

EFFECT OF POLLINATION ON FRUIT CHARACTERS OF THREE APRICOT CULTIVARS.

Ibrahim A .M. F.**; A.S. El-Sabagh,* and Sh.M. Abd El Mageed*
Pomology Department, Faculty of Agriculture, Alexandria University

ABSTRACT

The present investigation was carried out during the two successive seasons of 2002 and 2003 on mature trees of Canino, Amal and Perfection apricot cultivars. It aimed to study the effect of different pollination treatments on yield and fruit quality of the studied cultivars, to evaluate the degree of self compatibility and role of cross pollination in improving the production of these cultivars. The pollination treatments used in this study were as follows: Open pollination, Bagging only, and 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. Calculated values of fruit weight, flesh weight, stone weight, fruit length, fruit diameter, fruit firmness were higher after open pollination for Canino and Amal cultivars and cross pollination for Perfection cultivar by Canino pollen grains than those of the rest pollination treatments. Open pollination treatment for Canino and Amal cultivars and cross-pollination for Perfection cultivar by Canino pollen grains increased fruit total soluble solids and ascorbic acid (vitamin C) as well as, the same treatments increased the (T.S.S./acidity ratio) than those of the other pollination treatments. Fruits produced from open pollination for Canino and Amal cultivars and cross-pollination for Perfection cultivar by Canino pollen grains were higher in total sugars percentage and carotene than those of the other pollination treatments. However, there were no significant differences among all treatments in fruit total phenols content.

INTRODUCTION

The effect of different pollination treatments, namely, emasculation and bagging, bagging only, hand self-pollination and open-pollination on the fruit weight and shape and other chemical properties depends on varieties, and the pollen source (Abd El-fattah, 1973) working on guava (Ibrahim, 1974 and Xu *et al.*, 1993) working on pear (El-Menshawi, 1977) working on sweet orange, (Shaheen *et al.*, 1989) working on date palm, (Toth *et al.*, 1985,Ardelean *et al.*, 1992 , Arafat *et al.*, 1994 and Liu *et al.*, 2000). Working on apple, (Wallace and Lee, 1999) working on mandarin, (Girgis, 1999) working on olive (Rahemi and Mojaddad, 2001) working on hazelnut. Several Malus pollenizers had generally improved flesh firmness, calyx form and stem thickness of Jonathan, Starking, Golden Delicious and Staymared apple cultivars (Toth *et al.*, 1985). Pollens of Glostar apple cultivar had metaxenic effect on Duncan Red Delicious, Golden Delicious, and Idared

apple cultivars (Davarynejad *et al.* 1994). In mango, pollen source had Metaxenic effects on fruit weight, TSS, acid content, stone weight and fruit colour (Chaudhary and Desai, 1995). However fruit characters such as fruit size, and titratable acidity, TSS and pH of the fruit juice were not affected by the method of pollination in apricot cultivars (Mahanoglu *et al.*, 1995). Fruit weight averages of several pear cultivars (*Pyrus pyrifolia* Nakai) under self-pollination treatment were lower than that under open pollination and most fruits obtained after self-pollination had low marketing quality (Kang *et al.*, 1997). Pollens of different apple had metaxenic effect on fruit shape and colouration (Abdel-Aziz *et al.*, 1999). However different pollinizers of cherry cultivars had no significant effect on fruit quality, fruit weight, seed weight, fruit flesh:seed weight ratio and TSS. (Sutyemez and Eti, 19

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 nine-years-old at the beginning of the experiment and were budded on seedling rootstock. 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 Pollination studies: -The experimental work started on February 20th and continued to May 15th in 2002 and were repeated almost in the same dates 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 (♂), (P. X C.)(B) Perfection (♀) X Amal (♂), (P. X A.)(C) Perfection (♀) X {Canino+Amal} (♂), (P. X C. + A.). Except the open pollination treatment, the flowers in balloon stage for all treatments were counted and the other flowers at the same branch 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 began 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 were 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. *Physical properties*, sample of five fruits from every replicate was weighed, in grams, and the average weight of the fruits was calculated. The stones were extracted, washed, air dried and weighed. The percentage of stone weight to fruit weight was calculated. Fruit

length and diameter were measured by using a vernier caliper. The ratio of fruit length to fruit diameter (L/D ratio) was also calculated to find out the fruit shape index. Fruit firmness as Lb/Inch² was determined by pressure tester mod. FT 327 (3-27 Lbs). *Chemical constituents:* The percentage of total soluble solids (T.S.S %) in fruit juice was measured using a hand-refractometer. The acidity was estimated as malic acid using five milliliters of the fruit juice of each fruit sample and titrated with Sodium hydroxide solution of a known normality using phenolphthaline as an indicator (A.O.A.C., 1950). The results of these titrations were converted to percent of malic acid using the following equation:

$$\text{Percent of malic acid} = \frac{\text{N.NaoH} \times \text{ml.NaoH} \times 0.067^*}{\text{mL. Juice used}} \times 100$$

*0.067=Milliequivalent weight of malic acid.

