

Effect of Pollination and Thinning Methods on Yield and Fruit Quality of Saidu Date Palms

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Abstract

The effect of fruit thinning and pollen grains dusting as a pollination methods of Saidu date palm which combines of both mechanical pollination and fruit thinning were studied during 2013, 2014 and 2015 seasons. Pollen mixed with starch in ratio of 1:1, 3, 5, 7 and 9 as 50, 25, 17, 12.5 and 10% active ingredients. Fruit thinning was carried out by 15, 30 and 45% removal of setting fruits.

The obtained results indicated that there were reduction in the percentage of fruit retention and fruit weight/bunch as the pollen grains concentration was lower or fruit thinning was done. There were no significant differences in fruit weight/bunch due to dusting pollen grains powder at 50 or 25% compared to control. On other hand, there was an improve in the fruit quality in terms of increasing the fruit weight, pulp %, total soluble solids and sugar contents and decreasing the fruit moisture content was observed with reduction of pollen grain concentrations and doing fruit thinning. Furthermore, there were no significant difference due to pollination by 17% pollen grains and removing 15% of fruit setting, as well as 12.5% pollen grains and 30% removal of setting fruit.

It could be concluded that pollination by 12.5% pollen grains powder or removing 30% of fruit setting could be a considerable yield with good fruit quality. In addition, dusting pollen grains powder at 12.5% resulted in combined of mechanical pollination and fruit thinning effects.

Keywords: *Pollen grain, dusting, fruit thinning, yield, fruit quality.*

Introduction

Date palm (*Phoenix dactylifera* L.) is a major tree crops in arid regions of the Middle East and North Africa, having an important impact on economy of many countries in these regions (FAO, 2012). Egypt is considered among the top ten date producers, Zaghloul, Samany, Hayany and Sewy are the most economically important date palm cultivars grown in Egypt. Presently, the date growers are facing many difficulties to produce high quality date fruits for economical reasons and to compete

with the international market. Two of the important factors affecting fruit quality and productivity of date palm are pollination and fruit thinning. So, it is needed to find the best pollination technique that may be easiest and most convenient for improving fruiting of date palms. A research done of date palm showed that proper pollination and thinning practices are necessary to increase quantitative, qualitative and economical output of date production in palm growing (El-Salhy *et al.*, 2010 and Iqbal *et al.*, 2010).

Artificial pollination is considered the only way for commercial date production. It is necessary for successful fruit set and fruiting. Mixing pollen grains with various carriers and nutrient minerals were beneficial in establishing mechanical pollination and obtaining an economical yield with good fruit quality and enhancing pollination efficiency. Mixing pollen grains with various carriers is an untraditional method in date palm pollination which combines both mechanical pollination and fruit thinning (El-Kassas and Mahmoud, 1986; Mostafa, 1994; Haffer *et al.*, 1997; El-Sharabasy *et al.*, 2003; El-Salhy *et al.*, 2007; El-Salhy *et al.*, 2010; Iqbal *et al.*, 2010 and El-Salhy, 2012).

Thinning practice is an important managerial approach in date palm to improve fruit size, fruit weight, fruit quality and reduce chances of bunch breaking and alternate bearing. Several methods were used to thin date palm trees, i.e. bunch thinning, bunch strands thinning and individual fruit removal. Combination of removal of individual fruits and strands had substantially improved fruit quality (Abdel-Hamid, 2000; Ali-Dinar *et al.*, 2002; Marashi and Mousavi, 2007 and Mostafa and El-Akkad, 2011).

Flower or fruit thinning is a critical cultural practice in the date palm production chain that affects fruit development, quality, yield and regulate the tree yearly bearing. Thinning process is generally practiced either manually or chemically. There is much concern regarding the use of chemicals on the environmental pollution and health aspects. Therefore, development of a more save and eco-

nomical thinning agent for the date palm is critically required especially under harsh conditions. Fruit thinning treatments may lead to a decrease of the total yield, soluble tannins %, crude fibers % and total acidity % and are responsible for improving the weight, size and dimensions of fruit, pulp weight %, total soluble solids %, total and sugar contents (Khalifa *et al.*, 1987; Awad, 2006 and Abdel-Galil *et al.*, 2008). Thinning by removing 10-30% of bunches number significantly increased the bunch weight, advancing ripening and best fruit quality compared to unthinning (Godara *et al.*, 1990; El-Shazly, 1999; Abdel-Hamid, 2000; Akl *et al.*, 2004; El-Assar, 2005; Al-Wasfy & Mostafa, 2008 and Mostafa & El-Akkad, 2011).

