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Compatibility Relationships in Some Date Palm Cultivars (*Phoenix dactylifera* L.)

M.A.A. Bacha, M.A. Aly, R.S. Al-Obeed and A.O. Abdul-Rahman

Plant Production Department, College of Agriculture, King Saud University, Riyadh, Saudi Arabia

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Abstract. Crosses and reciprocal crosses were carried out between females and males of four date palm cultivars namely, Nebut Seif, Seleg, Succary and Barhi. The degrees of compatibility and incompatibility were determined. Pollen viability ranged from 86-100% by using acetocarmine method, while it ranged from 43-79% by germination method. Nebut Seif female produced lower fruit set percentage with self pollination, while Seleg, Succary and Barhi females gave different values of fruit set percentages when self pollinated. Four female palms under study produced the highest fruit setting when pollinated with Barhi pollens. These indicates the existence of partially self incompatibility and high degree of compatibility with Barhi males. Nebut Seif and Succary female cvs., have more unfertilized flowers in all pollination treatments in the first season than that in the other female palms. The maximum fruit drop occurred in June and still constant till the harvesting. Data showed that the percentages of ripening fruits, bunch weight and seed weight varied in the four date palm cultivars considerably according to the type of pollen used. Seed germination percentages increased markedly in Nebut Seif, Seleg and Barhi female cvs. when pollinated with Seleg pollens. Furthermore, the effect of self- and cross- pollination within or between four cultivars on physical and chemical properties of fruits were discussed.

Introduction

The date palm (*Phoenix dactylifera* L.) is dioecious trees with the male (staminate) and female (pistillate) flowers produced on separate palms. Common agreement among date growers that hand pollination of the female flowers produces fruits of superior quality compared with those produced by natural wind pollination. Also, pollination is the first step by which genes are exchanged between plants (cross pollination) or recombined within plants (self pollination). It has been assumed that species of the genus *Phoenix* are self compatible. Among the literature concerning the *Phoenix* genus, only a few reports have been concerned with degree of self- or cross- incompatibility [1-3]. On the other hand, many investigators stated the existence of incompatibility phenomena in different fruit species such as Cuevas and Plito [4] in Manzanillo, Mission and Ascolano olives, Chezhiyan [5] in some species of guava, Egea and Burgos [6] in apricots and Yamashita

et al. [7] in Japanese pear. Murfett *et al.* [8] reported that in self-incompatible (SI), the S locus acts to prevent growth of self pollen and this promotes out-crossing within the species. Self incompatible (SI) species reject pollen from self compatible (SC) species, but the reciprocal crosses are usually compatible.

Therefore, the objectives of this study were to determine if self and cross compatibility system exists in *dactylifera* species. Thus, crosses and reciprocal crosses were made within and between four date palm cultivars.

Materials and Methods

This investigation was carried out in 1995 and 1996 seasons at the Experimental Station, College of Agriculture, King Saud University in Dierab. Four female and male date palms cultivars were used for crosses and reciprocal crosses namely, Nebut Seif, Seleg, Succary and Barhi. Four palm trees were chosen for vigor and for being disease-free as a female parent (seed parent), while one vigor tree was used as a male parent (pollen parent) and the source of pollen grains in each cultivar. All trees were subjected to the same cultural practices. Pollen grains were extracted from mature spathes in a thin layer paper sheets and spread for 3-4 days till they became dry. Viability of pollen grains was determined by the acetocarmine technique described by Roberts [9] and by germination method in Albert media and pollen tube length was measured after 72 hours in a drop hanging solution [10].

Ten spathes were left on each female tree. All the remaining spathes and those produced thereafter were removed to minimize the nutritional competition. The spathes were immediately covered with paper bags before opening to protect the inflorescence from any unwanted pollens. The flower strands on each spathe were thinned to 60 strands. In each female tree, two spathes were treated for each treatment. Pollination treatments for each female cultivar included four replications. After pollination, spathes were bagged to prevent contamination with foreign pollen grains. Pollination was done with small dusters (10 g/capacity) containing 2 gm of pollen grains of each male used, then the spathes were bagged. The spathes were pollinated then unbagged 30 days after pollination, a period enough for fruit setting to be complete. The pollination treatments in each female cultivar were: Self pollination, cross pollination with pollen of the other cultivars, and pollination with mixed pollens.

Fruit set percentages were done on samples of 2 strands taken at random from each replicate. The number of unfertilized flowers and number of flowers on each strand were counted. Then, the percentage of fruit setting was calculated as a number of the total number of flowers/strands. Also, fruit drop percentages were determined monthly after fruit setting. Ripe fruit percentages were determined at harvest time by the following equation: Ripe fruits % = Number of mature fruits x100/Total number of flowers.

At harvest time (Rutab stage), bunch weight was determined and fruit samples from different pollination treatments were collected for determination physical and chemical properties. Fruit physical properties were determined on samples of 100 fruits. Weight, volume, length, diameter and shape of fruits (length/diameter ratio) were determined. Also, weight, length, diameter, shape and germination percentages of seeds were recorded. Moisture content and fruit chemical properties such as, total soluble solids (T.S.S.), acidity (%), sugars and tannins were determined according to A.O.A.C. [11].The reducing and non- reducing sugars were determined by Dubois *et al.* [12].Tannins were determined using the method of Indigo Carmine Indicator [11].

