

Physical Characteristics During Fruit Growth of Three Pomegranate Cultivars

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Abstract:

In recent years, the pomegranate (*Punica granatum* L.) has acquired wide acceptance due to the growing evidence that consumption is associated with beneficial health properties. The objective of this study was to compare some physical characteristics (fruit, peel and arils weight – fruit length and diameter) of three pomegranate cultivars grown in Egypt namely as Manfalouty, Hejazy and Nab-El-Gamal. The results showed significant differences in all measured characteristics of the pomegranate cultivars (except of fruit length between cultivars of each season).

Keywords: pomegranate, peel, arils, physical properties.

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Introduction:

Pomegranate (*Punica granatum* L.) has gained popularity in recent years due to its multi-functionality and nutritional value in human diet. The fruit is grown globally in many different geo-graphical regions, satisfying the nutritional and medicinal needs of populations of various countries (Holland *et al.*, 2009). During pomegranate fruit development, advancing maturity stages correspond to a number of coordinated physiological, biochemical, and structural processes that result in changes of size, color and flavor, ultimately making the fruit desirable for consumption (Ben-Arie *et al.*, 1984; Al-Maiman and Ahmad, 2002). Quality assessment of pomegranate fruit is based on important external attributes such as size, shape and color (Kader, 2006; Holland *et al.*, 2009). However, because fruit skin color does not indicate the extent of ripening or its readiness for consumption, internal attributes such as color, total soluble solids and acidity are also considered in assessing readiness for harvest to meet market requirements (Ben-Arie *et al.*, 1984; Kader, 2006; Holland *et al.*, 2009).

Pomegranate fruit growth pattern has been characterized as a single sigmoid curve from the beginning of fruit set till maturity (Ben-Arie *et al.*, 1984; Gozlekci and Kaynak, 2000; Varasteh *et al.*, 2008). According to Kumar and Purohit 1989, there are periods of fast fruit growth rate which alternate with periods of slow growth rate. The initial rapid increment in fruit growth occurs during cell division, which is characterized by growing kernel tissue and the increment in testa hardness (Shulman *et al.*, 1984), after which a slowdown in fruit growth occurs (Gozlekci and Kaynak, 2000). However, while the kernel stops growing, the aril contin-

ues to grow steadily as the fruit increase to its final size through cell enlargement during maturation (Ben-Arie *et al.*, 1984; Shulman *et al.*, 1984; Melgarejo *et al.*, 1997).

Materials and Methods:

The experiment was executed at the experimental orchard and the laboratory of fruit section, Assiut University throughout two successive seasons of 2012 and 2013. The experiment included three pomegranate cultivars namely as Manfalouty, Hejazy and Nab-El-Gamal. Ten trees from each cultivar were chosen and each tree was represented as a replicate. Fifty hermaphrodite flowers from each tree were marked on May of each season. Five fruits from each tree were periodically sampled at six growth stages beginning from 1st August till 15th of October at 15 days intervals. The samples were picked and transferred directly to the laboratory of fruit section, Faculty of Agriculture, Assiut University to determine:

- 1- Average fruit length and diameter (cm.): By using a Vernier caliper.
- 2- Average fruit, peel and arils weight (g.): By using a 0.1 sensitive balance.

Results & Discussion:

Table (1) and Fig.(1-5) illustrate the changes in the following physical properties:

Fruit weight:

There was a progressive increase in fruit weight. Generally, the average fruit weight (Table (1) and Fig.1) in the first season at any measurement period was less than the second season due to the heavier bearing in the first season of study than the second one.

Depending on the orchard data, the total yield recorded for 417 pomegranate trees were 14.494 kg in the

1st season (2012) and 4.446 kg in the 2nd one.

On the other hand, Hejazy cultivar recorded the lowest fruit weight during the two seasons (229.3 and 329.9g, respectively). In the first season of study there were significant differences between the studied cultivars. However, in the second season the significant differences were found between Hejazy and the other two cultivars.

Peel weight:

The second season recorded much higher peel weight (Table (1) and Fig.2) comparing to the first season. The average peel weight was 68.4; 66.2 and 62.9g. during the first season while it was 142.8; 152.5 and 147.0g. during the second season for Nab-El-Gamal; Manfalouty and Hejazy cultivars; respectively. The significant differences were found between Nab- El-Gamal and Hejazy in the first season and between Manfalouty and Nab- El-Gamal during the second season.

