

POLLINATION AND CYTOLOGICAL STUDIES ON THREE APRICOT (*Prunus armeniaca* L.) CULTIVARS.

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ABSTRACT

The present investigation was carried out during the two successive seasons of 2002 and 2003 on mature trees of Canino, Amal and Perfection three apricot cultivars. The pollination treatments used in this study were as follows: (1-) Open pollination. (2-) Bagging only. (3-) Cross-pollination as follows:-(A) Perfection (♀) X Canino (♂). (B) Perfection (♀) X Amal (♂). (C) Perfection (♀) X {Canino♂Amal} (♂). The results obtained could be summarized as follows: Canino and Amal cultivars succeed to give higher than 20% fruit set after Bagging only treatment. While, Perfection cultivar produced lower than 2% fruit set in the two seasons of study. Thus, Canino and Amal are considered self-compatible (fertile) cultivars. While, Perfection is considered self-incompatible (sterile) cultivar. Canino and Amal cultivars produced higher percentages of fruit set with open pollination than that of bagging only treatment. In addition, cross-pollination for Perfection cultivar by Canino pollen grains produced higher percentage of fruit set. While, the cross-pollination by Amal pollen grains gave lower percentage of fruit set than those of the rest pollination treatments in the two seasons of study. Open pollination treatment for Canino and Amal cultivars produced higher percentages of retained (mature) fruits than bagging only treatment. While, the cross-pollination for Perfection by Canino pollen grains produced higher percentages of retained (mature) fruits than those of the other pollination treatments. No retained (mature) fruits were obtained after bagging only treatment in the two seasons of study for Perfection cultivar. Pollen fertility tests either by staining or germination showed that there were no significant differences among three cultivars in their pollen fertility rates. As a result of cytological studies, one might conclude that the Perfection apricot cultivar was cytological stable and their pollen grains fertility was high.

INTRODUCION

Percentage of fruit set of either completely or partially self-sterile apricot cultivars differed according to the used pollenizers and the main cultivars., McLaren and Fraser, 1995 and Pellegrino *et al.*, 1997). Fruit set was relatively high in Valencia no 1 and Bulida 1 apricot cultivars (14.3 and 22.1%, respectively). Manual self-pollination produced similar results to natural self-pollination (from bagging) in all cultivars except "Valencia no 1" (8.4 vs. 12.8% fruit set (Garcia *et al.*, 1988). Fruit set with open pollination, self-pollination by hand and self-pollination (in cloth bags) of some apricot cultivars ranged from (zero to 72%), (18.52% to 87.04%) and (zero to 70%), respectively. (Sharma and Sharma, 1991). The apricot cultivars was classified to five groups based on the rate of self fertility represented by the percentage of fruit set as follows, 1-Fully self sterile (0%), Self sterile (0.1-1%), Partially self fertile (1.1-10%), Self fertile (10.1-20%) and Self fertile in very high rate (above 20%). The apricot cultivar Perfection has been considered self-sterile cultivar (fruit set 0-1%) (Szabo and Nyeki, 1991). Self-pollination of Sundrop apricot cultivars resulted in average of 9.1% fruit set compared with 17-90% with cross-pollination using pollen of 14 different cultivars. (McLaren *et al.*, 1992). In

incompatible apricot cultivar, microscopic examinations confirmed that there were no pollen tubes reaching the ovary (Burgos *et al.*, 1993). No incompatibility was observed among the cross combination of different apricot cultivars (Radrigo and Herreo, 1996). Hand pollination of Sundrop and Moorpark with 32 genetically diverse cultivars failed to show any incompatibility groups such as those found in cherries and plums (McLaren and Fraser, 1995). Fluorescence microscopy studies showed that tubes from Sundrop pollen are self-incompatible (fruit set <2%) and generally aborted in the upper part of the style. The strength of inhibition reaction varied so that the tubes occasionally reached the ovary but none penetrated ovules (Austin *et al.*, 1998 and Andres and Duran, 1998) on Monique Azaraque apricot cultivar. The related fruit set rating of some apricot cultivars in cross-pollination with coincident blooming varieties was often higher and compatible with a commercial production except in the case of "Goldrich" pollinated by "Lambert n1" where the combination appeared cross-incompatibility (Audergon and Duffillol, 1999). The average fruit set after controlled self- and cross-pollination in the self-compatible almond cultivar Tuono was 25.6% and 19.2 %, respectively (Ahmed *et al.*, 2002).

