

EFFECT OF VARIOUS POLLINIZERS ON FRUIT CHARACTERS OF LOW CHILLING APPLE CULTIVARS

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Abstract

Fruit shape of studied apple cultivars was influenced by the type of the parent pollen. When Anna was crossed by Dorsett Golden, the obtained fruits were round and flat, but when Ein-Shemer was used as a pollinizer round elongate fruits were obtained. Open pollination resulted in the best fruit colour. When both "Dorsett Golden" or Ein-Shemer were pollinated with Anna reddish parts were noticed on the fruit skin, complete seed, fruit firmness, fruit texture, total soluble solids and acidity were determined under types of pollination. Improvement in fruit quality is associated with number of Viable seeds per fruits.

INTRODUCTION

Recently, between 1980-1981 several apple cultivar including Anna, Dorsett Golden and Ein-Shemer were introduced from USA by the Agricultural Development System Project of the Ministry of Agricultural. They were grown at the ADS introduction orchard at Kanater.

Fruit characteristics were studied for Fruits resulted from open pollination, self pollination, emasculation without pollination or from different crosses made in the three apple cultivars.

Aeppli (1985) determined the fruit quality characteristics of 177 cultivars and found out the correlation and multiple regressions with eating quality. Effects of yield, weather tree age on fruit size in apple were stated by Sehuricht (1986) Toth *et al*, (1987) reported the effect of Malus pollinators on the quality of Apple, Generally, they found that pollinators improved flesh firmness.

The aim of this investigation is to study some fruit characters obtained from different pollination methods.

MATERIALS AND METHODS

The experiment was carried in the ADS experiment orchard at Barrage during the 1986 and 1987 seasons. Fruit characteristics were studied for fruits resulted from open pollination, self pollination, and emasculation without pollination or from different crosses made in the three apple cultivars. Samples were picked when fruits reached maturity. Fruit weight, fruit size, diameter, height, circumference, skin colour, texture, total soluble solids (T.S.S.), acidity as mallic acid and total viable seeds per fruit was determined on 25 fruits samples. Colour of fruit skin was determined using a colour chart (Rebert and Wilson, 1938). Firmness of fruits was carried by Penetrometer (pressure tester). The percentage of total soluble solids (T.S.S.) was measured using ATAGO (ATC. L) Mand refractometer. Acidity was determined by titration with 0.1 normal sodium hydroxide using phenol phthalene as indicator.

L.S.D. was used for data comparison according to Snedecor and Cochran, (1972).

RESULTS AND DISCUSSION

Effect of different pollination treatments on mature fruit characters

1 Anna:

Table 1 and Fig. 1 show main characteristics of fruits produced from open and cross pollinations.

a. Fruit weight: Statistical analysis revealed that significant differences occurred in weight of fruit produced from different pollination treatments. In 1986, the highest fruit weight was obtained from hybrid. Anna ♀ Ein-Shermer ♂ (148.26 g/fruit) followed by open pollination (116.26 g/fruit) then by the hybrid Anna ♀ x Dorsett Golden ♂ (82.20 g /fruit). In 1987, open pollination produced fruits with the highest weight (131.40g/fruit), followed by Anna ♀ x Dorsett Golden (108.23 g/fruit) and Anna ♀ x Ein-Shermer ♂ (98.30 g/fruit).

b- Fruit Size: The biggest fruit size was obtained from the hybrid Anna ♀ x Ein-Shermer ♂ (193.33 c.c./Fruit) followed by of open pollination (142.00 c.c./fruit) then by fruits of the hybrid Anna ♀ x Dorsett Golden ♂ (111-10 c.c./Fruit). In 1987, open pollination produced the best sized-fruit (159.00 c.c./Fruit), while the size of the