All data in the present investigation were statistically analyzed as complete randomized block design according to the method described by Steel and Torrie [13].

Results and Discussion

Viability of pollen

Pollen viability measured by acetocarmine method in the four date palm cultivars varied from 86 - 100%. Barhi and Nebut Seif cultivars had the lowest percentages of pollen viability (in 1995 and 1996 seasons, respectively). Pollen viability of Seleg cultivar gave the highest value in both seasons. The data showed that the viable pollen percentage was significantly higher in Seleg cultivar that that in Barhi in the first season and Nebut Seif in the second season (Table 1). Many investigators determined the pollen viability in some fruit species using the acetocarmine technique such as [14, 15] on pomegranate, [16] on citrus. Moreover, Ream and Furr [17] reported that fruit set on inflorescence of Deglet Noor palms pollinated with pollens of different viability was closely related to the percentage of viable pollen.

Table 1. Pollen viability and pollen tube length of four different pollen sources

Pollen source	% Pollen viability (Acetocarmine method)		% Pollen viability (Germination method)		Pollen tube length (μ)
	1995	1996	1995	1996	(Average of two seasons)
Nebut Seif	94.60a	96.75b	43.50b	52.25a	38.90b
Seleg	94.90a	100.0a	44.75b	48.00a	88.80a
Succary	93.35a	99.75a	54.00b	52.75a	61.80ab
Barhi	86.75b	98.50ab	79.25a	58.50a	68.80ab

Means not sharing the same letter(s) within each column are significantly different at 0.05 level.

Pollen germination

Data in Table 1 showed that Barhi cultivar was found to have a high pollen germination among the four cultivars, followed by Succary in both seasons. Seleg cultivar gave the lowest percentage of pollen germination in 1996 season. Significant differences for in vitro pollen germination were found between Barhi cultivar and all other cultivars on season 1995. This variation among the four cultivars suggest the presence of genetically differences [14, 18, 19].

Pollen tube length

Pollen tube length after cultured in sucrose hanging solution for 72h grew more rapidly in Seleg cultivar than other cultivars. Nebut Seif gave the lowest pollen tube length. No significant differences were found among Seleg, Succary and Barhi in pollen tube length. Nebut Seif showed a lower significant difference as compared with other cultivars (Table 1). These results suggested that the growth of pollen tubes is probably controlled by the cultivars [14, 18, 19].

Fruit set

Fruit set percentage as an important indicator for the exist of compatibility or incompatibility phenomena was studied and illustrated in (Table 2). In Nebut Seif cultivar, data showed that cross pollination (SuP) and (BP) gave the lowest fruit set percentage in 1995 and 1996 seasons, respectively. Barhi pollens (BP) gave the highest fruit set in the first season. The data showed that no significant differences were found among all pollination treatments in the second season, while (SuP) significantly reduced the percent fruit set as compared with (BP) in 1995 season. The data indicated that Nebut Seif cv. as a female parent is partially self- and cross- incompatible with Succary male parent.

In Seleg female, pollination with (SuP) produced the lowest fruit set percentage in the first season, while Succary pollens (SuP) produced the highest fruit set in the second season. The differences in Seleg fruit set in both seasons may be due to the differences in temperature of two seasons.

Succary female recorded the highest fruit set in the first season by (BP), while (SuP) gave the highest fruit set in the second season. No significant differences were found in fruit set percentages among all pollination treatments in both seasons.

In female cultivar Barhi, the highest fruit set was recorded in the first season when it was pollinated with (BP) and (SuP) treatments. Also, the data of the second season showed that fruit set of Barhi female cv. recorded the highest values when pollinated with (SuP), (BP) and (SeP) treatments. It can be concluded that in Barhi female cv. a high degree of compatibility exist with (SuP), while a degree of cross incompatibility with (NP). These variable fruit set with different female and pollinators may be due to the degree of compatibility and incompatibility among those cultivars. These findings are in agreement with those of [1,2,20, 21]. They all found a degree of compatibility in some date cultivars and a variable fruit set by different pollens.

Unfertilized flowers

The percentage of unfertilized flowers varied according to the male parent in four female cultivars. In Nebut Seif female cv., cross pollination with (BP) and (SeP) gave the lowest unfertilized flower percentages in the first and second seasons, respectively. No significant differences were found among all treatments in both seasons, except between (SuP) and (BP) in the first season (Table 2).

In Seleg cultivar, (SuP) produced the highest unfertilized flowers percentage in the first season, while it gave the lowest value in the second season. This may be due to the

differences in degrees of temperature in both seasons. Also, (BP) reduced generally the percentages of unfertilized flower. In Succary cultivar, the percentages of unfertilized flowers did not affected significantly by pollen source.

In Barhi female, (SeP) and (NP) gave the highest unfertilized flower percentage as compared with other pollination treatments in the first and second seasons, respectively. The data indicates existing the degree of cross incompatibility between Barhi female cultivar and both of (SeP) and (NP). The data in Table 2 showed that (BP) produced the lowest unfertilized flower percentages and this may be indicates the existing of high degree of compatibility between (BP) and other female cultivars included in this study. The same trend was found by Shaheen *et al.* [3].