Total sugars were determined by using the phenol sulfuric acid method (Smith, 1956). Ascorbic acid content was determined using 2,6 dichlorophenol indophenol methods described by (A.O.A.C., 1980). Chlorophyll A; B and Beta-Carotene were determined according to (Wintermans and Mats, 1965) as follows: half gram of fresh peel was extracted by about 15ml of 85% acetone with 0.5g. Calcium carbonate, the mixture was filtered through a glass funnel and the residue was washed with a small volume of acetone and completed to 25 ml. The optical density of a constant volume of filtrate was measured at a wavelength of 622 nm. for chlorophyll A, 644 nm. for chlorophyll B and 440 nm. For carotene using spectrophotometer. The following equations were used:-

$$\text{Chl.A} = 9.784 E_{.662} - 0.99 E_{.644} = \text{mg/L.}$$

$$\text{Chl.B} = 21.426 E_{.644} - 4.65 E_{.662} = \text{mg/L.}$$

$$\text{Carotene} = 4.695 E_{.440} - 0.268 (\text{Chl.A} + \text{Chl.B}) = \text{mg/L.}$$

Where, E. =Optical density at the wavelength indicated.

For determination total phenols, 2 gram of the fruit was extracted by 25ml ethanol 95% for 5 minutes and filtered in a 25ml test tube, using Whatman No.1 filter paper. Half milliliter of each extract was used for total phenols determination. Half milliliter of each 95% ethanol extract was added to 12.5ml-distilled water in a test tube; 0.5 ml Folin-Denis reagent was added. Test tubes were shaken and allowed to stand for 2-3 minutes; 3.5ml of 10% Sodium carbonate were added to each tube. Tubes were shaken and allowed to stand again for about 90 minutes until appear of blue colour. The optical density of 1 ml of each tube contents was determined using a spectrophotometer at a wave length of 660 nm. The total phenolic compounds were calculated according to a standard curve of Pyrogallol acid as mg per gm fresh weight. 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

Fruit quality: Physical properties: As shown in Tables (1 and 2) the average fruit weight resulted from the two different pollination treatments differed significantly in both seasons of investigation, for Canino, and Amal apricot cultivars. From the present results, it was obvious that the average fruit weight was higher after open

pollination treatment than that obtained by bagging only treatment. These results were in line with those of Kang *et al.* (1997), who found that the fruit weight of pear after self-pollination treatment was lower than that under open pollination. In addition, El-Shanhory (1997) stated that fruits produced from open pollination treatment were higher in weight than that of bagging only treatment in Adriana 2 apple cultivar. Also, Wallace and Lee (1999) working in mandarin came to the same conclusion. For Perfection cultivar, the data of Table (3) indicated that the average fruit weight was affected significantly with different pollination treatments. From the present data it was showed that the average fruit weight was differed according to the source of pollen. Cross-pollination with Canino pollen gave the highest value but pollen of Amal gave the lowest value. The results of the present study were in line with those of Ibrahim (1974), who found that cross-pollination of Leconte pear cultivar with pollen of Red Volos apple pollens gave lower fruit weight. However, fruits produced from cross-pollination with Calleryana and Bartlett pear pollens were higher in weight. In the same scope, Ardelean *et al.* (1992), working on apple confirmed that pollinizer affected fruit weight. Moreover, Girgis (1999), found that fruits of Picual olive cultivar were heavier in weight when trees were pollinated with Manzanillo or Koronaki pollens, in contrast to those in case of Mission pollinizer. Rahemi and Mojadad (2001), working on hazelnut showed that the 'Daviana' + 'Cosford' pollen mixture significantly increased nut and kernel weight. It was concluded that the pollen source affected nut and kernel weight. In addition, Shaheen *et al.* (1989), working on date palm, El-Shanhory (1997) and Ardelean *et al.* (1992) working on apple and Chaudhary and Desai (1995) working on Mango, came to the same conclusion. Generally, it was found that open pollination and cross-pollination treatments were the most effective in increasing fruit weight when compared with the remained treatments. Such an effect could be due to the stimulatory effect of the foreign pollen in comparison with the effect of the pollen of the same cultivar.