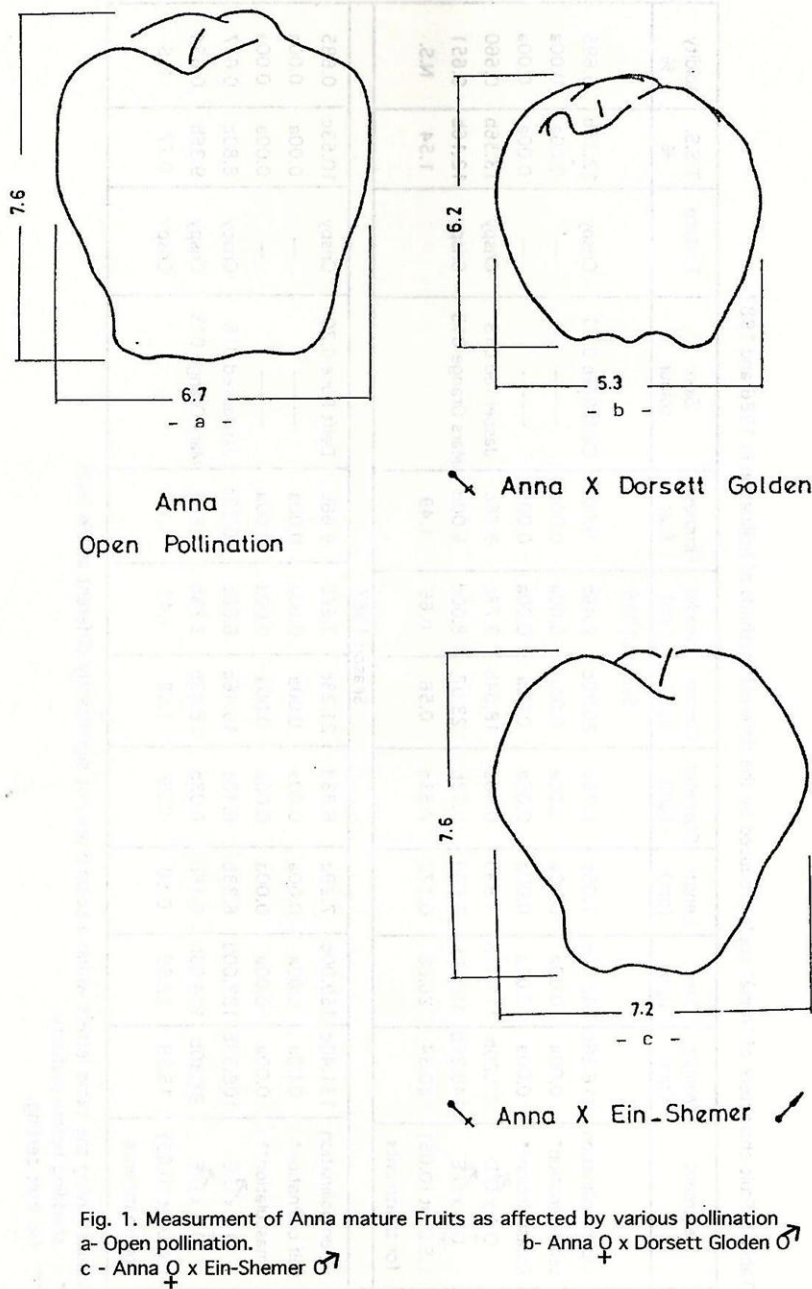
Table 1. Fruit characters of "Anna" apple produced by the different methods of pollination in 1986 and 1987.