Table 2. Effect of pollen source on fruit set, unfertilized flowers, and ripe fruits percentages of four date palm cultivars

Pollen source	% fruit set		% unfertilized flowers		% ripe fruits	
	1995	1996	1995	1996	1995	1996
Nebut seif						
Nebut seif (NP)	29.50ab	62.94a	70.49ab	37.06a	17.91a	22.14a
Seleg (SeP)	32.79ab	66.99a	67.21ab	33.00a	20.28a	18.65a
Succary (SuP)	28.69b	63.48a	71.31a	36.52a	12.78a	22.90a
Barhi (BP)	39.37a	62.89a	60.62b	37.10a	27.54a	25.13a
Mixed pollen (MP)	32.70ab	64.68a	67.30ab	35.32a	23.61a	22.83a
Seleg						
Nebut seif (NP)	47.69ab	78.08b	52.31ab	21.92a	31.98ab	56.27a
Seleg (SeP)	44.24ab	89.14ab	55.67ab	10.86ab	29.80ab	53.96a
Succary (SuP)	28.54b	92.89a	71.46a	07.11b	16.94b	54.18a
Barhi (BP)	56.81a	86.52ab	43.19b	13.48ab	42.97a	58.88a
Mixed pollen (MP)	48.41ab	86.95ab	51.59ab	13.05ab	39.38a	54.94a
Succary						
Nebut seif (NP)	23.40a	77.40a	76.59a	22.60a	14.72a	28.31a
Seleg (SeP)	23.23a	75.28a	76.77a	24.72a	12.54a	27.15a
Succary (SuP)	21.08a	81.85a	78.92a	18.15a	13.05a	35.92a
Barhi (BP)	26.73a	78.66a	73.26a	21.34a	13.27a	32.08a
Mixed pollen (MP)	19.56a	81.61a	80.43a	18.39a	12.09a	32.13a
Barhi						
Nebut seif (NP)	29.88b	62.27b	70.11a	37.72a	27.02a	25.48a
Seleg (SeP)	27.88b	73.97ab	72.11a	26.02ab	19.15a	21.46a
Succary (SuP)	32.31b	81.13a	67.69a	18.78b	17.76a	27.18a
Barhi (BP)	41.67a	76.75ab	58.32b	23.25ab	28.20a	22.11a
Mixed pollen (MP)	31.88b	67.68ab	68.12a	32.32ab	23.47a	24.50a

Means not sharing the same letter(s) within each column are significantly different at 0.05 level.

Fruit drop

Data in Fig.1a-d showed the percentages of fruit drop in four date cultivars as affected with different pollination treatments through the period from fruit setting until July. Nebut Seif, Succary and Barhi female cvs. showed maximum fruit drop in June and then still without dropping until harvesting time (Fig. 1a, c and d). In Seleg female

cv. data in Fig. 1b showed the highest fruit drop in June when pollinated with (SuP) and the reverse was true with NP. In Barhi female cultivar, data in Fig.1d showed a high degree of fruit drop in May and June.

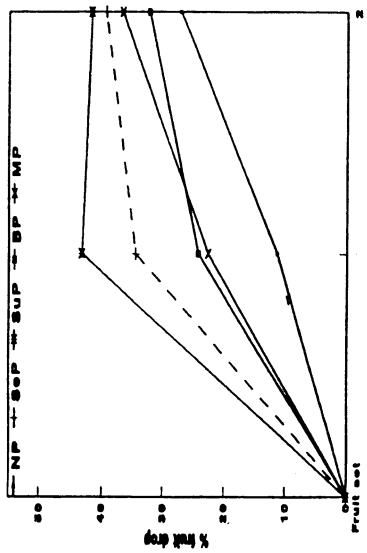

Fig. 1b. Effect of pollen source on fruit drop percentages of Seleg cultivar

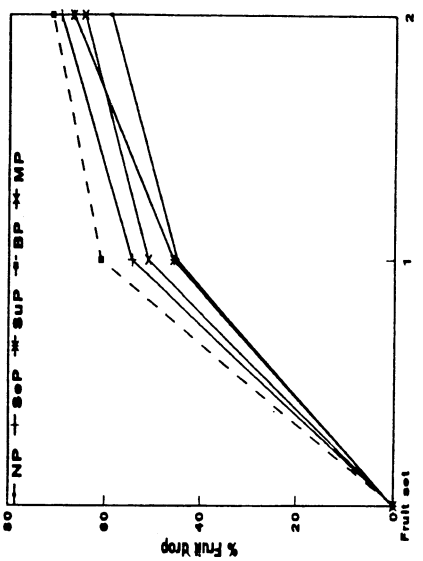

Fig. 1d. Effect of pollen source on fruit drop percentages of Barhi cultivar

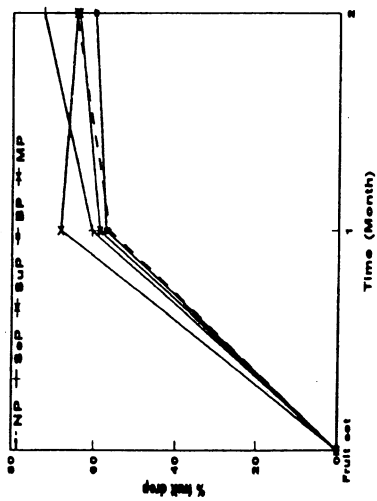

Fig. 1a. Effect of pollen source on fruit drop percentages of Nebut Seif cultivar

