



# Adaptability of three newly introduced apricot (*Prunus armeniaca* L.) cultivars to Egyptian conditions

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## Abstract

An experiment was conducted in 2013 and 2014 with three newly introduced cultivars of apricot (*Prunus armeniaca* L.), namely "Antonio Errani", "Tiryntos" and "Ninfa" to study their performance and adaptability under Egyptian conditions. Results indicated that calculating the chilling hours temperature at or below 15°C was more suitable than temperatures at or below 7.2°C and 10°C. The cultivar with a low chilling requirement started with the opening of vegetative and flower buds earlier when compared to other cultivars. Furthermore, the cultivar Ninfa required less heat units as compared to the other two cultivars. Thus, the accumulated growing degree-days (GDDs) from the time of the flower bud break until fruit maturity was low in early matured Ninfa cultivar. However, Antonio Errani and Tiryntos cultivars were late in the date of fruit ripening. Meanwhile, there was no significant difference in the opening percentage of vegetative and flower buds, trunk circumference, fruit drop, fruit number and yield weight among cultivars during the two seasons. Conversely, the leaf drop of Antonio Errani cultivar was earlier while Ninfa cultivar started its leaf drop later in the two seasons. Tiryntos gave the highest fruit weight, fruit size and fruit surface lightness. Meanwhile, the Antonio Errani cultivar was the highest in fruit firmness and total soluble solids. The appearance and behavior of cultivars under the study varied from one season to another with shoot length, leaf area, percentage of fruit set and acidity. It can be recommended from the present study that, Antonio Errani, Tiryntos and Ninfa cultivars are well adapted under Egyptian conditions. Further, fruits from the cultivars mature early and late in the season and can fulfill the demands of the market.

## Introduction

Apricot (*Prunus armeniaca* L.) is a popular fruit and considered one of the more important fruits in the world. Research is being conducted all over the world to optimize production of high-quality apricots (Vachun et al., 1995). It is not easy to incorporate traits such as heat and cold requirements, blossoming time, frost hardiness, disease resistance and high fruit quality into a single breeding program (Benedikova, 2004). Fortunately, during the last ten years, several apricot cultivars have been introduced to Egypt by the Central Administration of Horticulture, Ministry of Agriculture. These cultivars were

early and medium maturing ones and available for sale in the local markets with high prices. Areas of apricot orchard in Egypt reached about 8570 ha with a production of about 92444 tons (Ministry of Egyptian Agriculture, 2013). Thus new cultivars need to be evaluated and selected that can perform well on a commercial scale under local environmental conditions in Egypt (Tapor, 2002). Pedigree of "Ninfa" cultivar is a hybrid between (Ouaroy x p. dc Tyrinthe) and originated in Italy (Oguzhan et al., 2012). The pedigree of "Antonio Errani" cultivar was selected from Reale D, Lmola and has an Italian

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**Figure 1 a:** Antonio Errani - Pit, flesh and mature fruits of apricot cultivars



**Figure 1 b:** Tirynthos - Pit, flesh and mature fruits of apricot cultivars



**Figure 1 c:** Ninfa - Pit, flesh and mature fruits of apricot cultivars

origin (Oguzham et al., 2012). Antonio Errani, Tirynthos and Ninfa apricot cultivars were introduced from the Bari region in the south of Italy.

The aim of this study is to evaluate some new apricot

cultivars that have been introduced from Italy recently. This research study facilitates proper recommendations of suitable apricot cultivars to Egyptian conditions.

#### **Material and Methods**



The present study was conducted through the 2013 and 2014 seasons to evaluate three new apricot cultivars recently introduced to Egypt. These cultivars were "Antonio Errani" (Figure 1a) "Tiryntos" (Figure 1b) and "Ninfa" (Figure 1c). The trees were three year old budded Manicot seedlings rootstock, pruned to the vase shape system and planted at 5 X 4 m apart and grown in sandy soil under drip a irrigation system in a private orchard at Khatatba region, Egypt. Each cultivar was represented by three trees uniform in size and vigor. The following variables were measured:

**Chilling and heat requirements:** Thirty shoots at one-year-old were tagged on each tree of each cultivar. These shoots were left unpruned to determine bud break date to calculate chilling hours and heat hours requirements. Degrees of temperature at the Khatatba region from the Central Laboratory of Agricultural Climate (CLAC) were recorded all year around by means of hygrothermograph (model H 311 weather Measure Corporation) in a weather shelter, placed 1.5 M above ground.