Treatment	Weight (gm)	Size (gm)	Length (gm)	Diameter (gm)	Circum (gm)	Seeds/ (gm)	Firmness fruit	Skin colour	Texture	T.S.S. %	Acidity %	
Open pollination self pollination* Emasculatation** ♀ A x ♂ D ♀ A x ♂ E L.S.D. at (0.05) for treatments	Season 1986											
	116.26c	142.00c	7.05c	6.76c	20.20c	2.46b	9.00	Delft Rose 0.20	Crispy	12.56b	0.695	
	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	-----	---	0.00a	0.00a	
	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	-----	---	0.00a	0.00a	
	82.20b	111.10b	5.89b	0.00a	18.04b	3.73c	8.66c	Jasper red 018	Crispy	13.36b	0.660	
148.26b	193.33	7.66d	5.73b	23.07	8.00d	6.00b	Mars Orange 013	Crispy	12.16b	0.651		
20.34	26.88	0.172	7.53d	0.56	0.66	1.49			1.54	N.S.		
Season 1987												
Open pollination self pollination* Emasculatation** ♀ A x ♂ D ♀ A x ♂ E L.S.D. at (0.05) for treatments	131.40c	159.00c	7.29c	6.83d	21.23c	2.66b	9.66b	Delft Rose 0.20	Crispy	10.53c	0.685	
	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	-----	---	0.00a	0.00a	
	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	-----	---	0.00a	0.00a	
	108.33b	133.00b	6.33b	6.40c	19.46c	6.06c	10.33c	Jasper red 018	Crispy	8.80b	0.677	
	98.30b	124.03b	6.16b	6.03b	18.43b	3.33b	7.66b	Mars Orange 013	Crispy	9.36b	0.654	
15.39	12.58	0.50	0.29	1.06	1.48	1.15			0.77	N.S		

Values having the same letters within a column are not significantly different at 5% level.

* shedding before maturity

** No fruit setting.



fruit of the two hybrids Anna ♀ x Dorsett Golden ♂ or EinShemer ♂ were less in volume (133.00 and 124.03 c.c./fruit respectively).

C- Fruit shape: In 1986, the longest fruits were those of the hybrid Anna ♀ x Ein-Shemer ♂ (7.66 cm), while of open pollination averaged 7.06 cm followed by those of the hybrid Anna ♀ x Dorsett Golden ♂ (5.89 cm). In 1997 the longest fruits were those of open pollination (7.29 cm) then Anna ♀ x Dorsett Golden ♂ and Ein-Shemer ♂ were of 6.33 and 6.16 cm, respectively.

In 1986 the widest fruit diameter was that of the hybrid Anna ♀ x Ein-Shemer ♂ (7.23 cm) followed by those of open pollinated fruits (6.76 cm). The narrowest fruit diameter was noticed in hybrid Anna ♀ x Dorsett Golden ♂ (5.73 cm).

In 1987, open pollination gave fruits of widest diameter (6.83 cm), followed by those of hybrid Anna ♀ x Dorsett Golden ♂ (6.40 cm). However, Anna ♀ x Ein-Shemer ♂ produced fruit with only (6.03 cm) diameter.

In 1986, the fruit circumference ranged between (23.70 cm) for the hybrid Anna ♀ x Ein-Shemer ♂ and 18.04 cm for the hybrid Anna ♀ x Dorsett Golden ♂ and 20.2 cm was the open pollination. In 1987, it ranged between 21.23 cm. for open pollination and 18.43 cm. for the hybrid Anna ♀ x Ein-Shemer ♂.

II Dorsett Golden:

Table 2 and Fig. 2 show the characteristics of fruits produced from open, self and cross pollination. The characteristics of fruits produced by emasculatation without pollination were also presented.

a. **Fruit Weight** : In 1986, the average fruit weight ranged between 120.00g/fruit for emasculatation without pollination and 91.509/fruit for self pollination. In 1987, it ranged between 151.60 g/fruit for open pollination and 95.009/fruit for self pollination.

b. **Fruit size** : In 1986 the size ranged between 165.55 c.c./fruit for emasculatation without pollination and 90.02 c.c./fruit for self pollination. Nevertheleas in 1987 ranged between 165.66 cc/fruit for open pollination and 121.66 c.c./fruit for self pollination.

c. **Fruit shape** : In 1987, Fruit length varied between 5.40 cms and 6.66 cms for self pollination and open pollination respectively. It ranged between 5.40 cms and

Table 2. Fruit characters of "Dorsett Golden" apple produced by the different methods of pollination in 1986 and 1987.