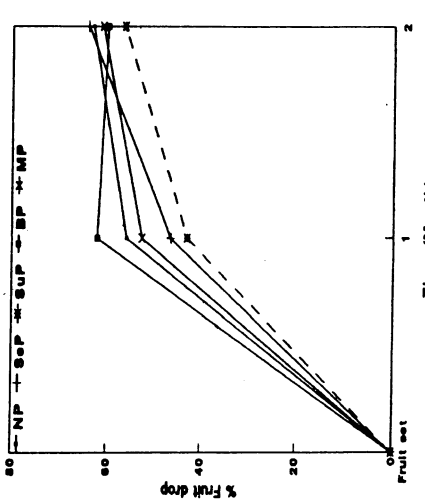

Fig. 1c. Effect of pollen source on fruit drop percentages of Succary cultivar.

Ripe fruits

Ripen fruit percentages presented in Table 2 revealed that in Nebut Seif female cv. Barhi pollens (BP) gave the highest ripe fruit percentages in both seasons. Also, different pollination treatments did not affect significantly on the ripe fruits. In Seleg female cv. the percent ripe fruits varied considerably according to the type of pollen used. Barhi pollens recorded higher yield in Seleg female cv. compared with other pollinators. Seleg female cv. produced the lowest ripe fruit percentages in the first season by Succary pollens (SuP) and by Seleg pollens (SeP) in the second season.

In Barhi and Succary female cultivars, no significant differences were found in ripe fruit percentages as affected by different pollinators in both seasons. Also, in Barhi and Succary female cultivars, self pollination produced the high values of ripe fruit percentages and these indicate the existence of a degree of self compatibility in Succary and Barhi cultivars (Table 2). These finding agree with those obtained by [2, 3, 22].

Bunch weight

The effect of pollen type had a clear effect on mean bunch weight (Fig.2a-d). In Nebut Seif female parent, showed that Succary pollen gave the highest mean bunch weight, while (SeP) gave the lowest one (Fig.2a). Also, in Seleg female c.v., (NP) recorded the highest mean bunch weight, but (SuP) gave the lowest value (Fig.2b). Seleg and Succary pollens produced the highest mean bunch weight in Succary and Barhi female parents, but (BP and SeP) gave the lowest values, respectively (Figs.2c and 2d). The above data indicates that mean bunch weight varied according to female and pollen parents. These findings are in line with those obtained by [2, 22].

Seed weight

Data in Table 3 revealed that in Nebut Seif cultivar, the highest seed weight was obtained when pollinated with Seleg pollen, while self pollination and cross pollination with (BP) gave the lowest values in 1995 and 1996 seasons, respectively. Seleg pollen significantly increased the seed weight in Nebut Seif cv. than (NP) and (BP) treatments.

Seleg fruits had the highest seed weight in the second season when pollinated with either (SuP, NP or BP) in 1995 and 1996 seasons, respectively. Self pollination (SeP) significantly increased seed weight in Seleg fruits as compared with (NP) treatments in the first season, while the differences in seed weight produced by different pollinators are insignificant in the first season.

Succary female had the highest significant seed weight with (BP) and (NP) in 1995 and 1996 seasons, respectively. Self pollination with (SuP) did not affect significantly the seed weight in both seasons. Also, data in Table 3 show that Succary fruits had a lowest effect on seed weight when pollinated with (SeP and MP) in the first and second

seasons, respectively.

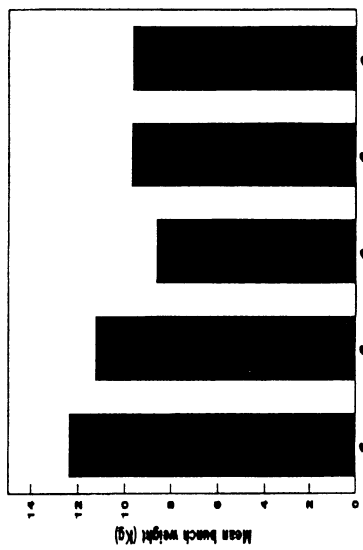

Fig. 2a. Effect of pollen source on mean bunch weight of Nebut Seif cultivar

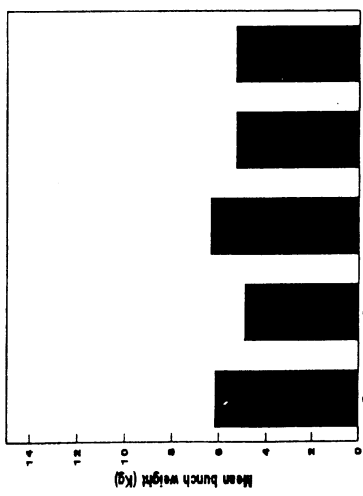

Fig. 2b. Effect of pollen source on mean bunch weight of Seteg cultivar

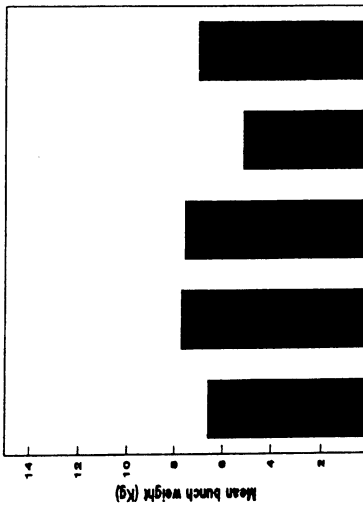

Fig. 2c. Effect of pollen source on mean bunch weight of Succary cultivar.