So, it is needed to find the best pollination technique that most convenient easiest and was act a thinning effects to get the economical yield with best fruit quality.

The, this study aimed to find out the effect of different methods of pollination and fruit thinning on yield and fruit quality. In addition to innovating an untraditional pollination method which combines both mechanical pollination and fruit thinning. Such practices might be very essential and great importance for palm growers.

Materials and Methods

This study was carried out during three successive seasons 2013, 2014 and 2015 on Saidy date palms grown at Research Farm of Agricultural Research Station that located at El-Kharga Oasis, New Valley Governorate, Egypt. Ten palms of 35 years old, with uniform vigour and in good

physical condition, free of insect damage and diseases. The number of spathes per palm were adjusted to ten by removing excess earliest, latest and smallest. The retained bunches were thinned to a constant number of strands. The involved palm trees received the horticulture practices. Nine pollination and fruit thinning treatments were arranged as follows:

1-Hand pollination by inserting 7-10 strands/bunch (T₁).

2-Dusting mixed pollen grains at 1 unit of pollen to 1 unit starch (50% active ingredients) on a volume basis (T₂).

3-Dusting mixed pollen grains at 1 unit of pollen to 3 units starch (25% active ingredients) on a volume basis (T₃).

4-Dusting mixed pollen grains at 1 unit of pollen to 5 units starch (17% active ingredients) on a volume basis (T₄).

5-Dusting mixed pollen grains at 1 unit of pollen to 7 units starch (12.5% active ingredients) on a volume basis (T₅).

6-Dusting mixed pollen grains at 1 unit of pollen to 9 units starch (10% active ingredients) on a volume basis (T₆).

7-Thinning by removing 15% of the fruits per strands (T₇).

8-Thinning by removing 30% of the fruits per strands (T₈).

9-Thinning by removing 45% of the fruits per strands (T₉).

The pollen grains were extracted by removing protective sheath and inflorescence was kept under sunlight on newspaper for releasing pollen grains. After one hour the flowers were open and pollen grains released. After drying pollen grains

were rubbed in foam duster. Dusting was done on opened spathe. To prevent contamination of pollens, after pollination every bunch was bagged by paper bags which is removed after fruit set.

Pollination was uniformed in respect of source date and method to avoid residues of metaxenia, as well as Fruit thinning treatments were done after fruit set and applied on the same palm.

The experiment was arranged in a complete randomized block design including nine treatments with ten replications, bunch each.

All bunches were harvested at tamar stage (last week of September) ultimate fruit retention and fruit weight/bunch (kg) were estimated. Samples of 50 fruits were picked at random from each bunch for the determination of some physical and chemical fruit properties, according to A.O.A.C. methods (1985). Data were subjected to statistical analysis according to the procedure reported by Gomez and Gomez (1984) and Snedecor and Cochran (1990). Treatments means were compared by the least significant difference test (L.S.D.) at the 5% level of probability in the three experimental seasons.

Results and Discussion

Yield index:

Bunch weight is an indicator for the yield of palm trees since the number of bunches on palm was constant. Table (1) exhibits the effect of pollination and fruit thinning treatments on the fruit retention and fruit weight/bunch of Saidu date palm in 2013, 2014 & 2015 seasons. It is obvious from the data that the results took similar trend during the three

studied seasons. Data declared that, fruit retention percentage and fruit weight/bunch were significantly decreased due to pollinating by dusting pollen grain with starch at 1 pollen to 5 (T₄), 7 (T₅) or 9 (T₆) starch (17, 12.5 or 10% pollen) as well as doing fruit thinning compared with the traditional pollination. On other hand data, showed that insignificant difference in fruit reduction and fruit weight/bunch due to dust pollen powder at 1 pollen to 1 starch (T₂) or 3 starch (T₃) (50 or 25% active ingredients on volume basis).

