Increasing pollination efficiency in saidy date palms by using starch carrier along with pollens suspension

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ABSTRACT

During 2011 and 2012 seasons, Saidy date palms product from offshoot were pollinated with pollens (water suspension pollens) at four levels namely 5.0, 2.5, 1.25 and 0.625 g/ I water with or without starch carrier at the same previous levels. The goal was enhancing pollination efficiency which reflected on promoting fruit setting %, yield and fruit quality of such date palm cv.

It is worth to mention that pollination with water containing pollen grains (0.625 to 5 g/ L water) and starch carrier (at 0.625 to 5.0 g/ I water) was preferable than using water suspension pollens alone in enhancing fruit setting %, yield and fruit quality.

The promotion was associated with increasing pollen levels in water without using starch carrier. This effect was changed with using pollens with starch carrier, since using water suspensions containing 1.25 g pollens/ I water besides 5.0 g starch carrier gave the best results in this respect.

For promoting production of Saidy date palms, it is necessary for carrying out pollination using water suspension containing 1.25 g pollens + 5.0 g starch/ I water.

Key words: Pollens, pollination, efficiency, starch, yield and Saidy date palms.

INTRODUCTION

Research on mechanical pollination started in 1950 . since then several systems for rapidly applying pollen were investigated to overcome these problems, including helicopters, fixed-wing aircraft, ground-level duster and pollen grain suspension sprays .

Hand pollination is the most expensive operation due to climbing several times according to the pattern of flowering for the palms (Al- Baker, 1972; Hussien *et al.,* 1979 and Hussein, 1983). The mechanical pollination requires mixing the pollen grains with a bulky material to minimize the amount needed of pollen grains. This bulky material must be available, cheap, dry and with specific gravity close to that of the pollen grains in order to obtain homogeneous mixture. They could be wheat flour, wheat bran, and crushed dry male flowers after the pollen grains extraction (Mostafa, 1994; Ahmed *et al.,* 1995; El-Makhtoun and Abdel-Aal, 1995: and Shabana *et al.,* 1998).

Mixing pollen grains with various carriers and nutrient minerals were beneficial in establishing mechanical pollination and obtaining an economical yield with good fruit quality. Also, it is responsible for enhancing pollination efficiency (Furr and Hewitt, 1964; Khalil and Al-Shawaan, 1982; El-Kassas & Mahmoud, 1986; El-Mardi *et al.,* 1995; Hussein and Hassan, 2001; Ragab *et al.,* 2004; Ashour *et al.,* 2004 and El-Salhy *et al.,* 2007).

Mechanization of date production is becoming more and important due to the rising cost of production and shortage of man power, in particular it is difficult to find skilled labor to work during the peak pollination season

Moreover, using of pollen grains mixed with pure water was successful in pollination of saidy date palm cultivar and it was recommended to use 2.5-5g/liter of water in pollination of it (El-Salhy, et al 2010).

This study aimed to innovating an untraditional method in date palm pollination which combined both mechanical pollination and fruit thinning effect in addition to get high yield with good quality.

MATERIALS AND METHODS

This study was conducted in date palm Research Farm in Agricultural Research Station, at El-Kharga Oasis, New Valley Governorate, Egypt, during two successive growing seasons 2011and 2012, on 40 years old saidy date palm cultivar (as semi dry date palm cv.)

Twelve date palms that are uniform in vigour and in good physical condition, free of insect damage and diseases were selected. The number of spathes per palm were adjusted to twelve by removing excess earliest, latest and smallest clusters for achieving of the following four treatments:

