry of Agriculture and Land Reclamation Publishes. Economic Affairs Sector*.

- Samouni, M. T., El-Salhy, A., Badawy, I. F., & Ahmed, E. (2016). Effect of pollination and thinning methods on yield and fruit quality of Saidy Date palms. *Assiut J. Agric. Sci*, 47, 92-103.
- Shaaban, M. M., Ahmed, E., & El-Akkad, M. (2019). Studies on the improvement of date palm productivity using different methods of pollination and fruit thinning levels. *Journal of Plant Production*, 10(4), 373-377.
- Snedecor, G., & Cochran, W. (1990). *Statistical Methods*. 6th Ed Iowa State Univ Press. Ames, Iowa, 507.
- Soliman, S., Alebidi, A., Al-Saif, A., Al-Obeed, R., & Al-Bahelly, A. (2017). Impact of pollination by pollen-grain-water suspension spray on yield and fruit quality of segae date palm cultivar (*Phoenix dactylifera* L.). *Pak. J. Bot*, 49(1), 119-123.

تحسين كفاءة تلقيح بعض أصناف نخيل البلح العربية تحت ظروف الوادي الجديد

عصام محمد عبد الظاهر رضوان¹، عبد الفتاح مصطفى الصالحي²، يوسف مصطفى دياب³، داليا معوض نافع¹

¹قسم البساتين- كلية الزراعة – جامعة الوادي الجديد

²قسم الفاكهة - كلية الزراعة – جامعة أسيوط

³مركز البحوث الزراعية - المعمل المركزي للأبحاث وتطوير نخيل البلح

تعتبر عملية التلقيح من العمليات البستانية الضرورية ذات التأثير المباشر على نمو الثمار وجودتها وكذلك إنتاجية نخيل البلح. وبعد تطوير عمليات التلقيح التي من شأنها الحصول على نسبة عقد مرتفعة مع جودة عالية للثمار دون الحاجة لاستخدام كميات كبيرة من حبوب اللقاح أمراً ضرورياً وفعالاً لتحسين إنتاجية نخيل البلح. ولذا أجريت هذه الدراسة خلال موسمي 2019 و2020 على بعض أصناف نخيل البلح العربية (المجدول والصقعي والخضري) بمزرعة خاصة بواحة الداخلة – الوادي الجديد – مصر حيث تضمنت الدراسة التلقيح رشاً بمعلق مائي يحتوى على 0.25، 0.5، 1.0، 2.0 جم حبوب اللقاح بالإضافة إلى 10% محلول سكري مقارنة بالتلقيح اليدوي العادي (8-10 شمراخ/سوباطة).

وقد أظهرت النتائج أن التلقيح بمعلق من 0.5 – 1 جم حبوب لقاح بالإضافة إلى 10% سكروز أدت إلى نقص نسبة العقد والعقد النهائى مع زيادة وزن الثمار وتحسين جودتها مقارنة بالتلقيح اليدوي العادي. وعليه تعتبر هذه الطريقة جيدة لإنتاج محصول عال ذو خصائص ثمرية جيدة فضلاً عن تقليل كمية حبوب اللقاح المستخدمة كما أنها عملية تجمع بين التلقيح والخف حيث يؤدي إلى إنتاج محصول عال ذو خصائص ثمرية جيدة فضلاً عن تقليل تكلفة الإنتاج وتحسين كفاءة التلقيح.

الكلمات الدالة: نخيل التمر، معلق حبوب اللقاح، التلقيح، جودة الثمار