Arils weight:

Concerning the arils weight (Table (1) and Fig.3); there were significant differences during the two seasons except of Manfalouty and Nab-El-Gamal in the first season.

Fruit size (length and diameter):

Fruit size increased steadily till 120 DAFB followed by slowly increment till the fruits reached the maturity. Data indicated that the increase in fruit size (Table (1) and Fig. 4 and 5) and weight also depend on the density of bearing during the season where the present study showed that the yield weight was moderate in the second season comparing with the first one (heavy crop).

The results of current study showed a significant increase in the fruit weight as well as peel and arils weight during different growth stages reaching to the highest value at fruit

maturity. The results indicated that the highest increase in the fruit weight during the first season recorded at 105DAFB while in the second season the largest increase occurred in the fourth period (135 DAFB).

The increment percentage at (from 90 to 105 DAFB) for the first season was 130.0%, while it was 32.3% for the same stage in the second season. The increment percentage of fruit weight at (from 120 to 135 DAFB) in the second season reached 42.5% while such percentage was 10.6 for the same stage in the first season. The fruit size, arils and peel weight exhibit the same direction of the fruit weight.

The obtained results was consistent with what found by Kumar and Purohit (1989) that the growth rate of pomegranate fruit doesn't take constant rate during the fruit growth but there are stages of rapid growth punctuated by slow growth stages.

Al-Maiman and Ahmed (2002) found a significant increase in the fruit and arils weight from unripe through half mature along with mature fruits. Gozlekci and Kaynak (2000) found that after the first two weeks of a rapid increase in Pomegranate fruit size, the growth will be slow until the arrival of harvest and they explained by the higher temperatures during the summer months. Our study indicated that both fruit diameter and length increased during the initial stages of development and then the rate of size growth slowly increased. Fawole and Opara (2013a&b) on Ruby and Bhagwa Pomegranate cultivars, Fawole and Opara (2013b) on Ruby cultivar grown in South Africa found that the fruit weight increased gradually till maturity in both cultivars and seasons.

Table (1): Changes in fruit weight (g) of Manfalouty, Hejazy and Nab-El-Gamal pomegranate cultivars during 2012 and 2013 seasons.

Cultivar	2012			
	Manfalouty	Hejazy	Nab-El-Gamal	Mean
90	78.0	79.5	96.2	84.6
105	194.5	182.5	206.9	194.6
120	261.5	253.8	276.4	263.9
135	300.4	269.7	305.9	292.0
150	324.3	284.5	324.9	311.2
165	328.4	305.8	349.9	328.0
Mean	247.9	229.3	260.0	
	2013			
90	178.2	155.3	154.3	162.6
105	231.8	195.3	218.2	215.1
120	291.5	287.7	298.2	292.5
135	404.3	421.5	424.2	416.7
150	453.1	432.5	462.2	449.3
165	488.7	487.2	484.3	486.7
Mean	341.3	329.9	340.2	

L.S.D (0.05)

Cultivar

Days after full bloom

Cultivar x Days after full bloom

2012

11.1

16.5

27.3

2013

9.9

10.2

19.4

Table (2): Changes in peel weight (g) of Manfalouty, Hejazy and Nab-El-Gamal pomegranate cultivars during 2012 and 2013 seasons.

Cultivar	2012			
	Manfalouty	Hejazy	Nab-El-Gamal	Mean
90	18.5	24.7	18.7	20.6
105	40.2	44.1	44.1	42.8
120	66.1	59.6	59.9	63.0
135	80.1	70.2	83.3	77.9
150	94.8	84.9	92.8	90.8
165	97.6	93.9	111.5	101.0
Mean	66.2	62.9	68.4	
	2013			
90	105.0	72.4	71.2	82.9
105	106.2	91.4	85.5	94.4
120	123.4	124.1	112.4	120.0
135	186.5	191.1	186.6	188.9
150	194.1	199.2	198.2	197.2
165	199.6	203.7	203.0	202.1
Mean	152.5	147.0	142.8	

L.S.D(0.05)	2012	2013
Cultivar	4.0	5.9
Days after full bloom	5.7	8.3
Cultivar x Days after full bloom	9.8	14.5