Pollen of apricot varieties of the central Asian and European groups showed the highest pollen viability. However, those of the Irano-Caucasian group having significantly lower pollen viability. (Lagutova, 1988). Most of 20 apricot varieties grown in Yugoslavia had good pollen germination (>30%). (Duric, 1990). Germination of pollen of several apricot cultivars was best on 10-12% sucrose. The pollen viability was ranged between (74-96%) (Obonova, 1995). There was a positive correlation between pollen viability and germination rate (Mahanoglu *et al.* 1995). Thirteen apricot clones were significantly different in their pollen viability but none was male sterile (Andres *et al.* 1999). The objectives of the present investigation was to study the effect of different pollination treatments on yield of the studied cultivars, to evaluate the degree of self compatibility and role of cross pollination in improving the production of these cultivars

MATERIALS AND METHODS

The pollination studies were carried out at Esmail Saleh farm of Dalangat, Beheira, A.R.E. Three apricot cultivars (*Prunus armeniaca* L.) namely Perfection, Amal and Canino were chosen for this investigation. The trees were budded on seedling rootstock and were nine-years-old at the start of the experiment. The soil of the experimental orchard was classified as sandy soil. The planting distance was 3.5 X 3.5 meters. The selected experimental trees were disease free and irrigated via drip system. This work included the following studies: 1-Pollination studies: -The experimental work started on February 20th to May 15th in 2002 and almost in the same time in 2003. The treatments in the two successive years were repeated on the same four trees for each cultivar. The following pollination treatments were carried out on the flowers of three cultivars: -(1) Open pollination (control), (O.P.). (2) Bagging only, (B.O.). (3) Cross-pollination as follows: -(A) Perfection (♀) X Canino (♂), (B) Perfection (♀) X Amal (♂), (C) Perfection (♀) X {Canino ♀ Amal} (♂). Except the open pollination treatment, the flowers in balloon stage for all treatments were counted and the other flowers on the same shoot or spur were removed. The flowers of open-pollination treatment were left under the natural

conditions. For the bagging only treatment the flowers were enclosed with perforated paper bags at balloon stage. For cross-pollination treatment, pollen grains of each tested cv. were collected when flowers beginning to open so long as the anthers have not begun to dehisce. Both flowers and pollen were kept at 1-3°C from the time of picking the flowers until the time of pollen used. The emasculation technique has done using fine-pointed forceps to cut the calyx cup where the bases of the stamens join. The pollen was applied to the stigmatic surface of emasculated flowers by fine-haired brushes, after that the flowers were enclosed with perforated paper bags. For each replicate and treatment, the number of flowers was recorded and fruit set was counted after 15 days from pollination date. The retained (mature) fruits in each replicate were collected, counted in order to calculate the percentage of the retained (mature) fruits produced per each replicate and treatment. Randomized sample of fruits for each replicate and treatment were chosen to studying the physical and chemical properties. The dehiscent anthers were tapped on a drop of acetocarmin stain on a slide. Five slides were made for each cultivars, for each slide ten microscopic fields were chosen at random and pollen grains were counted and divided into two classes viable and aborted. Pollen grains of normal size, which stained well with acetocarmin, were considered fertile. Those, which were unstained, appeared smaller than normal and considered aborted. This technique was previously described by Minessy *et al.*, (1970) and Ibrahim (1974).

Pollen grains of each cultivar were put in germination medium. The basic medium contained 15% sucrose in distilled water and 10 ppm Boric acid and 1% agar according to (Stancevic, 1963). After adding a small amount of pollen to each Petri dish, they were closed and allowed to stand for incubation period at 24°C for 24 hours to reach the maximum germination capacity. Per each cultivars four microscopic fields containing 50-100 pollen per field were examined, the numbers of germinated and ungerminated pollens were recorded. This technique has been used by Ibrahim and Sinble (1989). A randomized complete block design was applied to analyze the present data according to (Snedecor and Cochran, 1972) using Costat program. Least significant differences were used to compare between means of treatments according to (Walter and Duncan, 1969).

RESULTS AND DISCUSSION

1. Percentage of fruit set:

The data showed that, in 2002, fruit set percentage was significantly affected by pollination treatments. The percentages of fruit set of Canino apricot were 47.2 and 32.4 for open pollination and bagging only treatments, respectively. In respect to the season 2003, no significant difference was observed, Table (1). As for Amal cultivars, the results of table 2) showed that, fruit set percentage did not differ significantly by the two pollination treatments for

both growing seasons. The results also indicated that the bagging only treatment succeed to set fruits in the two growing seasons for Canino and

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Amal cultivars. Thus, Canino and Amal cultivars are considered as self-fruitful cultivars in very high rate, according to Szabo and Nyeki (1991) classification. In general, a higher percentage of fruit set was observed after open pollination than after bagging only treatment. These results were confirmed by the work of Shinde and Patil (1978) on grape, who found that fruit set percentage after open pollination of Bangalore Purple vines was higher than after self-pollination. Perfil (1982) and Baimetov (1988) on peach Gupta and Mehrotra (1985) on LeConte pear, Krylova (1987) and Dashad and Sharma (1993) working on apple and Bajwa *et. al.* (1991) working on plum, stated the same conclusion.