Flesh weight: The data of Tables (1&2) showed that the average flesh weight of Canino and Amal apricot cultivars was changed significantly in response to the two different pollination treatments. The obtained results clearly showed that open pollination treatment gave the higher average flesh weight than that obtained by bagging only treatment. The results of the present study were in line with those of Rahemi and Mojadad (2001), working on hazelnut. It was found that the pollen source affected nut and kernel weight. For Perfection cultivar, the data of Table (3) showed that the average flesh weight was affected significantly by the source of pollen . While, cross-pollination by Canino pollen gave the highest average flesh weight, the cross-pollination by pollen of Amal cultivar gave the lowest value in both seasons of the study. These results agreed with those obtained by the work of Girgis (1999) on olive, who found that the bigger pulp weights of Picual cultivar were obtained after cross-pollination with Manzanillo pollen grains. Rahemi and Mojadad, (2001) working on Hazelnut came to the same conclusion.

Stone weight: From the present data, Tables(1&3) it was obvious that open pollination increased significantly the average of stone weight in comparison with that of bagging only treatment for the two cultivars during the two seasons except

for 2003 season for Amal cultivar. For Perfection cultivar, the data of Table (3) showed that the average stone weight was affected significantly by the source of pollen. The highest value was in the case of cross-pollination by Canino pollen but the lowest was obtained after cross-pollination by Amal pollen in both seasons of study.

Table (1): Effect of different pollination treatments on fruit weight, flesh weight, stone weight and stone weight to fruit weight ratio (S.W./F.W. ratio) of Canino apricot cultivar during the seasons of 2002 and 2003.

Treatments	Fruit weight (gm)		Flesh weight (gm)		Stone weight (gm)		S.w/F.w. ratio	
	2002	2003	2002	2003	2002	2003	2002	2003
O.P.	38.33	40.51	35.61	37.59	2.72	2.92	0.071	0.072
B.O.	28.39	29.73	26.61	27.34	2.32	2.46	0.080	0.084
L.S.D. _{0.05}	3.77	6.83	3.80	6.53	0.27	0.44	n.s.	n.s.

O.P. = Open pollination

B.O. = Bagging only

Table (2): Effect of different pollination treatments on fruit weight, flesh weight, stone weight and stone weight to fruit weight ratio (S.W./F.W. ratio) of Amal apricot cultivar during the seasons of 2002 and 2003.

Treatments	Fruit weight (gm)		Flesh weight (gm)		Stone weight (gm)		S.w/ F.w. ratio	
	2002	2003	2002	2003	2002	2003	2002	2003
O.P.	32.23	33.90	30.10	31.72	2.13	2.17	0.080	0.064
B.O.	21.51	22.37	19.82	20.59	1.69	1.78	0.079	0.079
L.S.D. _{0.05}	2.94	10.57	2.70	10.18	0.14	n.s.	n.s.	n.s.

O.P. = Open pollination

B.O. = Bagging only.

Table (3): Effect of different pollination treatments on fruit weight, flesh weight, stone weight and stone weight to fruit weight ratio (S.W./F.W. ratio) of Perfection apricot cultivar during the seasons of 2002 and 2003.

Treatments	Fruit weight (gm)		Flesh weight (gm)		Stone weight (gm)		S.w./F.w. ratio	
	2002	2003	2002	2003	2002	2003	2002	2003
O.P.	37.58	40.63	34.85	37.58	2.73	3.05	0.073	0.075
P. x C.	41.28	41.75	38.20	38.63	3.07	3.13	0.075	0.075
P. x A.	31.43	32.83	29.25	30.60	2.18	2.23	0.069	0.067
P. x C. + A.	37.69	37.43	34.93	34.63	2.75	2.80	0.073	0.075
L.S.D. _{0.05}	4.17	4.03	4.70	3.69	0.30	0.36	0.003	0.003

O.P. = Open pollination,

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

P. x A. = Perfection (♀) x Amal (♂)

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

The results of the present study agreed with those of El-Shanhory (1997), who found that the cross-pollination with Anna or Adriana 2 apple pollens gave higher seed weight per fruit. In addition, Shaheen *et al.* (1989) stated that the pollen of 16 date palm male cultivars had metaxenic effects on seed weight of studied female cultivars. Moreover, Yang *et al.* (2002) found that the cross-pollination of Yangshao and Guifei apricot cultivars affected the stone size.

Stone weight to fruit weight ratio: As shown in Tables(1&2) there were no significant differences in the stone weight to fruit weight ratio between the two pollination treatments in both seasons of the study. For Perfection cultivar, the data of Table (3) showed that the stone weight to fruit weight ratio was significantly affected by the differ pollination treatments. Such differences could be due to the effect of the various pollen sources that different in their genotypes. Pollens of each source exerts their effect either stimulatory or inhibitory regarding decreasing or increasing the flesh as well as the stone weight, and consequently the ratio between both. However, the results of the present study contradicted with that of Sutyemez and Eti (1999) who stated that different pollinizers had no significant effect on fruit weight, seed weight and fruit flesh: seed weight ratio.