Fig. 2d. Effect of pollen source on mean bunch weight of Barhi cultivar

As for Barhi fruits, results in Table 3 revealed that (MP and NP) treatments gave the highest seed weight in 1995 and 1996 seasons, while the reverse was true with (SuP and BP) treatments, respectively. No significant differences were found in seed weight among all pollination treatments in both seasons. All data obtained in this study are in line with [1, 22 - 24]. They reported that the pollens from different pollen parents may produce almost identical effects, but the effects differ significantly in seed weight and size.

Table 3. Effect of pollen source on seed weight, length, diameter, length/diameter and seed germination percentages of four date palm cultivars

Pollen source	Seed weight (g)		Seed length (cm)		Seed diameter (cm)		Seed length/ diameter		% Seed germination	
	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996
Nebut seif										
Nebut seif (NP)	0.633c	0.667b	1.75a	1.61a	0.692a	0.64bc	2.53a	2.52a	81.5b	96.2a
Seleg (SeP)	0.687a	0.777a	1.77a	1.70a	0.685a	0.68a	2.60a	2.52a	94.0a	97.2a
Succary (SuP)	0.648bc	0.747a	1.73a	1.70a	0.675a	0.66abc	2.56a	2.61a	89.5ab	92.6a
Barhi (BP)	0.674ab	0.640b	1.72a	1.65a	0.687a	0.64c	2.51a	2.61a	89.5ab	93.6a
Mixed pollen (MP)	0.665abc	0.685b	1.74a	1.59a	0.697a	0.66abc	2.50a	2.43a	96.0a	95.6a
Seleg										
Nebut seif (NP)	0.930a	0.910ab	2.39a	2.31ab	0.66a	0.62a	3.62a	3.79a	76.0a	95.6a
Seleg (SeP)	0.982a	0.845b	2.43a	2.25ab	0.67a	0.63a	3.66a	3.60a	85.0a	95.2a
Succary (SuP)	0.965a	0.920ab	2.52a	2.26ab	0.66a	0.65a	3.83a	3.50a	77.5a	97.6a
Barhi (BP)	0.957a	0.910ab	2.34a	2.26ab	0.65a	0.64a	3.61a	3.56a	82.5a	93.0a
Mixed pollen (MP)	0.968a	0.872ab	2.47a	2.23b	0.68a	0.62a	3.64a	3.65a	83.0a	96.6a
Succary										
Nebut seif (NP)	1.232bc	1.265a	1.99a	1.97a	0.88a	0.89a	2.29a	2.22a	73.5a	83.2a
Seleg (SeP)	1.191c	1.122b	1.94a	1.81b	0.91a	0.93a	2.13a	1.96b	73.0a	79.4a
Succary (SuP)	1.198bc	1.132b	1.96a	1.81b	0.90a	0.91a	2.18a	1.99b	74.5a	89.0a
Barhi (BP)	1.362a	1.135b	1.99a	1.88ab	0.91a	0.90a	2.20a	2.10ab	77.0a	88.6a
Mixed pollen (MP)	1.203bc	1.105b	2.01a	1.89ab	0.91a	0.89a	2.22a	2.13ab	79.5a	91.8a
Barhi										
Nebut seif (NP)	0.735ab	0.755ab	1.68a	1.74ab	0.72a	0.75a	2.34a	2.32a	80.5b	97.4a
Seleg (SeP)	0.754a	0.707b	1.69a	1.64b	0.72a	0.73a	2.37a	2.25a	91.0a	96.0a
Succary (SuP)	0.733ab	0.740ab	1.69a	1.71ab	0.72a	0.75a	2.35a	2.29a	83.5ab	96.6a
Barhi (BP)	0.746ab	0.697b	1.67a	1.68ab	0.73a	0.72a	2.30a	2.35a	90.0a	96.4a
Mixed pollen (MP)	0.760a	0.725ab	1.70a	1.68ab	0.74a	0.75a	2.30a	2.27a	91.5a	92.6b

Means not sharing the same letter(s) within each column are significantly different at 0.05 level.

Seed shape and germination

Regarding the four female parents used in this study, data in Table 3 revealed that all pollination treatments did not significantly increased the seed length, seed diameter, and length to diameter ratio in both seasons, except seed diameter of Nebut Seif and seed length/diameter ratio of Succary in the second season. Seed diameter of Nebut Seif significantly increased as affected by Seleg pollen as compared with (NP) and (BP) treatments in the second season. Also, (NP) significantly increased seed length/diameter ratio in Succary cultivar compared with (SeP) in 1996 season. Data given in Table 3 show that female cultivar Nebut Seif produced the lowest seed germination percentage when self pollinated and this reduction was significant with that in Seleg and mixed pollen treatments. Nebut Seif and Barhi produced the highest and significant seed germination percentages when pollinated with mixed pollens in the first season.