1. Spraying pollen grains suspension (5 g pollens/L)
2. Spraying pollen grains suspension (5 g pollens/L + 5 g starch/L water).
3. Spraying pollen grains suspension (5 g pollens/L + 2.5g starch/L water).
4. Spraying pollen grains suspension (5 g pollens/L + 1.25 g starch/L water).
5. Spraying pollen grains suspension (5 g pollens/L + 0.625 g starch/L water).
6. Spraying pollen grains suspension (2.5 g pollens/L + 5 g starch/L water).
7. Spraying pollen grains suspension (2.5 g pollens/L + 2.5 g starch/L water).
8. Spraying pollen grains suspension (2.5 g pollens/L + 1.25 g starch/L water).
9. Spraying pollen grains suspension (2.5 g pollens/L + 0.625 g starch/L water).
10. Spraying pollen grains suspension (1.25 g pollens/L + 5 g starch/L water).
11. Spraying pollen grains suspension (1.25 g pollens/L + 2.5 g starch/L water).
12. Spraying pollen grains suspension (1.25 g pollens/L + 1.25 g starch/L water).
13. Spraying pollen grains suspension (1.25 g pollens/L + 0.625 g starch/L water).
14. Spraying pollen grains suspension (0.625 g pollens/L + 5 g starch/L water).
15. Spraying pollen grains suspension (0.625 g pollens/L + 2.5 g starch/L water).
16. Spraying pollen grains suspension (0.625 g pollens/L + 1.25 g starch/L water).
17. Spraying pollen grains suspension (0.625 g pollens/L +0.625 4 g starch/L water).

These treatments were applied on the same palm. Pollination was uniformed in respect of source and method to avoid residues of metaxenia. The experiment was set up in a complete randomized block design with eight replications of one bunch each.

Treatment sprays were applied at the third day of spathe cracking. Sprays of pollen suspension are thoroughly applied to the bunch by small hand sprayer (1/2 liter capacity) at the amount of 50 ml/bunch. To prevent contamination of pollens, after the spraying of pollen suspension, every bunch was bagged by paper bags which is removed after four weeks.

Measurements:

Fruit set %:

Fruit set percentage was evaluated after one month of pollination. Five female strands per bunch were randomly selected from each replication. The number of fruit set was recorded, then fruit set percentage was calculated as the following equation:

$$\text{Fruit set } \% = \frac{\text{Number of fruits setting on the strand}}{\text{Total number of flowers per the strand}} \times 100$$

Yield and fruit quality:

Bunches were harvested at tamr stage (last week of September), fruit weight/bunch (kg) was recorded. Twenty five fruits from each bunch were picked at random for determination of the following physical and chemical fruit characters:

1. Fruit and seed weight (in g), then pulp percentage was calculated
2. Fruit length (L) and diameter (D) were measured by vernier caliper (in cm).
3. Percentages of total soluble solids by hand refractometer.
4. Percentage of total, reducing and non-reducing sugars by using volumetric method that outlined in A.O.A.C. (1985) by Lane and Eynon.

All the obtained data were tabulated and subjected to the proper statistical analysis of variance using L.S.D. test for recognizing the significance differences among the various treatment means according to the method outlined by (Snedecor and Cochran 1980 and Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Yield index:

Fruits weight/bunch is an indicator for the yield of palm trees since the number of bunches on the palm was constant.

Data illustrated in table (1) showed the effect of pollination with pollens (water suspension pollens) four levels namely 5.0, 2.5, 1.25 and 0.625 g/ I water with or without starch carrier at the same previous levels on fruit set percentage and fruit weight/bunch of saidy date palm during 2011, and 2012 seasons.

Data showed that there are significant differences in fruit set percentage and fruit weight/bunch due to pollination by using pollen grains suspension (5 g/L) alone (T0) compared with using pollen grains suspension (5 g/L) with starch carrier (5 g) (T1). The fruit set percentage values were (60.45 and 70.39%) whereas, the fruit weight/bunch were (9.98 and 10.73kg) as an av. of two studied seasons

However, there was a reduction on the fruit set percentage and fruit weight/bunch with reducing of the pollen grains suspension concentration, and starch concentration in suspension so, there was a significant decrease in fruit set percentage and bunch weight due to pollination with 0.62 g/L plus 0.62 g starch/L water (T16). compared with 5g/L plus 5 g starch/L water (T1).

These findings could be attributed to the reduction of fruit set as the pollen grains suspension concentration is reduced. in turn This leads to reduce the fruit retention, hence the fruits weight/bunch was reduce. The above mentioned results are in agreement with those obtained by (Hussein et al 1979; Shabana et al1998; Ragab et al 2004and El-Salhy, et al 2010).