Fruit length: The data presented in Tables (4&5) showed that the average fruit lengths in Canino and Amal apricot cultivars was different significantly in both seasons of investigation. From the present data, it was found that the average fruit length was higher for open pollination than that of bagging only treatment for both cultivars in the two seasons of the study. The results of the present study were confirmed by the work of El-Menshawi (1977), who found that fruit length of Balady, Khalili White orange and Khalili Red orange varieties was affected by the different pollination treatments. In addition, El-Shanhory (1997) mentioned that bagging only treatment produced fruits with significant lower height than that in all other pollination treatments. For Perfection cultivar, the data of Table (6) showed that the average fruit length was affected significantly by both the source of pollen and different pollination treatments affected the average fruit length. The highest value of average fruit length was obtained by cross-pollination by Canino pollen compared with cross-pollination by Amal pollen that gave the lowest value. These results were confirmed by the work of Ibrahim (1974), how found that cross-pollination on pear gave the highest fruit height. In addition, Shaheen *et al.* (1989) working on date palm, found that the pollen of 16 date palm male cultivars had metaxenic effects on fruit length of Seleg, Sakhi, Khudari and Nebut Seif female cultivars, but these effects differed between years and between the male cultivar. El-Shanhory (1997) on apple came to the same conclusion. He was found that fruits produced from the cross-pollination with Anna or Adriana 2 apple pollens were higher in height than those of the other pollination treatments. Moreover, Ardelean *et al.* (1992) working on apple also came to the same conclusion.

Fruit diameter: The data presented in Tables (4&5) showed that the average fruit diameters for Canino and Amal apricot cultivars was affected significantly by the two different pollination treatments in both seasons, except in the case of Amal cultivar in the second season. The average fruit diameter was higher for open

pollination than that of bagging only treatment for both cultivars in the two seasons of the study except for Amal in 2003. These results agreed with those of El-Menshawi (1977) who found that fruit diameter of Balady orange, Khalili White orange and Khalili Red orange varieties, was affected by the different pollination treatments. In addition, El-Shanhory (1997) working on apple found that, open pollination treatment produced a significant higher fruit diameter as compared with that of bagging only treatments. For Perfection cultivar, the data of Table (6) showed that the average fruit diameter was affected significantly by the source of pollen and different pollination treatments. The highest average fruit diameter was obtained by cross-pollination by Canino pollen compared with that of cross-pollination by Amal pollen that gave the lowest value. The results of the present study were in line with those of Ibrahim (1974), who reported that fruits of Leconte pear cultivar produced from cross-pollination with Red Volos apple pollens were lower in diameter. However, fruits produced from cross-pollination with Calleryana and Bartlett pear pollens were higher in diameter. In addition, Shaheen *et al.* (1989) found that the pollen of 16 date palm male cultivars had metaxenic effects on fruit diameter of Seleg, Sakhi, Khudari and Nebut Seif female cultivars. Moreover, El-Shanhory, (1997) working on apple stated the same results. He found that fruits produced from the cross-pollination with Anna or Adriana 2 apple pollens were higher in diameter than those of the other pollination treatments. In addition, Toth *et al.* (1985) working on apple and Chaudhary and Desai (1995) working on mango came to the same conclusion.

Fruit shape (L / D ratio): The data presented in Tables (4&5) showed that the average fruit shape index (L / D ratio) in Canino and Amal apricot cultivars was not significantly affected by both pollination treatments in both seasons for the two cultivars. These results were confirmed by the work of Abd El-Fattah (1973) who found that fruit shape of seedy guava was not affected by either open pollination or bagging only treatments. In addition, El-Shanhory (1997) working on apple found that, there were no significant differences in fruit shape index between both open pollination and bagging only treatments. For Perfection cultivar, the data of Table (6) showed that the average fruit shape index (L / D ratio) did not differ significantly among different pollination treatments in both seasons of the study. The results were confirmed by the work of Degman and Auchter (1934) on certain apple cultivars, Stephen (1958) working on pears, EL-Shanhory (1997) and Abdel-Aziz *et al.* (1999) working on apple, they were found that the shape (Height / Diameter ratio) in fruits were not affected significantly by the pollen parent.,

Fruit firmness: The data presented in Table (4) showed that the average fruit firmness for Canino apricot cultivar did not differ significantly between both treatments in the first season while in the second season it was increased by open pollination. With regard to Amal cultivar, the data of Table (5) showed that the average fruit firmness was significantly affected by both pollination treatments in the two seasons of study. In the case of Amal in both seasons and Canino in the second season, agree with that of El-Shanhory (1997), who found that bagging only treatment significantly decreased fruit firmness as compared with that of open pollination in Anna apple cultivar. As for Perfection cultivar, the data of Table (6) showed that the source of pollen and

different pollination treatments did not affect significantly the average fruit firmness in both seasons. These results were contradicted with those of Arafat *et al.* (1994), who found that fruit firmness of Anna apple cultivar was highest with cross-pollination by Dorsett Golden or Ein Shemer. In addition, Davarynejad *et al.* (1994) working on apple, found that when Idared was pollinated with Summerred the firmness of the fruit decreased significantly in comparison with fruit obtained from open pollinated flowers. Moreover, Ibrahim (1981) working on strawberries and El-Shanhory (1997) and Liu *et al.* (2000) working on apple came to the same conclusion.