**Determination of chilling requirements:** In each season, temperatures were recorded every two hours all year round. Calculation of chilling hours was started in late fall when temperature dropped to 15°C (Nov. 20, 2013 and Nov. 18, 2014). The termination of vegetative bud was determined when about 50% of the total numbers of buds took the pyramidal shape. Conversely, the termination of flower buds was determined when about 50% of the total number of buds took the dome shape (Azza, 1995). The chilling requirements of vegetative and flower buds were calculated as follows:

Total hours at or below 7.2°C, 10°C and 15°C were recorded according to Weinberger (1950), Gilreath and Buchanan (1981), Sherman and Tyrene (1989) and Azza, (1995) respectively.

**Heat units:** Heat units were calculated when chilling was terminated and until the maturity of the fruit. Different stages of flower bud development (swelling bud, burst bud, pink balloon, advanced pink balloon, full bloom, petal fall, initial fruit set, final fruit set) as well as the beginning of pit hardening and fruit maturity in relation to accumulated heat units at each defined stage were determined for each cultivar. Heat units in terms of GDD from the predicted time of dormancy completion until fruit maturity were calculated as describe by Shallenberger et al., (1959) as per the equation 1 (Eq [1]):

$$GDD = \frac{(T_{min} + T_{max})}{2} - T_{base} \quad \text{Eq. 1}$$

Where,  $T_{base}$  is 4.4°C ( $T_{base}$  = base temperature)

### Vegetative growth

The same shoots previously selected for determination of chilling and heat units (30 shoots / tree) were used to determine the following measurements:

**Date and percentage of vegetative bud opening:** Date of vegetative bud opening per tree was determined at the opening of the bud burst. The opening percentage of vegetative buds (as a percentage of total number of vegetative buds) was determined 30 days after bud burst stage.

**Shoot length (cm), leaf area (cm<sup>2</sup>) and trunk circumference (cm):** Shoot length and trunk circumference were measured using measuring tape at the end of the growing season (December). For leaf area determination, samples were taken from the fourth to the sixth leaf from the top of the selected shoot (three leaves per shoot X thirty shoots per tree) to measure their leaf area using LI-COR-Portable leaf area mater (LI-3000, LI-COR Inc., Lincoln, USA) and expressed it as cm<sup>2</sup>.

**Dates of leaf drop:** Dates were taken when 50% of the leaves were dropped.

### Flowering and fruiting

The above selected shoots per tree (30 shoots) were used to determine the following measurements:

**Percentage of flower bud opening:** Percentages of flower bud opening were recorded and determined at the completion of flowering (full bloom) of each cultivar and calculated using equation 2 (Eq. [2]):

$$\text{Percentage of flower bud opening} = \frac{\text{Number of opened flower buds}}{\text{Total number of flower buds}} \times 100 \quad \text{Eq. 2}$$

The total numbers of flower buds were counted when they took the dome shape.

**Dates of different stages of flower bud opening:** Dates of the eight stages of flower bud development were recorded to be correlated with heat units required to reach each stage. These stages are:

1. Swelling bud
2. Burst bud
3. Pink balloon
4. Advanced pink balloon
5. Full bloom
6. Petal fall
7. Initial fruit set
8. Final fruit set

**Fruit set percentage:** The fruit set was determined by counting number of set fruits (after 30 days of full bloom). The percentage of the fruit set was calculated



**Table 1** : Chilling hours at or below 7.2°C, 10°C and 15°C of vegetative buds of selected new apricot cultivars in the years 2013 and 2014 seasons

Cultivar	Date of rest termination*	2013 season			Date of rest termination*	2014 season		
		Chilling at or below				Chilling at or below		
		7.2°C	10°C	15°C		7.2°C	10°C	15°C
Antonio Errani	Mar. 19	0	6	297	Mar.30	0	4	221
Tirynthos	Mar. 19	0	6	297	Mar.30	0	4	217
Ninfa	Mar.17	0	6	294	Mar.28	0	4	217

\* Date of termination was determined when 50% of vegetative buds take the pyramidal shape

using equation 3 (Eq. [3]).