It can be concluded from these results that using spraying, it had proved importance from economic point of view . The use of spray treatments reduce the amount of pollen to 0.01 from the amount used by dusting and this dose had insignificant effect on fruit retention or yield .On other hand, The pollination with pollen dust need to centuple of pollen grain amount that pollination as pollen grain suspension spraying. Therefore, pollen grain suspension lead to increase the pollination efficiency, decrease consumption of pollen grains and reduce the pollination costs

Fruit quality:

A-Physical characteristics:

Data in Table (2) clearly showed that there was significant differences in Fruit weight (g) Fruit length (cm) and Fruit diameter (cm) due to pollination by using pollen grains suspension (5 g/L) alone (T0) compared with using pollen grains suspension (5 g/L) with (5 g) starch carrier (T1). The Fruit weight (g) values were (9.84 and 10.52 g) whereas, Fruit length (cm) were (3.63 and 3.69 cm) and Fruit diameter (cm) (2.23 and 2.26) as an av. of two studied seasons These results could be due to the reduction on the fruit set percentage

However, there was an increasing on the fruit physical characteristics with reducing of the pollen grains suspension concentration, and starch concentration in suspension

So, there was a significant increase in fruit physical characteristics due to pollination with 5g/L plus 5 g starch/L water (T1),compared with 0.625 g/L plus 0.625 g starch/L water (T16).

The best results dealt with fruit physical properties is observed on palms pollinated with pollen grains suspension concentration at 0.625 g/L plus plus 0.625 g starch/L water (T16).

The obtained fruit weight were (9.84, 10.13, 10.33, 10.36, 10.14, 10.37, 10.61, 10.80, 10.57, 10.71, 10.89, 11.06, 11.52, 11.23, 11.42, and 11.45 g as an average of two studied seasons) due to T1 to T16, respectively.

Such improvement of fruit physical properties i.e. increasing the fruit weight and size might be occurred in response to using diluted pollen grains suspension plus starch concentration for pollination. So, it could be stated that “there is a positive correlation between fruit weight and fruit set percentage”.

These results could be due to the reduction on the fruit set percentage when using the diluted pollen grains suspension. Such reduction in fruit set percentage cause a shortage in the number of fruits per bunch without changing the number of leaves that may induce the better supply of carbohydrates that are manufactured in the leaves. Such effects were similar to the fruit thinning effects in improving the physical fruit properties. So, it could be easily to identify the fruit set percentage which gave the considerable yield characterized by high fruit quality using either different hand pollination or fruit thinning methods.

B-chemical characteristics

Data in Table (3) indicated that there was an increasing on T.S.S % and Total sugars % with reducing of the pollen grains suspension concentration, and starch concentration in suspension

So, there was a significant increase in T.S.S % and Total sugars due to pollination with 5g/L plus 5 g starch/L water (T1).compared with 0.625 g/L plus 0.625 g starch/L water (T16).

The pollination by diluted pollen grains suspension concentrations at 5 to 0.62 g/L and starch carrier (at

0.625 to 5.0 g/ I water) lead to a significant improvement of the fruit chemical constituents in terms of increasing the total soluble solids and sugar contents and a reduction of the moisture content percentage.

The reduction of the fruit moisture content is very necessary for improving the quality of such cultivar and resulted in an increase in packable yield.

These findings might be due to a reduction in the fruit set percentage by using the diluted pollen grain suspension. Such reduction in fruit setting was effective on lowering the competition that may be occurred between fruits and induce an adequate carbohydrates and other essential foods for the residual ones consequently enhance the fruit maturity and improve its contents of total soluble solids and sugar contents. So, it cold be said that the use of diluted pollen grain suspension has a similar effect like the fruit thinning on improving fruit quality.