Chemical constituents: The data presented in Tables (7 & 8) showed that the percentages of total soluble solids of Canino and Amal fruits were significantly affected by both pollination treatments in the first season for both cultivars, however in the second season, there was no significant difference observed between both treatments for the two cultivars. In general, the percentage of total soluble solids was higher in open pollination than in bagging only treatment for both cultivars. This result was confirmed by the work of El-Shanhory (1997) on apple, who found that open pollination significantly increased T.S.S. % than that in bagging only treatment, but such an increment was in one season only. The data of Table (9) showed that the percentage of total soluble solids in fruits of Perfection cultivar was affected significantly by the source of pollen in both seasons. The highest value was obtained by cross-pollination by Canino pollen, whereas, the lowest was obtained by cross-pollination by Amal pollen. These results of the present work contradicted with those of Mahanoglu *et al.*, (1995) who showed that the fruit total soluble solids were not affected by the method of pollination in apricot cultivars. In addition, Arafat *et al.* (1994) working on apple, found that the percentage of total soluble solids were not affected by cross-pollination. Moreover, Ibrahim (1973) reported that the percentage of total soluble solids in the berry juice was decreased in both seasons by the cross-pollination treatment as compared with the other pollination treatments. Yang *et al.* (2002) working on apricot, came to the same result. In the meantime, our results were in line with those of Ibrahim (1974) who stated that, LeConte pear fruits that were produced after cross-pollination with Bartlett pear pollens contained high percent of total soluble solids in the fruit juice. In addition, El-Shanhory (1997) working on apple found that fruits produced from the cross pollination with Anna or Adriana 2 apple pollens were higher than those of the other pollination treatments. Moreover, Chaudhary and Desai, (1995) found that cross-pollination of Kesar by Vanraj pollen increased mango fruit total soluble solids.

Acidity: The data presented in Tables (7 & 8) showed that the percentage of acidity in Canino and Amal apricot cultivars was not affected significantly by both treatments for the two cultivars in the two seasons of study, except, in the case of Canino cultivar in the season of 2003 where, the difference between two treatments was significant. This result agreed with that of Abd El-Fattah (1973) who showed that the percentages of acidity were not affected by both pollination treatments (open pollination or bagging only treatments) in the two guava varieties (seedy guava and seedless guava). Furthermore, Ibrahim (1973) stated that the acidity of the grapes juice was not effected by the

different pollination treatments for the two varieties (Ghariby and Thomposon Seedless) in both seasons of study. The data of Table (9) showed that the percentages of acidity in fruit juice was significantly affected by different pollination treatments in the two seasons of study. From the present data, it was shown that the percentage of acidity differed according to the source of pollen used. The highest value was obtained from cross-pollination by Amal pollen. These results were in line with those of Ibrahim (1974) working on pear, who found that cross pollination with Red Volos apple pollens produced fruits which contained high percent of acid.

Table (4): Effect of different pollination treatments on fruit length, fruit diameter, shape index (L/D ratio) and fruit firmness of Canino apricot cultivar during the seasons of 2002 and 2003.

Treatments	Fruit length (cm)		Fruit diameter (cm)		(L/D ratio)		Fruit firmness (lb/inch ²)	
	2002	2003	2002	2003	2002	2003	2002	2003
O.P.	4.03	4.02	4.00	4.04	1.008	1.00	4.03	4.08
B.O. Treatments	3.49	3.56	3.48	3.51	1.003	1.01	3.45	3.28
L.S.D. _{0.05}	0.47	0.45	0.40	0.32	n.s.	n.s.	n.s.	0.50

O.P. =Open pollination

B.O. =Bagging only.

Table (5): Effect of different pollination treatments on fruit length, fruit diameter, shape index (L/D ratio) and fruit firmness of Amal apricot cultivar during the seasons of 2002 and 2003.

Treatments	Fruit length (cm)		Fruit diameter (cm)		(L/D ratio)		Fruit firmness (lb/inch ²)	
	2002	2003	2002	2003	2002	2003	2002	2003
O.P.	3.74	3.65	3.68	3.77	1.02	0.97	3.13	3.28
B.O. Treatments	2.95	3.10	3.10	3.15	0.95	0.99	2.38	2.63
L.S.D. _{0.05}	0.45	0.48	0.25	n.s.	n.s.	n.s.	0.28	0.38

O.P. =Open pollination

B.O. =Bagging only.