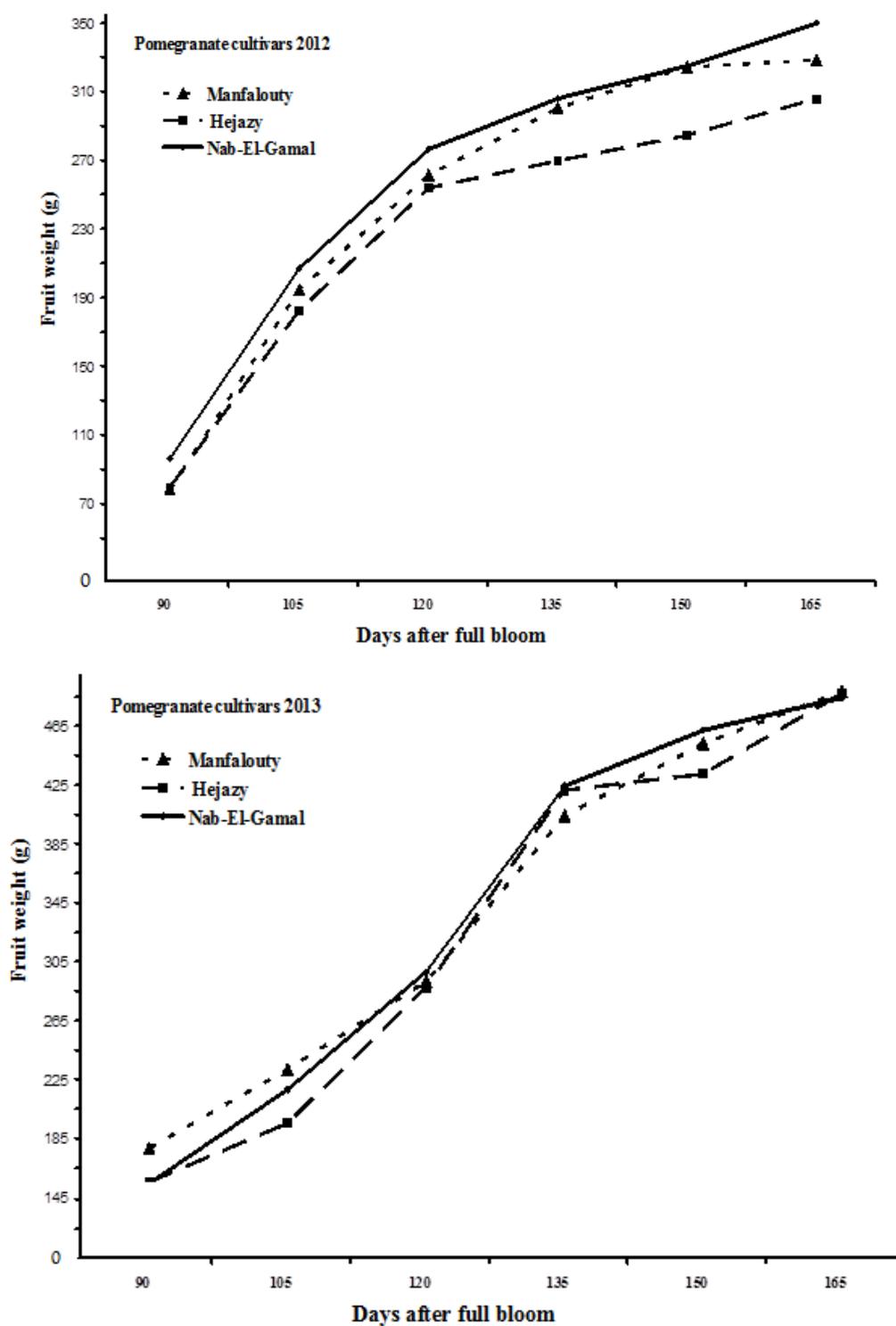


Fig. (1): Changes in fruit weight (g) of Manfalouty, Hejazy and Nab-El-Gamal pomegranate cultivars during 2012 and 2013 seasons.