Treatment	Weight- (gm)	Size (gm)	Length (gm)	Diameter (gm)	Circum (gm)	Seeds/ (gm)	Firmness fruit	Skin colour	Texture	T.S.S. %	Acidity %	
	Season 1986											
Open pollination	99.66b	126.13c	6.66b	6.33b	19.76b	1.33b	9.80a	Straw yellow 604	Slightly	12.73a	0.646	
self pollination*	65.10a	90.20a	5.40a	5.10a	17.00a	0.50a	12.00a	Salmon 412	crispy	11.90a	0.682	
Emasculation**	120.00d	165.00	6.40a	6.70b	21.00c	0.00a	11.16ab	Straw yellow 604	Crispy	13.50b	0.642	
♀ A x ♂ D	108.50c	139.31d	6.46b	6.23b	19.63b	4.06d	10.50a	Nasturtium orange	slightly	12.00a	0.618	
♀ A x ♂ E	91.70b	111.53b	5.66a	6.16ab	18.93b	3.93c	11.26b	610/3	crispy	12.46a	0.681	
L.S.D. at (0.05) for treatments	14.56	12.84	1.04	0.76	1.00	0.61	1.40	Barium yellow 503/2		0.87	N.S.	
	Season 1987a											
Open pollination	151.60bc	148.66b	6.73c	7.10c	23.96c	1.93c	10.33a	Straw yellow 604	Slightly	12.56b	0.624	
self pollination*	95.00a	121.66a	5.90a	5.63a	18.23a	1.00b	11.33b	Salmon 412	crispy	13.00c	0.654	
Emasculation**	95.83a	132.33ab	5.40a	6.10b	17.76a	0.00a	10.66a	Straw yellow 604	Crispy	12.96c	0.647	
♀ A x ♂ D	122.13b	165.66c	6.20b	6.16b	19.19ab	4.66d	10.83a	Nasturtium orange	slightly	12.03a		
♀ A x ♂ E	128.56b	141.33b	6.50b	5.73a	20.39b	4.66d	10.66a	610/3	crispy	12.93c		
L.S.D. at (0.05) for treatments	13.95	11.09	0.51	0.26	1.76	0.87	0.52	Barium yellow 503/2		0.23	N.S.	

Values having the same letters within a column are not significantly different at 5% level.