Table (6): Effect of different pollination treatments on fruit length, fruit diameter, shape index (L/D ratio) and fruit firmness of Perfection apricot cultivar during the seasons of 2002 and 2003.

Treatments	Fruit length (cm)		Fruit diameter (cm)		(L/D ratio)		Fruit firmness (Pound/inch ²)	
	2002	2003	2002	2003	2002	2003	2002	2003
O.P.	4.08	3.95	4.00	3.90	1.02	1.02	3.69	3.80
P. x C. Treatments	4.23	4.30	4.13	4.20	1.02	1.03	3.79	3.70
P. x A.	3.58	3.50	3.53	3.46	1.01	1.01	4.00	4.00
P. x C. + A.	4.03	4.03	3.90	3.93	1.03	1.02	3.90	3.90
L.S.D. _{0.05}	0.35	0.34	0.38	0.36	n.s.	n.s.	n.s.	n.s.

O.P. = Open pollination,

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

P. x A. = Perfection (♀) x Amal (♂)
 P.xC.+A.=Perfection(♀)x(Canino+Amal)(♂).

Table (7): Effect of different pollination treatments on total soluble solids (TSS), acidity, TSS/acidity ratio and ascorbic acid content of Canino apricot cultivar during the seasons of 2002 and 2003.

Treatments	TSS (%)		Acidity (%)		TSS/Acid ratio		V.C (mg/100 ml juice)	
	2002	2003	2002	2003	2002	2003	2002	2003
O.P.	14.63	15.5	0.50	0.42	29.26	36.90	1.63	1.73
B.O. Treatments	13.88	14.63	0.55	0.47	25.23	31.12	1.69	1.84
L.S.D. _{0.05}	0.46	n.s.	n.s.	0.042	2.65	1.93	n.s.	n.s.

O.P. =Open pollination

B.O. =Bagging only.

Table (8): Effect of different pollination treatments on total soluble solids (TSS), acidity, TSS/acidity ratio and ascorbic acid content of Amal apricot cultivar during the seasons of 2002 and 2003.

Treatments	TSS (%)		Acidity (%)		TSS/Acid ratio		V.C mg/100 ml juice	
	2002	2003	2002	2003	2002	2003	2002	2003
O.P.	15.40	15.95	0.41	0.37	37.56	43.11	1.43	1.49
B.O. Treatments	14.63	15.20	0.45	0.41	32.51	37.07	1.51	1.61
L.S.D. _{0.05}	0.51	n.s.	0.042	n.s.	3.75	n.s.	0.047	n.s.

O.P. =Open pollination

B.O. =Bagging only.

Table (9): Effect of different pollination treatments on total soluble solids (TSS), acidity, TSS/acidity ratio and ascorbic acid content of Perfection apricot cultivar during the seasons of 2002 and 2003.

Treatments	TSS (%)		Acidity (%)		TSS/Acid ratio		V.C (mg/100 ml juice)	
	2002	2003	2002	2003	2002	2003	2002	2003
O.P. Treatments	14.38	15.13	0.41	0.41	35.07	36.90	1.54	1.58
P. x C.	14.93	15.88	0.40	0.42	37.33	37.80	1.77	1.82
P. x A.	14.25	15.13	0.45	0.42	31.66	36.03	1.58	1.65
P. x C. + A.	14.38	15.13	0.41	0.41	35.07	36.90	1.42	1.47
L.S.D. _{0.05}	0.46	0.44	0.039	n.s.	2.15	n.s.	0.22	0.20

O.P. = Open pollination,

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

P. x A. = Perfection (♀) x Amal (♂)

P.xC.+A.=Perfection(♀)x(Canino+Amal)(♂).

However, cross-pollination with Bartlett and Calleryana pear pollens produced fruits with low percent of acid in the fruit juice. In addition, El-Menshawi (1977) found that the acid percentage in fruit juice was affected by the

different pollination treatments (open pollination, hand self-pollination and cross pollination) in Balady orange and Balady blood orange varieties. Furthermore, Davarynejad *et al.* (1993) showed that apple cultivars Duncan Red Delicious, Golden Delicious and Idared produced fruits with a greater acid content when pollinated by the cultivar Gloster. El-Shanhory (1997) stated the same conclusion, that cross-pollination with Anna or Adriana 2 apple pollen cultivars produced fruits with high percentage of acid. Moreover, Chaudhary and Desai (1995) working on mango and Yang *et al* (2002) working on apricot came to the same conclusion