Also, no significant difference in these traits due to dusting by 17% pollen grains (T₄) and fruit thinning by removing 15% of fruits (T₇), as well as dusting by 12.5% pollen grains (T₅) and fruit thinning by removing 30% of fruits (T₈).

The fruit retention percentage were (79.10, 77.65, 76.48, 65.25,

55.10, 34.88, 68.60, 57.13 and 45.59% as av. of the three studied seasons) due to pollinating by traditional pollination (T₁), dusting pollen with starch at (50%, T₂), 1:3 (25%, T₃), 1:5 (17%, T₄), 1:7 (12.5%, T₅), 1:8 (10%, T₆), 15% thinning (T₇), 30 thinning (T₈) and 45% thinning (T₉), respectively. The corresponding fruit weight/bunch were (11.30, 10.95, 10.80, 10.30, 9.20, 6.58, 10.32, 9.55 and 8.17 kg) due to use of T₁ to T₉, respectively. The decrement percentage of fruit weight/bunch due to dust pollen powder or fruit thinning over traditional pollination and unthinned fruits (T₁) were (3.10, 4.42, 8.85, 18.58, 41.77, 8.67, 8.45 and 27.70% as av. of the three studied seasons) due to T₂ to T₉, compared to T₁, respectively.

Table 1. Effect of pollination and fruit thinning treatments on fruit retention and fruit weight/bunch of Saily date during 2013, 2014 and 2015 seasons.

		Fruit retention (%)				Fruit weight/bunch (kg)			
		2013	2014	2015	Mean	2013	2014	2015	Mean
Hand pollination.	T ₁	75.30	76.64	85.35	79.10	11.22	11.69	11.00	11.30
Dusting (50% pollen)	T ₂	73.85	75.18	83.90	77.65	10.84	11.38	10.65	10.95
Dusting (25% pollen)	T ₃	72.70	73.88	82.74	76.48	10.70	11.28	10.42	10.80
Dusting (17% pollen)	T ₄	61.80	62.74	71.22	65.25	10.10	10.85	9.94	10.30
Dusting (12.5% pollen)	T ₅	52.60	52.86	59.85	55.10	9.17	9.52	8.92	9.20
Dusting (10% pollen)	T ₆	33.70	34.25	36.68	34.88	6.55	6.92	6.26	6.58
Thinning (15% fruits)	T ₇	66.76	66.39	72.65	68.60	9.95	10.15	10.85	10.32
Thinning (30% fruits)	T ₈	53.38	52.78	65.11	57.13	9.10	9.30	10.25	9.55
Thinning (45% fruits)	T ₉	45.50	43.35	47.92	45.59	7.95	7.80	8.75	8.17
L.S.D.		3.81	3.70	4.10	3.11	0.59	0.55	0.61	0.53

The reduction on fruit weight / bunch was associated with decreasing the pollen grain percentage from 50 to 10% as well as fruit thinning from 15 to 45% of fruit set. These results could be attributed to the reduction of fruit set because of decreasing the

pollen grain concentration as well as reducing the fruit retention, hence, the fruit weight/bunch was decreased. Then, it could be concluded that there was a significant positive correlation between the fruit retention and fruit weight/bunch.

Such a finding might be attributed to the pollen grains that have different sensitivities during pollen tube growth on stigmas. Higher pollen concentration resulted in more initial fruit set due to the pollination of a larger number of available female flowers. The mixed carriers on reducing fruit set might be due to low pollen concentration as well as the carrier either decrease the moisture absorption around the stigma or their competition with pollen grains on stigmas.

It can be concluded from these results that using dusting, had proved important from economic point of view which are shown 12.5 to 25% from the need amount of traditional pollination without reduction on yield.

Fruit quality:

A- Physical characteristics:

Data in Tables (2 & 3) indicated that there was an improvement of the fruit physical quality in terms of increasing the fruit weight, size dimensions and fruit pulp percentage and decreasing moisture content due to pollination with dusting methods or fruit thinning compared to the traditional pollination (control). The improving of these traits was associated with the decrease of the used pollen grains concentration from 25-10% as well as retained fruits from 85 to 55% of setting fruits. The heaviest fruits were detected on palms pollinated with pollen grain concentration at 10% of dusting powder (T₆), as well as removing 45% of setting fruit (T₉). No significant differences in fruit weight, dimensions, fruit pulp % and moisture content were observed due to using dusting of pollen grains at 10

or 12.5% as well as fruit thinning by removing 30 to 45% of setting fruits.