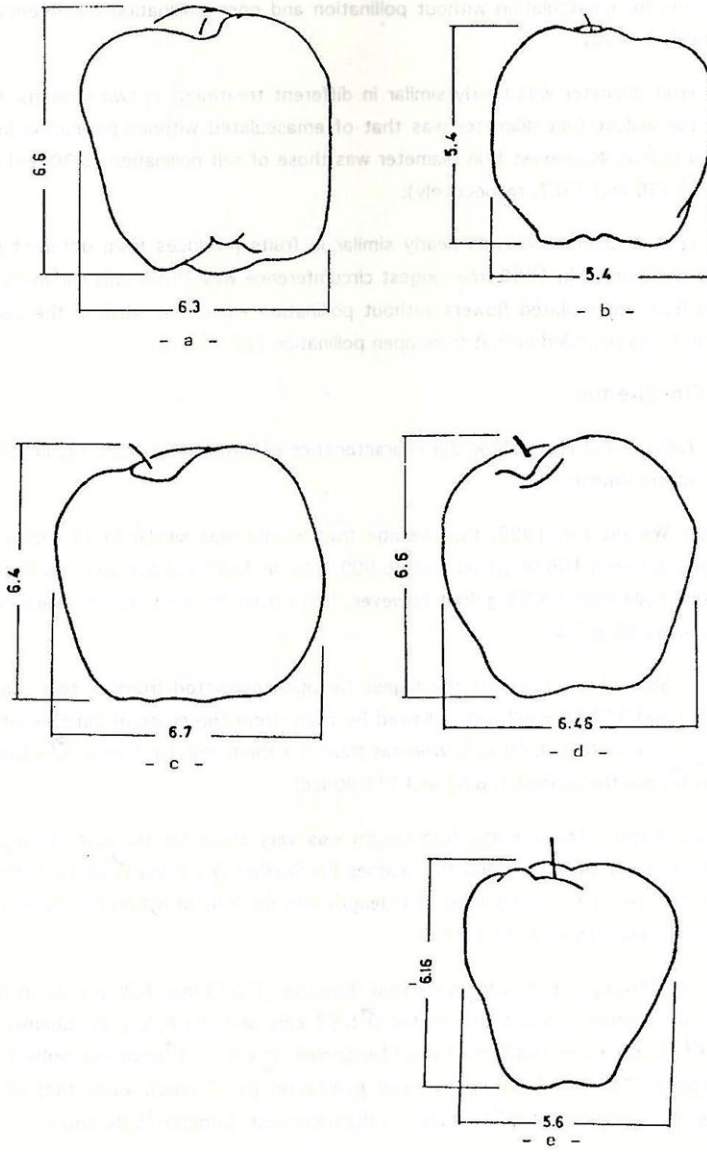


Fig. 2. Measurement of Dorsett Golden mature Fruits as affected by various pollination.
 a- Open pollination. b- Self pollination c - emasculation without pollination
 d - Dorsett Golden ♀ x Anna ♂ e - Dorsett Golden ♀ x Ein-Shemer ♂

6.73 cms for emasculation without pollination and open pollination treatments, respectively in 1987.

Fruit diameter was nearly similar in different treatment in two seasons. However, the widest fruit diameter was that of emaseulated without pollination in the second season. Narrowest fruit diameter was those of self pollination (5.30 and 5.64 cms in 1986 and 1987, respectively).

Fruit circumference was nearly similar in fruits produces from different pollination treatments. In 1986, the longest circumference was 21.00 cms for fruits produced from emasculated flowers without pollination treatment while in the second season it was recorded in fruit from open pollination (23.96 cms).

III Ein-Shemer:

Table 3 and Fig 3 show the characteristics of Ein-Shemer fruits resulted from different treatments.

a. Fruit Weight : In 1986, the average fruit weight was similar in all treatments ranging between 166.00g/fruit and 86.009/fruit. In 1987 the average was heaviest for open pollination 99.93 g/fruit however, fruits from the two crosses were nearly equal i.e 63.66 g/fruit.

b. Fruit Size : Fruit size was the biggest for open pollinated fruits in two seasons (125.33 and 151.33 c.c/fruit), followed by fruits from the cross of Ein-Shemer ♀ x Anna ♀ (85.00 and 136.00 c.c). Whereas those for the hybrid Ein-Shemer ♂ x Dorsett Golden ♂ were the lightest (76.83 and 111.60 c.c).

c. Fruit shape : The average fruit length was very close for the open pollination (6.30 and 6.60 cms/fruit) and the crosses Ein-Snemer ♀ x Anna ♂ (6.16 and 6.76 cm) in two seasans. The shortest fruit length was for fruit of hybrid Ein-Shemer ♀ x Dorsett Golden O (5.46 and 6.20 cm).

In 1986, open pollination gave fruit diameter of 6.23 cms followed by those of hybrid Ein-Shemer ♀ x Dorsett Golden ♂ 5.53 cms and the hybrid Ein-Shemer ♀ x Anna ♂ (5.26 cms In 1987, the hybrid Ein-Shemer ♀ x Anna ♂ gave the highest fruit diameter (6.76 cms) followed by open pollination (6.50 cms). while that of Ein-Shemer ♀ x Dorsett Golden ♂ resulted in the narrowest diameter (5.86 cms).

In 1986, fruit circumference was 19.53 cms for open pollinated fruits followed

Table 3. Fruit characters of "Ein-Shemer" apple produced by the different methods of pollination in 1986 and 1987.