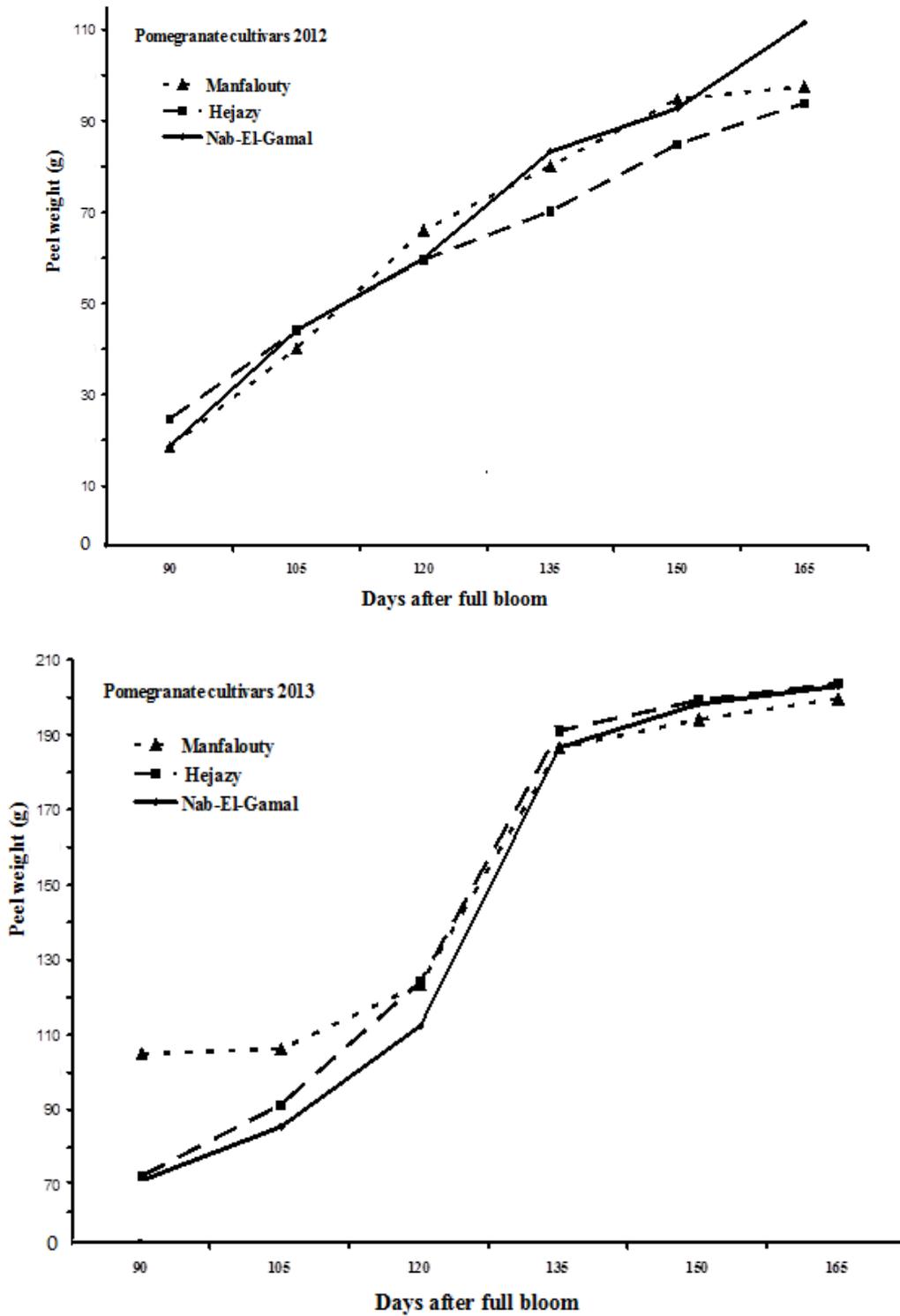


Fig. (2): Changes in peel weight (g) of Manfalouty, Hejazy and Nab-El-Gamal pomegranate cultivars during 2012 and 2013 seasons.

Table (3): Changes in arils weight (g) of Manfalouty, Hejazy and Nab-El-Gamal pomegranate cultivars during 2012 and 2013 seasons.

Cultivar	2012			
	Manfalouty	Hejazy	Nab-El-Gamal	Mean
90	59.5	54.8	77.5	63.9
105	154.3	138.4	162.8	151.8
120	195.4	194.2	216.5	202.0
135	220.3	199.5	222.6	214.1
150	229.5	199.6	232.1	220.4
165	230.8	211.9	238.4	227.0
Mean	181.6	166.4	191.7	
	2013			
90	82.2	82.9	83.1	82.7
105	125.6	103.9	132.7	120.7
120	168.1	163.6	185.8	172.5
135	217.8	230.4	237.6	228.6
150	259.0	233.3	264.0	252.1
165	289.1	283.5	281.3	284.6
Mean	190.3	182.9	197.4	

L.S.D(0.05)	2012	2013
Cultivar	10.8	6.1
Days after full bloom	14.3	8.6
Cultivar x Days after full bloom	25.1	15.1

Table (4): Changes in fruit height (cm) of Manfalouty, Hejazy and Nab-El-Gamal pomegranate cultivars during 2012 and 2013 seasons.