The recorded fruit weight were 8.64, 8.72, 8.82, 9.57, 10.97, 11.23, 10.08, 11.14 and 11.40g (average of the three studied seasons) due to T₁ to T₉, respectively. The increment percentage of fruit weight in response to different pollination and fruit thinning treatments over control (T₁) were 0.92, 2.08, 10.76, 26.97, 29.98, 16.67, 28.94 and 31.94% (average of the three studied seasons) due to T₂ to T₉ respectively.

The increase in fruit weight and its size are most important target than total yield due to the increase of fruit weight and size resulted in an increase in the packable yield.

Such improvement of fruit physical properties i.e. increasing fruit weight, dimension and pulp % might be occurred in response to the use of diluted pollen grains dusting for pollination. These findings could be due to the reduction of fruit retention that cause a reduction in the number of fruits per bunch without changing the number of leaves that may induce the better supply of carbohydrates which are synthesized in the leaves. Such effects were similar to fruit thinning effects on improving the physical fruit properties. So, it could be easy to identify the initial fruit set percentage which gave the considerable yield characterized by high fruit quality using either different hand pollination techniques dusting pollens or fruit thinning methods.

B- Chemical characteristics:

Data in Tables (4 & 5) indicated that pollination by pollen grains dusting or fruit thinning were significantly improved the fruit chemical consti-

tments in terms of increasing the soluble solids and sugar contents compared to pollination by traditional pollination. The improvement of these fruit traits was associated with the reduction of pollen grain concentration from 25 to 10% as well as retained fruits from 85-55% of setting fruits or pollen powder dusting at 10% pollen (T₆) as well as removing

45% of setting fruit (T₉) gave the maximum values of soluble solids and sugar contents, whereas, using the traditional pollination (T₁) gave the minimum values. No significant difference in fruit chemical properties were observed due to use of either dusting pollen at 10-12.5% or removing 30-45% of setting fruits.

Table 2. Effect of pollination and fruit thinning treatments on fruit weight and dimension of Saidu date during 2013, 2014 and 2015 seasons.

Charac. Treat.	Fruit weight (g)				Fruit length (cm)				Fruit diameter (cm)			
	2013	2014	2015	Mean	2013	2014	2015	Mean	2013	2014	2015	Mean
T ₁	8.68	8.71	8.52	8.64	3.39	3.42	3.36	3.39	2.10	2.11	2.10	2.10
T ₂	8.76	8.80	8.60	8.72	3.43	3.44	3.39	3.42	2.11	2.13	2.12	2.12
T ₃	8.87	8.85	8.75	8.82	3.52	3.55	3.50	3.52	2.12	2.13	2.12	2.12
T ₄	9.65	9.67	9.40	9.57	3.58	3.59	3.54	3.57	2.24	2.25	2.23	2.24
T ₅	10.97	11.10	10.86	10.97	3.78	3.81	3.76	3.78	2.26	2.28	2.25	2.26
T ₆	11.20	11.40	11.10	11.23	3.98	4.07	3.82	3.96	2.28	2.31	2.26	2.28
T ₇	10.05	10.15	10.05	10.08	3.66	3.70	3.65	3.67	2.14	2.16	2.25	2.18
T ₈	11.24	11.20	10.99	11.14	4.00	3.94	3.82	3.92	2.21	2.25	2.32	2.26
T ₉	11.39	11.47	11.35	11.40	4.01	4.01	3.94	3.99	2.23	2.25	2.34	2.27
L.S.D.	0.53	0.58	0.51	0.44	0.17	0.15	0.15	0.13	0.09	0.10	0.08	0.06

Table 3. Effect of pollination and fruit thinning treatments on pulp weight and moisture percentage of Saidu date during 2013, 2014 and 2015 seasons.