TSS / acid ratio:Data of TSS / acid ratio are shown in Tables (7&8) The data showed that the TSS / acid ratio in Canino and Amal apricot cultivars was higher in those traits that resulted by open pollination treatment than those obtained by bagging only treatment. The effect of both pollination treatments was significant for both cultivars in the two seasons of study. This result was confirmed by the work of El-Menshawi (1977), who found that T.S.S. / acid ratio were affected by the different pollination treatments in Balady orange and Balady blood orange varieties. Moreover, El-Shanhory (1997) working on apple reported that TSS / acid ratio was significantly lower in open pollination than in bagging only treatment. The data of Table (9) presented the TSS / acid ratio in fruits of perfection apricot cultivars. In general the cross-pollination by Canino pollen significantly increased TSS / acid ratio as compared with those of the other pollination treatments in the first season. In contrast, cross-pollination by Amal pollen significantly decreased this ratio in both seasons of study. These results agreed with those of El-Menshawi (1977), who reported that the TSS / acid ratio was affected by the different pollination treatments in Balady Blood orange and Balady orange varieties. Moreover, El-Shanhory (1997) working on apple came to the same conclusion.

Ascorbic acid:The data presented in tables (7& 8) showed that the ascorbic acid contents in Canino and Amal fruit juice for both cultivars in the two seasons of study except in the first season for Canino cultivar, open pollination significantly decreased ascorbic acid content in the fruit juice compared with bagging only treatment. This result was contradicted by the work of El-Shanhory (1997) working on apple, who found that vitamin (C) in bagging only treatment was significantly lower than that in open pollination. For Perfection cultivar, the data of table (9) showed that, ascorbic acid contents in fruit juice was significantly affected by the different pollination treatments in the two seasons of study. The highest value was obtained from cross-pollination by Canino pollen, whereas, the lowest was after cross-pollination by Amal pollen. The results of the present study were confirmed by the work of El-Shanhory (1997), who found that cross-pollination with Anna or Adriana 2 apple pollens produced fruits with high percentage of ascorbic acid. In addition, Abd El-Fattah (1973) found that vitamin (C) content of the fruit juice was not affected by the different pollination treatments for the two guava varieties. Moreover, Mohamed (1974) reported that percentage of vitamin C content in fruit juice of Marsh and Duncan grapefruit varieties were not affected by the different pollination treatments.

Total sugars: The data of Table(10) showed that, the percentage of total sugars in fruit juice of Canino cultivar were significantly affected by pollination treatments in

the two seasons of study. As for Amal cultivar, the results of Table (11) showed that the percentage of total sugars in the first season was not significantly affected by pollination treatments. However, in the second season it was observed a significant difference between both treatments. In general, the results of the present study showed that open pollination increased the percentage of total sugars in fruits as compared with that resulted by bagging only treatment. This result was confirmed by the work of El-Shanhory (1997) who found that open pollination treatments produced fruits with a significant higher percentage of total sugars as compared with that of bagging only treatment. For Perfection cultivar, the data of Table (12) also showed that the percentage of total sugars was significantly affected by the different pollination treatments in both seasons of study. From the present data, it was clear that the percentage of total sugars was affected by the source of pollen. Cross-pollination by Canino pollen significantly gave the highest percentage compared with those of the other treatments, however, cross-pollination by Amal gave the lowest value. These results were in line with those of Shaheen *et al.* (1989) who found that the pollen of 16 date palm male cultivars had metaxenic effects on sugars of fruits for Seleg, Sakhi, Khudari and Nebut Seif female cultivars. In addition, El-Shanhory (1997) found that fruits produced from the cross pollination with Anna or Adriana 2 apple pollens were higher in the percentage of total sugars than that of open pollination treatment. Moreover, Wallace and Lee (1999) working on citrus stated the same conclusion.

Carotene: The data of (Table12) showed that, open pollination significantly increased the average carotene content in the fruit peel (skin) for both cultivars in the two seasons of study. For Perfection cultivar, the data of Table (12) also showed that the average carotene content in fruit peel was significantly affected by the different pollination treatments. From these results, it was obtained that average carotene content in fruit peel (skin) was affected by the sources of pollen used. Pollen of Canino significantly gave the highest value, while, the pollen of Amal gave the lowest value. This result was in line with those of Toth *et al.* (1985), who found that SBK-8 apple pollinizer improved the coloring of Jonathan and Staymared cultivars compared with open pollination. In addition, Chaudhary and Desai (1995) working on mango, found that pollination of Kesar by Vanraj increased fruit coloring . Moreover, Liu *et al.* (2000) Working on apple, came to the same conclusion.

Total Phenols: The data of Tables (10&11) showed that the average phenol content in Canino and Amal fruits were not affected significantly by both pollination treatments in both seasons for the two cultivars. For Perfection cultivar, the data of table (12) showed that average phenol content in fruit juice was significantly affected by the different pollination treatments in the two seasons of study. The highest value was obtained from cross-pollination with Amal pollen and the lowest value was found after cross-pollination with Canino pollen. These results were confirmed by the work of Shaheen *et al.*, (1989), who found that the pollen of 16 date palm male cultivars had metaxenic effects on fruit tannins of Seleg, Sakhi, Khudari and Nebut Seif female cultivars.