Cultivar	2012			
	Manfalouty	Hejazy	Nab-El-Gamal	Mean
90	4.9	5.0	4.9	4.9
105	7.0	6.9	6.9	6.9
120	7.7	7.5	7.6	7.6
135	7.8	7.7	7.6	7.7
150	7.9	7.8	7.9	7.9
165	8.0	7.8	8.2	8.0
Mean	7.2	7.1	7.2	
	2013			
90	6.1	6.4	6.2	6.2
105	7.0	6.9	6.9	6.9
120	7.6	7.7	7.5	7.9
135	8.3	8.4	8.5	8.4
150	8.7	8.5	8.6	8.6
165	9.0	8.9	8.7	8.9
Mean	7.8	7.8	7.7	

L.S.D (0.05)

Cultivar

Days after full bloom

Cultivar x Days after full bloom

2012

N.S

0.2

0.3

2013

N.S

0.2

0.3

Table (5): Changes in fruit diameter (cm) of Manfalouty, Hejazy and Nab-El-Gamal pomegranate cultivars during 2012 and 2013 seasons.

Cultivar	2012			
	Manfalouty	Hejazy	Nab-El-Gamal	Mean
90	5.6	5.6	6.0	5.7
105	7.8	7.3	7.6	7.6
120	8.6	8.2	8.6	8.5
135	8.7	8.5	8.9	8.7
150	9.0	8.6	8.9	8.8
165	9.1	8.7	9.2	9.0
Mean	8.1	7.8	8.2	
	2013			
90	6.9	6.9	7.0	6.9
105	7.6	7.3	7.5	7.5
120	8.4	8.4	8.5	8.4
135	9.1	9.3	9.4	9.3
150	9.6	9.6	9.7	9.6
165	9.8	9.9	9.8	9.8
Mean	8.6	8.6	8.7	

L.S.D (0.05)	2012	2013
Cultivar	0.2	0.1
Days after full bloom	0.2	0.1
Cultivar x Days after full bloom	0.4	0.2