These results were supported by the results of (Al-Sabahi et al 2006 and Alabri et al. 2006) who recommended that the use 0.1 g pollen grains/liter of H2O for Helaly Oman date palm. To get an economic yield with good fruit quality. Moreover, El- Salhy et al 2010)and concluded that pollination of Saidy date palm using pollen grain suspension concentration at 2.5 g/L plus 1g ascorbic acid

In regard of the previously mentioned results, it can be recommended that pollination of the saidy date palm using pollen grain suspension concentrations at 1.25 g/L plus 1.25 or 2.5 or 5.0g starch/L water was sufficient to get a high yield with good fruit quality. The advantages of such pollination method is the reduction of Manpower and duration of pollination, both contributing to the reduction of the cost of pollination. Furthermore, it does not require a highly trained labors as with the traditional technique. It ensures the possibility of pollinating a palm at several times in a short period of time. Moreover, allowing the use of mixture of pollens originating from different sources, ensuring good fertilization, and eliminating the risk of accidents occurring as with the old method of climbing a palm several meters high.

CONCLUSION

The objective of this experiment was to examine the effect of some pollination treatments to innovate an untraditional method in date palm pollination which combines both mechanical pollination, fruit thinning and reducing the quantity of pollen grain so we recommend using 1.25 g pollens plus 1.25 to 5.0 g starch/ litre water It can be said that the use of starch in suspense pending action on the stability of pollen and also served as the carrier for the pollen of flowering alnorat glued to fertilization this leads for a harvest good fruits as well as properties provides the amount of pollen and pollination process offering a good treatment of horticultural and economic aspects

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Tables

Table 1: Effect of pollination with pollens (water suspension pollens) with or without starch carrier in fruit set and fruit weight/ bunch (Kg) of Saidy date palm cultivar during 2011 and 2012 seasons.

Treatment		Characteristics.					
		Fruit set%			Fruit weight/ bunch (Kg)		
		2011	2012	Mean	2011	2012	Mean
5 (g / L) pollen	T_0	62.66	58.24	60.45	10.36	9.59	9.98
5 (g / L) pollen + 5g starch	T_1	73.42	67.36	70.39	10.95	10.51	10.73
5 (g / L) pollen + 2.5 g starch	T_2	69.31	63.72	66.52	10.64	10.23	10.44
5 (g / L) pollen + 1.25 g starch	T_3	66.77	60.08	63.43	10.50	9.79	10.15
5 (g / L) pollen + 0.625g starch	T_4	64.53	58.81	61.58	10.31	9.50	9.91
2.5 (g / L) pollen + 5g starch	T_5	69.00	63.40	66.2	10.59	10.21	10.4
2.5 (g / L) pollen + 2.5g starch	T_6	65.43	59.62	62.53	10.38	9.71	10.05
2.5 (g / L) pollen + 1.25g starch	T_7	61.65	55.20	58.43	9.98	9.22	9.60
2.5 (g / L) pollen + 0.625g starch	T_8	57.24	53.30	55.27	9.5	9.00	9.25

Treatment		Characteristics.					
		Fruit set%			Fruit weight/ bunch (Kg)		
		2011	2012	Mean	2011	2012	Mean
1.25 (g / L) pollen + 5g starch	T_9	62.17	56.55	59.36	10.04	9.39	9.72
1.25 (g / L) pollen + 2.5g starch	T_{10}	59.44	53.21	56.33	9.62	9.09	9.36
1.25 (g / L) pollen + 1.25g starch	T_{11}	55.52	51.02	53.27	9.32	8.67	9.00
1.25 (g / L) pollen + 0.625g starch	T_{12}	51.00	47.11	49.06	8.7	8.13	8.42
0.625 (g / L) pollen + 5 starch	T_{13}	51.94	48.34	50.14	8.82	8.31	8.57
0.625 (g / L) pollen + 2.5g starch	T_{14}	47.81	43.10	45.46	8.23	7.59	7.91
0.625 (g / L) pollen + 1.25g starch	T_{15}	43.76	39.22	41.49	7.68	7.00	7.34
0.625 (g / L) pollen + 0.625g starch	T_{16}	41.22	36.30	38.76	7.25	6.50	6.88
L.S.D. 5%		3.61	4.33	3.97	1.46	1.22	1.34

Table 2: Effect of pollination with pollens (water suspension pollens) with or without starch carrier on Fruit weight (g) Fruit length (cm) and Fruit diameter (cm) of Saidy date palm cultivar during 2011 and 2012 seasons