Treatment	Weight (gm)	Size (gm)	Length (gm)	Diameter (gm)	Circum (gm)	Seeds/ (gm)	Firmness fruit	Skin colour	Texture	T.S.S. %	Acidity %
Open pollination self pollination* Emasculat>** ♀ A x ♂ D ♀ A x ♂ E L.S.D. at (0.05) for treatments	116.00c	125.33c	6.30	6.23c	19.63d	1.86b	11.56b	Straw yellow 604 ----- Straw yellow 604 Orange Bulf 507/2	Crispy Crispy Crispy	11.96b 0.00a 0.00a 13.69d 12.83c 0.59	0.669 0.00 0.00 0.677 0.628 N.S
	0.00a	0.00a	0.00	0.00a	0.00a	0.00a	0.00a				
	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a				
	116.00c	85.00b	6.16c	5.26b	16.26b	0.00a	8.33b				
	86.00b	76.83b	5.46b	5.53b	17.43c	3.06c	12.50c				
	9.85	8.74	0.29	0.31	0.92	0.9	3.55				
Open pollination self pollination* Emasculat>** ♀ A x ♂ D ♀ A x ♂ E L.S.D. at (0.05) for treatments	99.93c	151.33d	6.60c	6.50c	20.83c	1.30b	8.33b	Straw yellow 604 ----- Straw yellow 604 Orange Bulf 507/2	Crispy Crispy Crispy	11.00c 0.00a 0.00a 11.30d 9.36b 0.22	0.678 0.00 0.00 0.64 0.6 N.S
	0.00a	0.00a	0.00a	0.00	0.00a	0.00a	0.00a				
	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a	0.00a				
	63.66b	136.00c	6.76d	6.76d	21.20	0.30a	9.00b				
	63.66b	111.60b	6.20b	5.86b	18.46b	1.16b	10.50c				
	66.80b	7.49	0.14	1.35	0.50	1.68					
	10.68										

Values having the same letters within a column are not significantly different at 5% level.

* Shedding before maturity

** No fruit sitting.

by those of the hybrid Ein-Shemer ♀ x Dorsett Gollowed ♂ (17.43 cms) and the shortest was obtained from the hybrid Ein-Shemer ♀ x Anna ♂ (16.26 cms), However, in 1987 the hybrid Ein-Shemer ♀ x Anna ♂ gave the longest Fruit circumference (21.20 cms) followed by open pollination (20.83 cms), while the shortest was noticed in the hybrid Ein-Shemer ♀ x Dorsett Golden ♂ (18.46 cms).

The data on fruit weight and size showed that parthenocarpic fruits formed from Dorsett Golden were nearly similar to those resulted from open and hand pollination. These results are in agreement with those of Griggs and Iwakiri (1954) working on Bartlett pears. It was found that self pollination caused a significant decrease in fruit weight and size in Dorsett Golden in seasons as compared with the other pollination treatments.

It is evident from the present investigation that the fruit shape of the three apple cultivars were influenced by the type of the pollen parent. When Anna was crossed by Dorsett Golden, the obtained fruits were rounded and flattened while when Ein-Shemer was used as male parent rounded and elongated fruit were obtained. cross pollinated fruits are often of better shape and size than those obtained from self pollination. This is probably due to the fact that cross pollinated fruits have more developed seeds. They are more uniform in shape and have better size at picking time. These results confirm those of other investigators (Tufts and Hansor, 1933, Griggs and Iwakiri, 1954 on pears). They reported that the pollen parent influenced the shape of the fruit, and concluded that variation in shape might have been due to the ability of the particular pollen to produce seed rather than to metaxenia. Steche (1959), while in studying the effect of pollination by bees of fruit formation in pear, found that, there was a clear correlation between number of seeds and fruit shape. The higher the number of developed seeds, the better was the shape of the fruit. Differences in fruit shape in apple and pear were often associated with the number and condition of the seeds which developed within the fruit. A clear correlation exists between the number of seeds and fruit size and shape. In this respect Nitsch *et al*, (1961) gave some evidence that the seeds stimulate fruit growth by providing auxins, for an paste could adequately substitutes for the seed on the fruit.