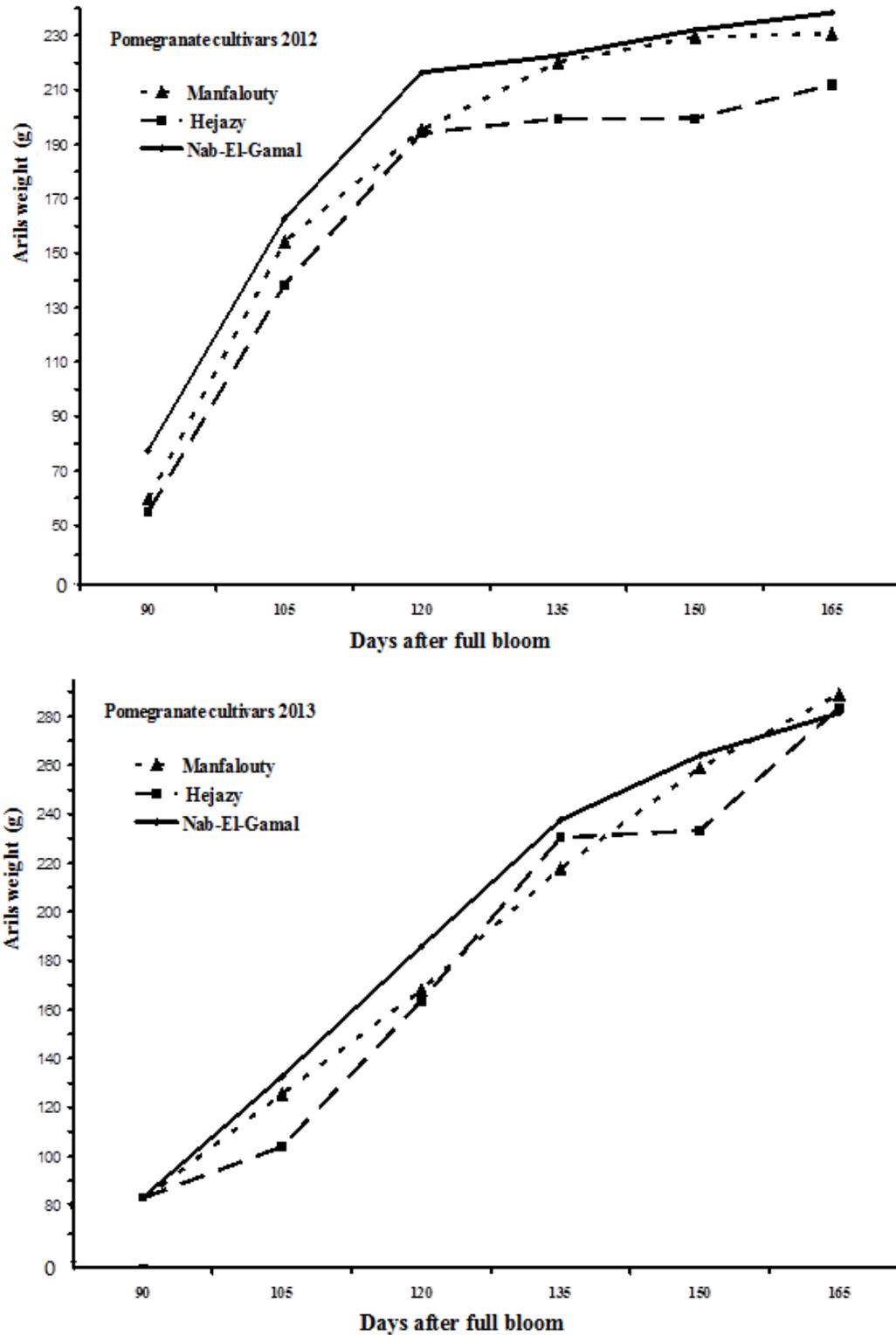


Fig. (3): Changes in arils weight (g) of Manfalouty, Hejazy and Nab-El-Gamal pomegranate cultivars during 2012 and 2013 seasons.