For Perfection cultivars, the data of table (3) showed that fruit set percentages were significantly affected by the different pollination treatments in both seasons. In 2002, the percentages of fruit set were 28.32, 1.74, 31.56, 26.70 and 30.97 for open pollination, bagging only, cross-pollination by Canino pollen, cross-pollination by Amal pollen and cross-pollination by the mixture of both Canino and Amal pollens, respectively. In 2003, the corresponding values were 35.20, 0.0, 29.97, 19.25 and 27.86, respectively for the five treatments mentioned above. From these results, the average fruit set percentage for two seasons after bagging only treatment was 0.87, thus; this cultivars is considered as a self-unfruitful (self-sterile) cultivar, according to Szabo and Nyeki (1991) classification. Thus, cross-pollination with pollen of different pollinizers is necessary for this cultivars to set fruits. These results were confirmed by the work of Wood_Des (1983) on apricot, who found that fruit set after self-pollination in Sundrop, self incompatible apricot cultivars, was 2%, compared with 38 and 19% after used Trevatte and Moorpark cultivars as pollinizers, respectively. Egea *et al.* (1991) came to the same conclusion on Velazqueaz Tardio and Moniqui Fino apricot cultivars. They found that both cultivars were self-incompatible (0 and 1% fruit set, respectively) after self-pollination, these values reached (15 and 11%, respectively) with Ojaico pollinizer. In the same scope, McLaren *et. al.* (1992), Burgos *et al.* (1993), McLaren and Fraser (1995), Radrigo and Herrero (1996), Austin *et al.* (1998) and Audergon and Duffillol (1999) working on apricot., fruit set after cross-pollination was differed according to the source of pollens used. Canino pollen was the best among other pollens used, followed by the mixture of both Canino and Amal pollens. However, Amal pollen gave the lowest fruit set among all. These results agreed with those of Wood_Des (1983), who found that Trevatte pollen gave 38% fruit set against 19% fruit set when Moorpark was used as pollinizer to Sundrop apricot cultivar. It could be concluded that the higher fruit set percentages that obtained by open pollination in all cultivars may be due to the high level of attraction or compatibility between pollens of the surround's cultivars and stigmas of the studied ones.

2. Percentage of retained (mature) fruits:

From the present results, Table (1&2) it was obtained that the percentages of retained fruits were higher after open pollination treatment than that of bagging only treatment. The statistical analysis showed that the

differences among pollination treatments were significant in both seasons for the two-studied cultivars. These results were confirmed by the work of El-Shanhory (1997) on apple who found that the percentage of mature fruits after open pollination were 5.17 and 8.27 compared with 1.02 and 2.43 resulting from bagging only treatment for Anna and Adriana 2 apple cultivars, respectively. Regarding Perfection cultivars, the data of Table (3) showed that the percentage of retained fruits were significantly affected by the different pollination treatments in both seasons. The results of the present study agreed with those of Ibrahim (1974), who reported that cross-pollination of LeConte pear cultivars with pollens of Bartlett and Calleryana cultivars produced high percentage of mature fruits. Working with Plum, StÖsser (1989) found that cross-pollination roughly doubled fruit set and yield in comparison with self-pollination. An appropriate mixture of pollinizers cultivars in the orchard was recommended. Moreover, Ibrahim (1973) found that cross-pollination significantly produced higher percentages of berry-set and mature berries of both Ghariby and Thomposon Seedless grape cultivars. In addition, Kocheskova and Vartapetyan (1979) reported that high yields of some apple varieties were obtained by cross-pollination. In the same line, El-Shanhory (1997) found that cross pollination with Anna or Adriana 2 apple pollen produced higher percentage of mature fruits than the other pollination treatments (open pollination, Bagging only, Emasculation and bagging and hand selfing-pollination). Moreover, bagging only treatment produced lower percentage of mature fruits than the other pollination treatments. Also, Abd-El Fattah (1973) reported that cross-pollination in seedless guava with pollens of seedy guava increased fruit set and yield. Working on olive, Girgis (1999) confirmed that marked increase in retained fruits was noticed when Picual olive trees were pollinated with Leccino pollen grains, in contrast to the Manzanillo or Koronaki pollens. The Least retained fruit percentage was noticed in trees under selfing conditions.