The flesh firmness in Anna apples was slightly affected by the method of pollination. Ein-Shemer pollinizer slightly decreased the flesh firmness (6.00 and 9.66 pound/sq. inch) compared with the case when Dorsett Golden was used as a pollinizer (8.66 and 10.33 pound/sq. inch) in both seasons. Under open pollination conditions. the obtained fruits had nearly the same flesh firmness in two seasons (9.00 and 9.66 pound/s.q. inch.).

The colour of Anna fruits was not affected with the colour of the pollinizer either Dorsett Goldeh or "Ein-Shemer. While, Anna pollen was used for either Dorsett Golden or Ein-Shemer reddish parts appeared on the skin of the obtained fruit. Brown (1975) reported that colour is inherited quantitatively in apples, all aspects of fruit colour is complex and often confusing because expression of this characters can be affected by the state of maturity of the fruit, by the general environment and by the micro-environment within the area and the tree.

In both seasons, the fruit texture of Anna and Ein-Shemer was crispy under all different pollination treatments. Similar results of texture of Anna and Ein-Shemer were determined by Brooks and Olmo (1972). As regards to Dorsett Golden cultivar selfed flowers produced crispy fruits, but when either Anna or Ein-Shemer was used as a pollinizer, the fruits were slightly crispy. Miller and Sherman, (1980) reported that the flesh is medium firm, slightly crisp and of medium sweetness in Dorsett Golden texture.

The percentage of total soluble solids content was not affected by different pollination treatments in Anna apple in the first season, while in the second season open plination caused higher value (10.53%) on both seasons under all different pollination treatments Dorsett Golden gave higher percentage (11.90 and 13.50%). When Anna pollen was used for Ein-Shemer the percent of T.S.S. was higher (13.69 and 11.30%) than in other treatments in both years.

Appli (1985) indicated that 12.00% of suger contants in some apple varieties is essential for good eating quality. As regards to acidity, the results obtained both seasons 1986 and 1987 indicated that the three apple cultivars differed insignificantly under all methods of pollination.

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صفات الثمار ومدى تأثرها باختلاف الملقح فى أصناف التفاح ذات احتياجات البرودة القليلة

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الغرض من هذه الدراسة هو معرفة مدى تأثير الملقح وطريقه التلقيح المختلفه (تلقيح ذاتى - خصى الازهار بدون تلقيح - تلقيح صناعى - التلقيح الطبيعى) على صفات الثمار من ناحيه الشكل (الوزن - الحجم - القطر - الارتفاع - المحيط) ولون الثمار - وعدد البذور بها والمواد الصلبه الذائبه والحموضه والصلابه والطعم وقد ظهر تأثير الملقح بشكل واضح فى بعض الصفات وان قل التأثير فى بعض صفات أخرى.

- تأثر شكل ثمار الثلاثة أصناف من التفاح (الآنا - الدورست جولدن - عين شمير) بنوع حبوب لقاح الأب فعندما لقيح الآنا بالدورست جولدن كانت الثمار مستديرة ومبطله بينما عندما استخدم العين شمير كملقح كانت الثمار مستديرة وطويله.

- تحت ظروف التلقيح الطبيعى كانت نسبة البذور أقل منها تحت ظروف التلقيح الصناعى.

- التلقيح الطبيعى الخلطى أعطى أحسن لون أحمر للثمار فى التفاح الآنا والاصفر فى الدورست جولدن أو العين شمير، أما فى ثمار الهجن الناتجه من الدورست جولدن او العين شمير بالآنا فظهر لون أحمر بالثمار.

- بالنسبه للمواد الصلبه الذائبه فكانت متشابه الى حد كبير فى ثمار الثلاثة أصناف مع طرق التلقيح المستخدمه.