However, differences in seed properties due to pollen types were evident in the second season but not in the first season. The same results were found by [1, 22, 25].

Physical properties of fruits

Results concerning the effect of pollen type on fruit weight and volume of Nebut Seif, Seleg, Succary and Barhi female cvs., indicated that the mean weight and volume of fruit differed significantly according to pollen type (Table 4). Nebut Seif female produced better results of mean weight of fruits with (BP) and (SeP) in 1995 and 1996 seasons, respectively. Furthermore, self pollination treatment reduced the fruit volume of Nebut Seif in both seasons. No significant differences were found in Nebut Seif fruit weight and volume in different pollination treatments in 1995 season.

Table 4. Effect of pollen source on some fruit physical properties of four date palm cultivars

Pollen source	Fruit weight (g)		Fruit volume (cm^3)		Fruit length (cm)		Fruit diameter(cm)		Fruit length /diameter	
	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996
Nebut seif										
Nebut seif (NP)	9.92ab	10.18ab	9.62ab	9.50ab	3.16a	2.78bc	2.14b	2.13a	1.48a	1.30a
Seleg (SeP)	10.07ab	11.44a	9.93a	10.31a	3.19a	3.05a	2.28a	2.21a	1.40ab	1.38a
Succary (SuP)	10.16ab	10.66a	10.18a	9.75ab	3.23a	2.91ab	2.21ab	2.11a	1.46a	1.37a
Barhi (BP)	10.48a	10.75a	9.81a	9.75ab	3.11ab	2.84ab	2.15ab	2.18a	1.45ab	1.30a
Mixed pollen (MP)	10.41a	9.08b	10.06a	8.43b	3.19a	2.58c	2.23ab	1.91b	1.43ab	1.35a
Seleg										
Nebut seif (NP)	10.20a	8.27a	9.81a	7.75a	4.14a	3.83a	1.86a	1.74ab	2.21a	2.23a
Seleg (SeP)	11.20a	8.36a	10.12a	7.50a	4.23a	3.83a	1.83a	1.77ab	2.30a	2.17a
Succary (SuP)	11.13a	6.69b	10.31a	5.87b	4.23a	3.45b	1.81a	1.61b	2.34a	2.16a
Barhi (BP)	10.78a	8.55a	10.12a	7.56a	4.17a	3.72ab	1.79a	1.77ab	2.32a	2.10a
Mixed pollen (MP)	10.65a	8.54a	9.62a	8.00a	4.16a	3.80a	1.79a	1.78a	2.33a	2.15a
Succary										
Nebut seif (NP)	11.41ab	11.51a	13.05a	12.16a	3.60ab	3.15a	2.67a	2.52ab	1.35a	1.25a
Seleg (SeP)	11.22b	10.54ab	13.31a	10.40b	3.51b	3.00a	2.60a	2.3 ab	1.35a	1.27a
Succary (SuP)	11.71ab	10.64ab	13.31a	10.16b	3.55ab	3.04a	2.68a	2.34b	1.32a	1.30a
Barhi (BP)	11.93ab	10.91ab	13.50a	10.62b	3.55ab	3.25a	2.59a	2.53a	1.37a	1.28a
Mixed pollen (MP)	11.53ab	9.95b	13.68a	9.62b	3.66a	2.94a	2.67a	2.40ab	1.37a	1.22a
Barhi										
Nebut seif (NP)	8.71ab	8.51ab	9.12b	8.56ab	3.01a	2.92ab	2.22a	2.23a	1.36a	1.31a
Seleg (SeP)	8.50b	8.96a	9.12b	8.74ab	3.01a	2.90ab	2.20a	2.12a	1.37a	1.37a
Succary (SuP)	8.71ab	8.12ab	9.18b	8.00b	3.03a	2.79b	2.16a	2.11a	1.41a	1.33a
Barhi (BP)	8.93ab	8.74ab	9.31ab	8.75ab	3.01a	2.94ab	2.16a	2.16a	1.39a	1.36a
Mixed pollen (MP)	8.85ab	8.02b	9.50ab	8.43ab	3.01a	2.83ab	2.14a	2.14a	1.41a	1.32a

Means not sharing the same letter(s) within each column are significantly different at 0.05 level.

In Seleg female parent, self pollination with (SeP) increased fruit weight and volume in the first season, while (SuP) decreased it in the second season. In Succary female parent, (BP and NP) produced the highest mean weight and volume of fruit in the first and second seasons, respectively. From the results obtained it could be concluded that pollen type had a great effect on fruit weight and volume of female cultivars. The findings agree with the reports of Higazi *et al.* [2] Shaheen *et al.* [3] and El-Sabrout [22].

The ratio of fruit length to diameter may be used as a shape index, which may help in fruit classification. As this ratio varies, fruit shape tends to change. Data in Table 4 show that no significant differences were found in length to diameter ratio of fruits in four female cvs. as affected by different pollinators in both seasons. These results are in line with those obtained by Higazi *et al.* [2], EL-Sabrout [22] and EL-Wakil and Ibrahim [26].