The data of Table (4) showed that percentages of pollen stainability were 66.15, 70.31 and 62.98 in 2002 season and 65.05, 67.79 and 66.15 in 2003 season for Canino, Amal and Perfection, respectively. It was obtained that pollen stainability of Amal cultivar was the highest compared with the two other cultivars. However, the differences among three cultivars were not significant. The results of the present work were confirmed by the work of Tsarenya (1980) who found that there were no significant differences between stainable pollens of certain apple cultivars. In addition, El-Shanhory (1997) showed that there were no significant differences between pollen stainability of Anna and Adriana 2 apple cultivars in both seasons of study.

The data concerning the percentages of pollen germinability for Canino, Amal and Perfection cultivars in 2002 and 2003 seasons are presented in Table (4). The data showed that the percentages of germinated pollens in 2002 were 32.46, 39.82 and 30.04 for Canino, Amal and Perfection cultivars, respectively. In the second season of study, the corresponding values were 29.96, 34.2 and 30.86, respectively for the three cultivars mentioned above. Differences of the tested cultivars in viability of pollen grains may be related to their genetic feature. The viability of Amal pollen grains as percentage of stainable pollen or germinated pollen was slightly higher than those of the other cultivars. However, the differences

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among the three cultivars were not statistically significant in both seasons. The data of the present study stated that staining test gave higher percentages of pollen viability for three cultivars, in the two seasons, than that of direct germination test. This result was in line with those of Ibrahim and Sinble (1989) working on date palm. They were found that the percentages of germinated pollen grains were significantly lower than those of stained pollens. In addition, El-Shanhory (1997) working on apple came to the same conclusion. The results mentioned above could be explained according to the fact that staining test may overestimate viability because non-germinated pollens may still possess sufficient enzymes, starch, chromatin, etc. to accept a stain.

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**دراسات تلقيحية وسيتولوجية على ثلاثة أصناف من أصناف المشمش
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تم إجراء هذه الدراسة خلال موسمين متتاليين ٢٠٠٢، ٢٠٠٣ على أشجار مشمش بالغة لأصناف مشمش كانينو، أمل بيرفكشن. كانت تهدف هذه الدراسة الى دراسة تأثير معاملات التلقيح المختلفة على مدى التوافق الذاتي تحت الدراسة ودور التلقيح الخلطي في تحسين انتاجية تلك الاصناف كانت معاملات التلقيح المستخدمة في هذه الدراسة كما يلي:

- (١) التلقيح المفتوح، (٢) التكريس فقط.
(٣) التلقيح المختلط وتشتمل على مايلي (١) بيرفكشن ♀ * كانينو ♂، (ب) بيرفكشن ♀ * أمل ♂، (ج) بيرفكشن ♀ * أمل ♀ كانينو ♂.

وتتلخص النتائج المتحصل عليها فيما يلي:

- تجاوزت نسبة عقد الثمار ٢٠% وذلك لمعاملة التكريس فقط لصنف أمل وكانينو، في حين انخفضت نسبة العقد عن ٢٠% لصنف بيرفكشن لنفس المعاملة خلال موسمي الدراسة.
- يتضح من ذلك أن صنف أمل وكانينو خصبان ذاتيا بينما صنف بيرفكشن يعتبر صنف غير متوافق ذاتيا. كانت نسبة العقد لصنف أمل وكانينو تحت ظروف التلقيح المفتوح أعلى مقارنة بمعاملة التكريس فقط.
- اضافة الى ذلك فان معاملة التلقيح المختلط لصنف بيرفكشن بحبوب لقاح من صنف كانينو أعطت أعلى نسبة مئوية لعقد الثمار في حين أن معاملة التلقيح المختلط بحبوب لقاح صنف أمل أعطت أقل نسبة مئوية لعقد الثمار وذلك مقارنة بباقي المعاملات خلال موسمي الدراسة.
- التلقيح المفتوح لصنف كانينو وامل أعطت أعلى نسبة مئوية للثمار المتبقية (مكتملة النمو) وذلك مقارنة بمعاملة التكريس فقط في حين أعطت معاملة التلقيح الخلطي لصنف بيرفكشن بحبوب لقاح من صنف كانينو أعلى نسبة مئوية للثمار مكتملة النمو مقارنة بباقي المعاملات.
- لم تعطى معاملة التكريس لصنف بيرفكشن أي ثمار مكتملة النمو خلال موسمي الدراسة. بين اختبار حيوية حبوب اللقاح سواء بالصبغ أو بالانبات أنه لم يكن هناك اختلافا معنويا فيما بين الأصناف الثلاثة في هذا الخصوص. توضح هذه النتائج أن صنف بيرفكشن تتمتع بحبوب لقاحه بحيوية عالية.