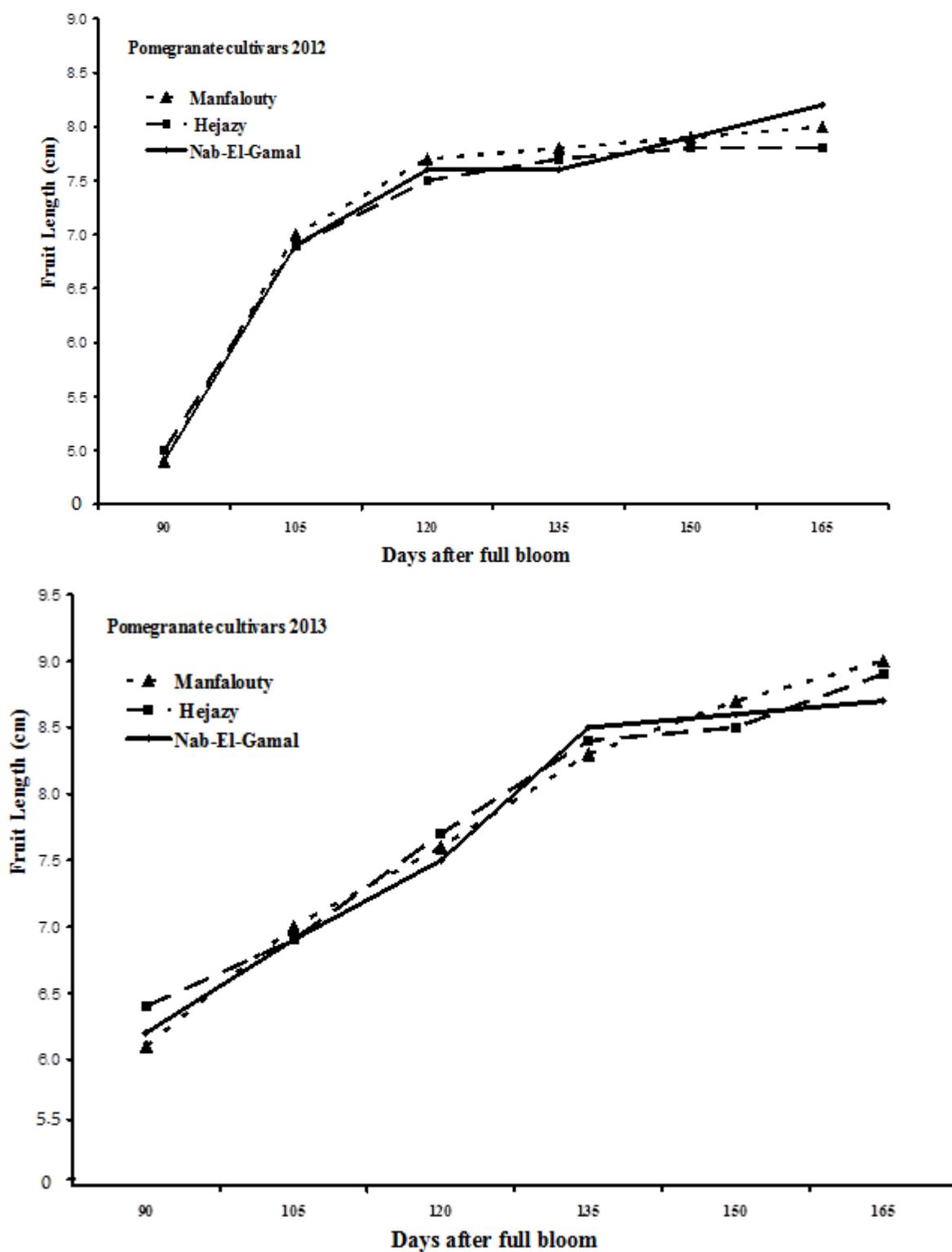


Fig. (4): Changes in fruit height (cm) of Manfalouty, Hejazy and Nab-El-Gamal pomegranate cultivars during 2012 and 2013 seasons.