Chemical properties of fruits

Data in Table 5 showed that when Nebut Seif and Succary cvs. were used as seed parent, moisture percentages of the fruits did not affected significantly by any pollinators. At the same time, moisture content in Barhi fruits significantly affected according to pollen type especially (SuP) treatment which gave the highest moisture content. Variation in moisture content in fruits according to pollen type and female cultivars reported by Higazi *et al.* [2], Shaheen *et al.* [3] and Hussein [25].

Table 5. Effect of pollen source on moisture, sugars and tannins percentage of four date palm cultivars (average of two seasons)

Pollen source	% Moisture	% Reducing sugars	% Non-reducing sugars	% Total sugars	% Tannins
Nebut seif					
Nebut seif (NP)	15.02a	55.86a	10.81a	67.24ab	0.48a
Seleg (SeP)	13.83a	57.75a	6.18ab	64.25ab	0.51a
Succary (SuP)	13.82a	57.45a	5.86ab	63.62ab	0.51a
Barhi (BP)	14.47a	57.43a	3.48b	61.10b	0.48a
Mixed pollen (MP)	14.44a	63.81a	7.32ab	71.52ab	0.50a
Seleg					
Nebut seif (NP)	9.4ab	62.78ab	9.04a	72.24a	0.393a
Seleg (SeP)	9.22b	66.22a	5.89a	72.42a	0.420a
Succary (SuP)	9.45ab	57.06b	9.97a	67.81a	0.393a
Barhi (BP)	9.72ab	66.29a	6.55a	73.18a	0.386a
Mixed pollen (MP)	9.98a	58.77ab	6.04a	65.13a	0.433a
Succary					
Nebut seif (NP)	8.39a	27.82a	34.83a	64.74a	0.493a
Seleg (SeP)	8.78a	29.00a	31.42a	62.38a	0.484a
Succary (SuP)	8.52a	25.54a	34.68a	62.05a	0.460a
Barhi (BP)	8.85a	25.62a	36.99a	64.56a	0.447a
Mixed pollen (MP)	8.89a	27.38a	34.84a	64.06a	0.396a
Barhi					
Nebut seif (NP)	11.46b	58.68a	12.81a	72.16a	0.415a
Seleg (SeP)	11.88b	58.66a	14.36a	73.78a	0.403a
Succary (SuP)	13.51a	68.12a	9.49a	78.86a	0.425a
Barhi (BP)	12.03b	66.03a	14.35a	78.46a	0.408a
Mixed pollenMP)	12.03b	62.35a	12.91a	76.45a	0.391a

Means not sharing the same letter(s) within each column are significantly different at 0.05 level.

As for reducing sugar content, data in Table 5 showed that in Nebut Seif, Succary and Barhi cvs., all pollination treatments had no significant effect on reducing sugar contents. In Seleg female cultivar, (BP) and (SeP) gave the highest content of reducing sugars in the fruits, while (SuP) gave the lowest one. Significant difference was found in reducing sugar content of Seleg fruits between (SeP) and (SuP) treatments.

Regarding the non-reducing sugars, the results revealed that non-reducing sugars in fruits were much lower than reducing sugars. Data in Table 5 indicated that the pollen types had no significant effects on the non-reducing sugar contents of Seleg, Succary and Barhi fruits. In Nebut Seif cv., the percent non-reducing sugars were significantly increased when self pollinated with (NP) than when cross pollinated with (BP).

Concerning the total sugars, Nebut Seif fruits contained significantly higher total sugars when pollinated with (MP) than when pollinated with (BP). In Seleg, Succary and Barhi female cvs., total sugars in fruits were not significant with any pollination treatments. Differences in sugar contents due to pollen sources and female parents were reported by [2,3,25,27,28].

Results presented in Table 5 revealed that in four female cvs., the percentages of tannins in fruits was affected by pollen sources and these differences were not statistically significant. In Nebut Seif female cv., (BP and NP) gave the lowest tannins content, while (SeP) and (SuP) gave the highest content of tannins. In Seleg female cv., (MP) increased tannins content in fruits, while the reverse was true with (BP). In Succary female cv., (NP) gave the higher tannins in the fruits, while (MP) gave the lowest one. In Barhi female cv., (SuP and NP) gave the highest value of tannins, while (MP) gave the lowest. Shaheen *et al.* [3], El-Hamady *et al.* [20] and Khalifa *et al.* [28] found that pollen type affected significantly on tannins content of different female cvs. fruits.

Data in Table 6 showed that the total soluble solids (T.S.S.) varied considerably with both female and male parents. The highest T.S.S. in Nebut Seif female cultivar was produced with (MP) in the first season and with (SuP) in the second season. Seleg female cv. produced the highest T.S.S. with (NP) in the first season and with (BP) in the second season. Fruits of female Succary produced the highest T.S.S. with (NP) and (BP) in the first and second seasons, respectively. Fruits of Barhi cultivar contained the highest T.S.S. with (BP) and (MP) in 1995 and 1996 seasons, respectively. These results are in line with those concluded by [20, 22, 28].