Table (3): Effect of different pollination treatments on fruit set and retained (mature) fruits of Perfection apricot cultivar during the seasons of 2002 and 2003.

	2002					2003				
Treatments	Total No. of Flowers	Fruit set		Retained fruits		Total No. of Flowers	Fruit set		Retained fruits	
Treatments	Total No. of Flowers	Total No.	Aver. %	Total No.	Aver. %	Total No. of Flowers	Total No.	Aver. %	Total No.	Aver. %
Treatments	Total No. of Flowers	Total No.	Aver. %	Total No.	Aver. %	Total No. of Flowers	Total No.	Aver. %	Total No.	Aver. %
O.P.	950	269	28.32	170	17.89	767	270	35.20	143	18.64
B.O.	345	6	1.74	0.0	0.00	190	0	0.00	0	0.00
P. x C.	320	101	31.56	59	18.44	297	89	29.97	62	20.88
P. x A.	412	110	26.70	42	10.19	353	68	19.25	22	6.23
P. x C. ♀ A.	310	96	30.97	55	17.74	280	78	27.86	47	16.79
L.S.D. _{0.05}	-----	-----	8.85	-----	4.56	-----	-----	6.97	-----	2.61

O.P. = Open pollination,

B.O. = Bagging only,

P. x C. = Perfection (♀) x Canino (♂),

P. x A. = Perfection (♀) x Amal (♂)

P. x C. ♀ A. = Perfection (♀) x {Canino ♀ Amal} (♂).

Table (4): The percentage of stainable and germinated pollen grains of Canino Amal and perfection apricot cultivar during the seasons of 2002 and 2003.

	Stainable pollen grains						Germinated pollen grains					
	2002			2003			2002			2003		
Cultivars	Total N. of examined pollens	No.	Aver. %	Total N. of examined pollens	No.	Aver. %	Total N. of examined pollens	No.	Aver. %	Total N. of examined pollens	No.	Aver. %
Cultivars	Total N. of examined pollens	No.	Aver. %	Total N. of examined pollens	No.	Aver. %	Total N. of examined pollens	No.	Aver. %	Total N. of examined pollens	No.	Aver. %
Canino	325	215	66.15	421	286	65.05	305	99	32.46	288	98	29.96
Amal	293	206	70.31	392	255	67.79	226	90	39.82	257	77	34.2
Perfection	362	228	62.98	387	256	66.15	273	82	30.04	243	75	30.86
LSD _{0.05}	----	----	n.s.	----	----	n.s.	----	----	n.s.	----	----	n.s.

Table (1): Effect of different pollination treatments on fruit set and retained (mature) fruits of Canino apricot cultivar during the seasons of 2002 and 2003.

	2002					2003				
Treatments	Total No. of Flowers.	Fruit set		Retained fruits		Total No. of Flowers.	Fruit set		Retained fruits	
Treatments	Total No. of Flowers.	Total No.	Aver. %	Total No.	Aver. %	Total No. of Flowers.	Total No.	Aver. %	Total No.	Aver. %
O.P.	773	365	47.2	168	21.7	635	255	40.2	131	20.6
B.O.	432	140	32.4	73	16.9	312	110	35.3	49	15.7
L.S.D. _{0.05}	-----	----	2.04	----	0.59	-----	----	n.s.	----	4.32

O.P. =Open pollination

B.O. =Bagging only.

Table (2): Effect of different pollination treatments on fruit set and retained (mature) fruits of Amal apricot cultivar during the seasons of 2002 and 2003.

	2002					2003				
Treatments	Total No. of Flowers.	Fruit set		Retained fruits		Total No. of Flowers.	Fruit set		Retained fruits	
Treatments	Total No. of Flowers.	Total No.	Aver. %	Total No.	Aver. %	Total No. of Flowers.	Total No.	Aver. %	Total No.	Aver. %
O.P.	825	323	39.2	212	25.7	730	281	38.5	162	22.2
B.O.	485	165	34.0	75	15.5	420	135	32.1	64	15.2
L.S.D. _{0.05}	-----	-----	n.s.	-----	6.4	-----	-----	n.s.	-----	0.74

O.P. =Open pollination

B.O. =Bagging only.