Treatments	Characteristics								
	Fruit weight (g)			Fruit length (cm)			Fruit diameter (cm)		
	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
T_0	10.41	10.62	10.52	3.68	3.69	3.69	2.25	2.26	2.26
T_1	9.62	10.06	9.84	3.58	3.68	3.63	2.21	2.24	2.23
T_2	9.90	10.35	10.13	3.67	3.70	3.69	2.25	2.26	2.26
T_3	10.14	10.51	10.33	3.68	3.71	3.70	2.26	2.27	2.27
T_4	10.30	10.42	10.36	3.69	3.70	3.70	2.26	2.27	2.27
T_5	9.90	10.38	10.14	3.68	3.70	3.69	2.25	2.26	2.26
T_6	10.23	10.50	10.37	3.70	3.71	3.71	2.26	2.27	2.27
T_7	10.44	10.77	10.61	3.69	3.72	3.71	2.27	2.28	2.28
T_8	10.70	10.89	10.80	3.72	3.76	3.74	2.28	2.28	2.28
T_9	10.41	10.72	10.57	3.69	3.69	3.69	2.27	2.27	2.27
T_{10}	10.61	10.81	10.71	3.73	3.75	3.74	2.27	2.28	2.28
T_{11}	10.82	10.96	10.89	3.75	3.84	3.80	2.28	2.30	2.29
T_{12}	11.00	11.12	11.06	3.85	3.90	3.88	2.30	2.31	2.31
T_{13}	10.95	11.08	11.52	3.85	3.84	3.85	2.30	2.30	2.30
T_{14}	11.10	11.35	11.23	3.88	3.89	3.89	2.31	2.31	2.31
T_{15}	11.32	11.51	11.42	3.93	3.95	3.94	2.34	2.35	2.35
T_{16}	11.34	11.55	11.45	3.93	3.95	3.94	2.34	2.35	2.35
L.S.D. 5%	0.31	0.36	0.34	0.05	0.04	0.05	0.02	0.02	0.02

Table 3: Effect of pollination with pollens (water suspension pollens) with or without starch carrier on T.S.S % Fruit moisture % and Total sugars of Saidy datepalm cultivar during 2011 and 2012 seasons

Treatments	Characteristics								
	T.S.S %			Fruit moisture %			Total sugars		
	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
T_0	78.00	78.27	78.10	14.33	14.15	14.24	73.24	73.42	73.33
T_1	76.95	77.93	77.44	15.40	15.04	15.22	72.18	73.02	72.60
T_2	77.88	78.12	78.00	14.45	14.27	14.36	73.13	73.35	73.24
T_3	78.00	78.30	78.15	14.45	14.30	14.38	73.24	73.45	73.35
T_4	78.07	78.44	78.26	14.21	14.19	14.20	73.31	73.73	73.52
T_5	77.92	78.14	78.03	15.05	14.21	14.63	73.09	73.37	73.23
T_6	78.11	78.33	78.22	14.24	14.28	14.26	73.34	73.47	73.41
T_7	78.35	78.92	78.64	14.27	14.03	14.15	73.41	74.03	73.72
T_8	78.60	78.97	78.79	14.15	14.00	14.08	73.81	74.12	73.97
T_9	78.19	78.80	78.50	14.21	14.09	14.15	73.26	73.98	73.62
T_{10}	78.53	79.09	78.81	14.16	13.82	13.99	73.66	74.19	73.93
T_{11}	78.90	79.51	79.21	13.8	13.30	13.55	74.09	74.58	74.34
T_{12}	79.50	79.78	79.64	13.30	13.21	13.26	74.57	74.90	74.74
T_{13}	79.36	78.70	79.03	13.45	14.10	13.73	74.51	73.99	74.25
T_{14}	79.84	80.35	80.10	13.18	12.62	12.90	74.81	75.36	75.09
T_{15}	80.23	80.55	80.39	12.70	12.45	12.58	75.18	75,55	75.37
T_{16}	80.40	80.73	80.57	12.56	12.30	12.43	75.41	75.64	75.52
L.S.D. 5%	**1.12**	**1.04**	**1.08**	**1.26**	**1.13**	**1.19**	**0.59**	**0.58**	**0.59**