Table (10): Effect of different pollination treatments of total sugars, carotene and phenols of Canino apricot cultivar during the seasons of 2002 and 2003.

Treatments	Total sugars (%)		Carotene (mg/L)		Phenols	
	2002	2003	2002	2003	2002	2003
O.P.Treatments	4.32	4.35	1.055	1.028	0.11	0.11
B.O.	4.14	4.17	0.956	0.894	0.11	0.12
L.S.D. _{0.05}	0.13	n.s.	n.s.	0.084	n.s.	n.s.

O.P. =Open pollination

B.O. =Bagging only.

Table (11): Effect of different pollination treatments of total sugars, carotene and phenols of Amal apricot cultivar during the seasons of 2002 and 2003.

Treatments	Total sugars (%)		Carotene (mg/L)		Phenols	
	2002	2003	2002	2003	2002	2003
O.P.Treatments	4.38	4.50	1.40	1.39	0.17	0.18
B.O.	4.28	4.30	1.12	1.16	0.19	0.20
L.S.D. _{0.05}	0.13	0.17	0.16	0.14	n.s	n.s.

O.P. =Open pollination

B.O. =Bagging only.

Table (12): Effect of different pollination treatments of total sugars, carotene and phenols of Perfectio apricot cultivar during the seasons of 2002 and 2003.

Treatments	Total sugars		Carotene Mg/L		Total phenols Mg/gm.fresh weight	
	2002	2003	2002	2003	2002	2003
O.P.Treatments	4.27	4.26	0.87	0.95	0.12	0.13
P. x C.	4.47	4.49	1.02	1.03	0.09	0.09
P. x A.	4.15	4.12	0.68	0.73	0.16	0.16
P. x C. + A.	4.26	4.29	0.91	0.89	0.14	0.13
L.S.D. _{0.05}	0.15	0.13	0.13	0.03	0.025	0.020

O.P. = Open pollination,

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

P. x A. = Perfection (♀) x Am

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

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تأثير التلقيح علي خصائص الثمار لثلاثة أصناف من أصناف المشمش
عاطف فتح الله ابراهيم**أحمد سعيد الصباغ*وشريف محمد عبد المجيد*
كلية الزراعة بدمهور ,جامعة الاسكندرية*,كلية الزراعة بالشاطبي جامعة الاسكندرية**

تم اجراء هذه الدراسة خلال موسمين متتاليين ٢٠٠٢, ٢٠٠٣ علي أشجار مشمش
بالغة لأصناف مشمش كانينو, أمل, بيرفكشن. كانت تهدف هذه الدراسة الي دراسة تأثير
معاملات التلقيح المختلفة علي صفات الثمار للأصناف تحت الدراسة. كانت معاملات
التلقيح المستخدمة في هذه الدراسة كما يلي:

(١) التلقيح المفتوح

(٢) التكريس فقط.

(٣) التلقيح المختلط وتشتمل على مايلي (ا) بيرفكشن ♀ *كانينو ♂ (ب) بيرفكشن ♀ * أمل ♂ (ج)
بيرفكشن ♀ * أمل + كانينو ♂ .

أدت معاملة التلقيح المفتوح الي زيادة معنوية في كل من متوسط وزن الثمرة ,وزن اللحم ,وزن
النواة, طول وقطر الثمرة ,وكذلك صلابة الثمار وذلك لصنفى أمل وكانينو,وكذلك أدت معاملة التلقيح
الخلطي لصنف بيرفكشن بحبوب لقاح من صنف كانينو الي زيادة معنوية مقارنة بباقي معاملات
التلقيح. أيضا ادت معاملة التلقيح المفتوح لصنف كانينو وأمل وكذلك معاملة التلقيح الخلطي لصنف
بيرفكشن بحبوب لقاح صنف كانينو الي زيادة معنوية في محتوى الثمار من المواد الصلبة الذائبة
الكلية وكذلك فيتامين ج اضافة الي ذلك ازادت نسبة المواد الصلبة الذائبة الكلية الي الحموضة وذلك
مقارنة بباقي المعاملات. الثمار الناتجة من معاملة التلقيح المفتوح لصنفى أمل وكانينو وكذلك معاملة
التلقيح الخلطي لصنف بيرفكشن بحبوب لقاح صنف كانينو فان محتواها كان عاليا من السكريات
الكلية وكذلك الكاروتين مقارنة بباقي معاملات التلقيح المختلفة. ومع ذلك لم يكن هناك اختلافا معنويا
فيما بين المعاملات المختلفة من حيث محتوى الثمار من الفينولات.