Charac. Treat.	Pulp weight (%)				Fruit moisture (%)			
	2013	2014	2015	Mean	2013	2014	2015	Mean
T ₁	84.49	84.62	84.51	84.54	15.00	14.80	14.00	14.60
T ₂	84.60	84.80	84.76	84.72	14.86	14.65	13.85	14.45
T ₃	84.78	84.86	84.80	84.81	14.45	14.65	14.00	14.37
T ₄	86.44	86.54	86.65	86.54	13.50	13.75	13.50	13.72
T ₅	87.25	87.44	87.43	87.37	13.10	13.25	12.90	13.08
T ₆	87.72	88.22	87.98	87.97	12.10	12.90	12.85	12.82
T ₇	85.71	87.35	86.95	87.27	13.75	13.75	13.50	13.67
T ₈	87.52	88.48	87.28	88.13	13.25	13.30	13.05	13.20
T ₉	88.72	88.63	88.13	88.49	12.80	12.95	12.75	12.83
L.S.D.	1.85	1.90	1.88	1.63	0.56	0.53	0.38	0.42

Table 4. Effect of pollination and fruit thinning treatments on total soluble acids and total sugars contents of Saily date during 2013, 2014 and 2015 seasons.

Charac. Treat.	TSS (%)				Total sugars (%)			
	2013	2014	2015	Mean	2013	2014	2015	Mean
T ₁	74.50	75.70	74.00	74.73	69.43	69.30	67.48	68.74
T ₂	75.10	76.20	74.54	75.28	69.95	69.85	68.10	69.30
T ₃	75.60	76.40	75.42	75.81	70.32	70.04	68.86	69.74
T ₄	77.30	78.10	76.24	77.21	71.57	71.75	69.86	71.06
T ₅	78.80	80.60	78.50	79.30	73.21	73.96	71.67	72.95
T ₆	79.90	81.10	79.50	80.17	73.36	74.26	71.88	73.17
T ₇	78.88	79.40	77.77	78.68	72.57	73.40	72.00	72.66
T ₈	80.08	80.52	79.40	79.97	73.72	74.47	73.14	73.78
T ₉	81.04	81.80	80.48	81.11	74.95	75.44	74.46	74.95
L.S.D.	2.28	2.36	2.05	1.96	2.44	2.74	2.43	2.24

Table 5. Effect of pollination and fruit thinning treatments on reducing and non-reducing contents of Saily date during 2013, 2014 and 2015 seasons.

Charac. Treat.	Reducing sugars (%)				Non-reducing sugars (%)			
	2013	2014	2015	Mean	2013	2014	2015	Mean
T ₁	60.77	60.98	59.38	60.38	8.66	8.32	8.10	8.36
T ₂	61.20	61.38	60.25	60.94	8.75	8.47	7.85	8.36
T ₃	61.34	61.64	60.60	61.19	8.98	8.41	8.26	8.55
T ₄	62.10	63.14	61.25	62.16	9.47	8.61	8.61	8.90
T ₅	63.38	65.51	62.99	63.79	9.83	8.76	8.68	9.16
T ₆	63.30	65.35	63.25	63.97	10.06	8.91	8.63	9.20
T ₇	62.95	63.42	63.64	63.34	9.62	9.98	8.36	9.40
T ₈	63.42	64.31	64.19	63.97	10.30	10.16	8.95	9.80
T ₉	64.71	65.12	65.35	65.06	10.24	10.32	9.11	9.89
L.S.D.	1.89	1.80	1.78	1.61	0.41	0.38	0.29	0.33

The obtained total soluble solids (TSS) were (74.73, 75.28, 75.81, 77.21, 79.30, 80.17, 78.68, 79.97 and 81.11 as av. the three studied seasons) due to T₁ to T₉, respectively. The increment percentage of TSS due pollen dusting or fruit thinning was attained (0.73, 1.45, 3.32, 6.12, 7.28, 5.29, 7.01 and 8.54% as av. the three studied seasons) due to T₂ to T₉ compared to T₁, respectively.

These findings might be due to the reduction in the fruit retention percentage by using the diluted pollen grain concentration or remained fruits

due to fruit thinning. Such reduction in fruits was effective on lowering the competition among the fruits and induces adequate carbohydrates and other essentials assimilated for the residual ones, which consequently enhance the fruit maturity and improves its contents of total soluble solids and sugar contents. In addition, fruit thinning, effectively lowered the competition occurred between fruits and consequently raised the total soluble solids and sugar contents for each fruit. So, it could be said that the use of diluted pollen grain concentra-

tion has a similar effect like the fruit thinning on improving the fruit quality.