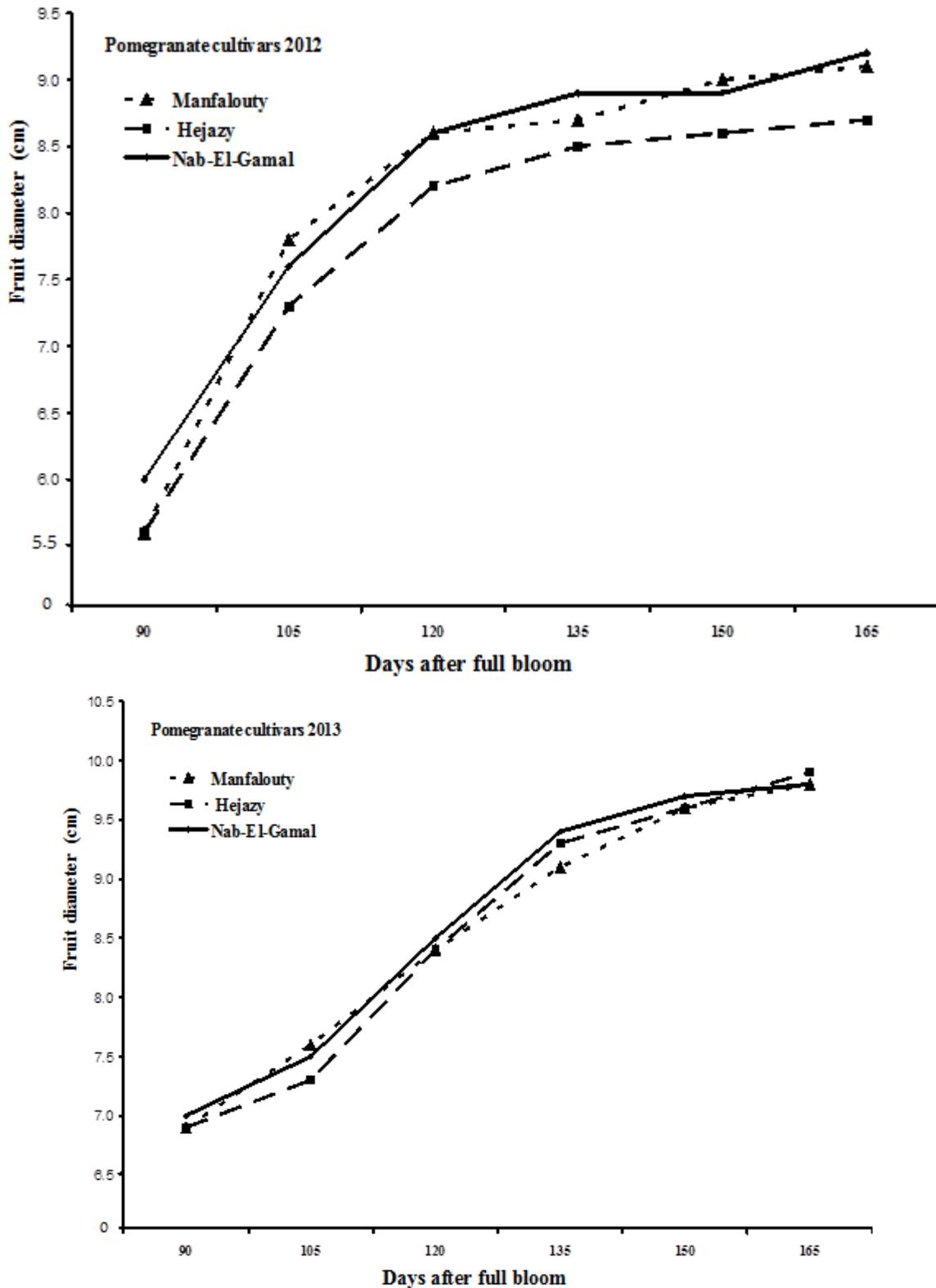


Fig. (5): Changes in fruit diameter (cm) of Manfalouty, Hejazy and Nab-El-Gamal pomegranate cultivars during 2012 and 2013 seasons.

They also found that the fruit weight significantly increased between the first and second measurement (54 and 82 days from full bloom) followed by a rapid increase at the 3rd stage (110 days) along with the 4th stage (140 days from full bloom) before hitting the maximum weight at the 5th stage.

Conclusion:

The experiment involved three Egyptian pomegranate cultivars namely as Manfalouty, Hejazy and Nab-El-Gamal. Our study revealed that there were significant differences between the studied cultivars in physical properties (except of fruit length between cultivars in the two seasons of study).

These cultivars have a special importance in their areas either for domestic consumption or to meet the growing demands of export. Great interest is growing now in Egypt towards pomegranate export mainly to Arabian Gulf countries, Russia and some European countries. Finally, it is important, therefore, to direct the research effort towards the pomegranate cultivars.

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الصفات الطبيعية أثناء نمو الثمرة لثلاثة أصناف من الرمان

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الملخص:

أجريت هذه الدراسة لتقدير التغيرات في بعض الصفات الطبيعية (طول الثمرة - قطر الثمرة - وزن الثمرة - وزن الحبوب ووزن القشرة) لثلاثة أصناف من الرمان وهي "الحجازى" ، " المنفلوطى" و "ناب الجمل" خلال موسمى ٢٠١٢ و ٢٠١٣ - وذلك بمزرعة ومعمل قسم الفاكهة - كلية الزراعة - جامعة أسيوط ، حيث تم تصميم تجربة عاملية (٦×٣).

أوضحت النتائج أن هناك زيادة كبيرة في وزن الثمار. وعامة كان وزن الثمار في الموسم الأول - خلال أي من فترات النمو - أكبر من الموسم الثاني بسبب الحمل الغزير خلال الموسم الأول من الدراسة عن الموسم الثاني (البيانات غير موجودة).

وبخصوص وزن القشرة فإن وزنها خلال الموسم الثاني كان أعلى من الموسم الأول، حيث كان متوسط وزن القشرة ٦٨.٤ ، ٦٦.٢ و ٦٢.٩ جم خلال الموسم الأول ، بينما كانت ١٤٢.٨ ، ١٥٢.٥ و ١٤٧.٠ جم خلال الموسوم الثاني لأصناف ناب الجمل ، المنفلوطي والحجازى على الترتيب. وكانت الفروق معنوية بين صنفى ناب الجمل والحجازى فى الموسم الأول ، وبين المنفلوطى وناب الجمل فى الموسم الثانى.

وبخصوص وزن الحبوب: فقد كان هناك فروق معنوية خلال موسمى الدراسة ما عدا صنفى المنفلوطى وناب الجمل فى الموسم الأول .

أبعاد الثمرة (الطول والقطر) حدث بها زيادة سريعة حتى ١٢٠ يوم بعد الإزهار الكامل فى الموسم الأول و ١٣٥ يوم بعد الإزهار الكامل فى الموسم الثانى ، وبعدها زادت ببطء حتى وصول الثمار للنضج.

يتبع نمو ثمار الرمان المنحنى ذو الدورة الواحدة، ويعزى زيادة حجم ووزن الثمار إلى زيادة حجم الحبوب ومحتوى العصير وأيضاً نمو القشرة خلال مراحل النمو المختلفة.

وقد أوضحت نتائج تلك الدراسة أن هناك زيادة معنوية فى وزن الثمرة والقشرة والحبوب خلال مراحل نمو الثمار وصولاً لأعلى قيمة عند النضج.

وقد حدث أيضاً زيادة فى طول وقطر الثمرة خلال المراحل الأولى للنمو ، وبعدها حدث زيادة بطيئة فى تلك الزيادة.