In Nebut Seif cv. data in Table 6 showed that the acidity in fruits were highest when pollinated with (MP) followed by (SuP, FP, SeP and NP) and the lowest values when (BP) was used in the second season. No significant differences were found in acidity percentages of Nebut Seif fruits as affected by all pollination treatments in the first season. Fruits of female Seleg cv., contained the highest values of acidity with (NP) in the first season and with (BP) in the second season. No significant differences in acidity percentages of Seleg fruits were found among all pollinators used in the second season. Fruits of Barhi cv. gave the highest acidity percentages when pollinated with (NP) and this increase was significantly higher compared with (SuP and MP) in the first season. It can be concluded from the above data that great variation in fruit chemical properties may be due to the use of different pollens [1, 25, 28].

Table 6. Effect of pollen source on TSS and acidity of four date palm cultivars

Pollen Source	% TSS		% Acidity	
	1995	1996	1995	1996
Nebut seif				
Nebut seif (NP)	80.0a	84.4a	0.620a	0.617ab
Seleg (SeP)	78.6ab	84.6a	0.650a	0.618ab
Succary (SuP)	78.2b	85.3a	0.690a	0.640ab
Barhi (BP)	79.0ab	83.5a	0.630a	0.561b
Mixed pollen (MP)	80.2ab	82.0a	0.640a	0.684a
Seleg				
Nebut seif (NP)	81.2a	80.0 b	0.823a	0.850a
Seleg (SeP)	78.2a	82.3ab	0.742b	0.846a
Succary (SuP)	77.5a	82.9ab	0.747b	0.834a
Barhi (BP)	78.3a	84.7ab	0.704b	0.870a
Mixed pollen (MP)	78.2a	82.8ab	0.713b	0.834a
Succary				
Nebut seif (NP)	78.8a	73.9a	0.553a	0.525a
Seleg (SeP)	77.2a	78.2a	0.531a	0.513a
Succary (SuP)	77.2a	74.9a	0.498a	0.567a
Barhi (BP)	78.6a	77.8a	0.519a	0.588a
Mixed pollen (MP)	76.6a	76.6a	0.527a	0.521a
Barhi				
Nebut seif (NP)	78.4ab	81.5a	0.891a	0.938a
Seleg (SeP)	76.6ab	82.4a	0.795ab	0.884a
Succary (SuP)	76.0b	82.6a	0.761b	0.942a
Barhi (BP)	79.2a	82.4a	0.857ab	0.888a
Mixed pollen (MP)	77.8ab	83.1a	0.766b	0.888a

Means not sharing the same letter(s) within each column are significantly different at 0.05 level.

From the above mentioned data, it can be concluded that pollen viability and pollen tube growth is probably controlled by the cultivars. The degrees of self and cross incompatibility were found among the four date palm cultivars under study. The chemical and physical properties of fruits varied according to female and pollen parents.

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علاقات التوافق في بعض أصناف نخيل البلح

محمد علي أحمد باشه، محمود أحمد علي، راشد سلطان العبيد، و عبد السلام عثمان عبد الرحمن

قسم الإنتاج النباتي، كلية الزراعة، جامعة الملك سعود، الرياض، المملكة العربية السعودية.

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ملخص البحث. تم دراسة التلقيحات والتلقيحات العكسية داخل أو بين أربعة أصناف من نخيل البلح هي نبوت سيف، سكري، سلج وبرحي، وذلك لتقدير درجة التوافق في هذه الأصناف.تراوحت نسبة حيوية حبوب اللقاح بين ٨٦-١٠٠٪ باستخدام طريقة الأسيتوكارمن، بينما تراوحت نسبة الإنبات من ٤٣-٧٩٪ في الأصناف الأربعة. وقد أظهر الصنف نبوت سيف درجة من عدم التوافق الذاتي الجزئي ودرجة عالية من التوافق مع حبوب لقاح صنف البرحي. كما أعطت الأصناف سلج، سكري وبرحي أعلى نسبة مئوية من عقد الثمار عندما لقحت بواسطة حبوب لقاح صنف برحي، وهذا يعني وجود درجة عالية من التوافق بين إناث هذه الأصناف ولقاح الصنف برحي. أيضا أظهرت إناث صنفي النبوت سيف والسكري نسبة عالية من الأزهار غير الملقحة مع كل التلقيحات تحت الدراسة في الموسم الأول.

وقد اختلفت النسبة المئوية للثمار الناضجة، متوسط وزن العذق، وزن وطول وعرض وشكل البذرة في الأصناف الأربعة تبعا لنوع حبوب اللقاح المستخدمة. وقد لوحظ أن أقصى نسبة مئوية لتساقط الثمار حدث في شهر يونيو وظلت النسبة ثابتة حتى ميعاد جمع الثمار وذلك في الأصناف الأربعة. وقد أظهرت النتائج زيادة النسبة المئوية لإنبات البذور في إناث أصناف نبوت سيف، سلج وبرحي عندما لقحت بحبوب لقاح ذكور سلج. أيضا درس تأثير التلقيح الذاتي والخلطي داخل وبين الأصناف الأربعة على الصفات الطبيعية والكيميائية، وقد أفادت النتائج إلى التأثير المباشر لنوع اللقاح والصنف الأنثوي.