In general, it could be concluded that there is a positive relationship between fruit thinning and improvement of physical quality and the chemical constituents. On other hand, there is a negative relationship between the fruit retention and improvement of fruit quality.

These results are in harmony with the results of Haffer *et al.* (1997), Khayyat *et al.* (2007), El-Salhy *et al.* (2007), Ashour *et al.* (2008), Alabri *et al.* (2006), El-Salhy *et al.* (2010), El-Sese *et al.* (2010), Iqbal *et al.* (2010), Abdalla *et al.* (2011) and El-Salhy *et al.* (2012).

In addition, the enhancing effect of fruit thinning on date fruiting are in harmony with the results obtained by Godara (1990), Moustafa (1998), El-Shazly (1999), Abdel-Hamid (2000), Hussein & Hassan (2001), Hammam *et al.* (2002), Nirmaljit *et al.* (2006), Tavakkoli *et al.* (2006), Marzouk *et al.* (2007), Marashi & Mousavi (2007), Al-Wasfy & Mostafa (2008), Abdel-Galil *et al.* (2008), Mostafa & El-Akkad (2011), Damanekshan & Panahi (2013), Bashir *et al.* (2014) and Al-Saikhan & Sallam (2015).

Conclusion

On the light of the current results, it could be concluded that pollination by 12.5% pollen grains powder or fruit thinning by remaining 30% of fruits setting could lead to a considerable yield with good fruit quality. In addition, dusting pollen grains powder at 12.5% play a combined mechanical pollination and fruit thinning effects.

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تأثير طرق التلقيح وخف الثمار علي محصول وخصائص ثمار نخيل البلح الصعيدي
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المخلص

أجريت هذه الدراسة خلال ثلاثة مواسم متتالية هي ٢٠١٣ ، ٢٠١٤ ، و ٢٠١٥ علي نخيل البلح الصعيدي النامية بالمزرعة البحثية بمحطة البحوث الزراعية بواحة الخارجة - الوادي الجديد - مصر. لدراسة تأثير خف الثمار وتعفير حبوب اللقاح كوسيلة تجمع بين التلقيح الميكانيكي وخف الثمار.

أجري التلقيح بتعفير مخلوط حبوب اللقاح مع النشا كمادة حاملة بمعدل (١:١ ، ٣ ، ٥ ، ٧ ، ٩) وبنسبة تركيز ٥٠ ، ٢٥ ، ١٧ ، ١٢,٥ ، ١٠% من حبوب اللقاح علي التوالي مقارنة بالتلقيح اليدوي وكذلك أجري خف الثمار بإزالة ١٥ ، ٣٠ ، ٤٥% من الثمار. وقد أجريت معاملات الخف بعد العقد وتم مقارنة هذه المعاملات بالتلقيح اليدوي وبدون خف. وقد أظهرت النتائج:

- حدوث نقص جوهري في نسبة الثمار المتبقية ووزن الثمار/السويطة نتيجة تخفيف مخلوط التلقيح او إجراء خف الثمار ولم يكن هذا النقص جوهرياً عند استخدام مخلوط التلقيح بمعدل ٥٠ أو ٢٥% حبوب لقاح.
- حدوث زيادة معنوية في صفات الثمار الطبيعية والكيميائية نتيجة نقص تركيز مخلوط التلقيح أو إجراء خف الثمار.
- لم تسجل فروق معنوية لنسبة الثمار المتبقية ووزن الثمار للسويطة وكذلك صفات الثمار الطبيعية والكيميائية نتيجة التلقيح بمخلوط بتركيز ١٢,٥% أو الخف بإزالة ٣٠% من الثمار أو التلقيح بمخلوط ١٠% أو الخف بإزالة ٤٥% من الثمار .
- من نتائج الدراسة يمكن التوصية بأهمية التلقيح تعفيراً بمعدل ١٢,٥% حبوب لقاح أو خف الثمار بإزالة ٣٠% من الثمار بعد عقد الثمار وذلك لإنتاج محصول عال ذو خصائص ثمرية جيدة. فضلاً علي أن التعفير بمعدل ١٢,٥% يجمع بين عملية التلقيح الميكانيكي وخف الثمار مما يقلل من تكلفة الإنتاج وزيادة كفاءة التلقيح وتحسين خصائص الثمار.