$$\text{Fruit set \%} = \frac{\text{Number of set fruit}}{\text{Total number of flowers at full bloom}} \times 100 \text{ — Eq. 3}$$

**Fruit drop percentage:** Fruit drop percentage was calculated every ten days starting from fruit set until fruit maturation. The fruit drop percentage was calculated using equation 4 (Eq. [4]).

$$\text{Fruit drop \%} = \frac{\text{Number of dropped fruit on a given date}}{\text{Total number of set fruits}} \times 100 \text{ — Eq. 4}$$

#### Yield

At the harvest time of each cultivar, the number of fruits per tree was taken for studying the following physical and chemical properties of fruits:

**Fruit physical properties:** Weight, size, height and diameter of fruit, flesh diameter and seed weight were determined. Flesh colour was recorded visually. Fruit skin colour measurement was taken using a Hunter Colorimeter (type DP-9000. In this system of colour representation the value b\* describe a uniform negative for blue and positive for yellow (90°= yellow, 270° = blue). L\* colour lightness were quantified at stimulus colormetry data, it was determined using chromameter model DP-9000, colour was represented by L (whiteness/darkness, ranged from 0 to 100 being (McGuire, 1992). Stone freeness was determined as free semi free and cling size and the weight of the pips were recorded. Firmness was evaluated with a manual penetrometer (model Effegi FT 327, Italy) on two peeled opposite sides at the equatorial region of the apricot. Using an 8mm - wide plunger and expressed as LP/inch<sup>2</sup>.

**Fruit chemical properties:** Total soluble solids in juice (T.S.S) were measured with a hand-held refractometer model 10419. Juice Acidity was determined according to A.O.A.C. (1970) and calculated as gram anhydrous citric

acid/ 100 ml Juice.

#### Statistically analysis

The data of vegetative growth, flowering and fruit set during the 2013 and 2014 experimental seasons were subjected to analysis according to Snedecor and Cochran (1990) using the MSTAT program. Least significant ranges (LSR) were used to compare means of the treatments responses according to Duncan (1955) at a probability of 5%.

## Results and Discussion

### Chilling requirements

#### a) Chilling requirements of vegetative buds:

Available and estimated chill hours (C.H.) from dormancy onset until vegetative bud took the pyramidal shape (**Table 1**) equal at or below 7.2°C and 10°C with selected cultivars. However, it was varied at or below 15°C.

#### b) Chilling requirements of flower buds:

The available and estimated chill hours from dormancy onset until the flower bud took the dome shape were affected by cultivar and season at or below 15°C. Meanwhile, it was equal at or below 7.2°C and 10°C (**Table 2**).

In this respect, Campoy et al., (2010) mentioned that high temperatures during the chilling period have a negative effect on breaking the dormancy and shading of trees and reduces the incidence of radiation and the temperature in the apricot. Furthermore, Guerriero and Bartolini (1991) argued that apricot cultivation is greatly restricted by climatic conditions, especially related to chill accumulation in several growing areas with a significant influence on productivity.

#### c) Dates of vegetative bud opening:

The Ninfa cultivar started opening in the first and second



**Table 2 :** Chilling hours at or below 7.2°C, 10°C and 15°C of flower buds of selected new apricot cultivars in the years 2013 and 2014 seasons

Cultivar	Date of rest termination*	2013 season			Date of rest termination*	2014 season		
		Chilling at or below				Chilling at or below		
		7.2°C	10°C	15°C		7.2°C	10°C	15°C
Antonio Errani	Mar.5	0	5	281	Mar.10	0	4	197
Tiryntos	Mar.5	0	5	281	Mar.6	0	4	189
Ninfa	Mar.7	0	5	273	Feb.24	0	4	178

**Table 3 :** Dates of vegetative bud opening of selected new apricot cultivars in the years 2013 and 2014 seasons

Cultivar	Dates of vegetative bud opening	
	2013 season	2014 season
	Antonio Errani	Mar.19
Tiryntos	Mar.19	Mar.30
Ninfa	Mar.17	Mar.28

**Table 4 :** Opening percentages of vegetative and flower bud per shoot of selected new apricot cultivars in the years 2013 and 2014 seasons

Cultivar	Vegetative buds (%)		Flower buds (%)	
	2013 season	2014 season	2013 season	2014 season
Antonio Errani	40.22	45.56	77.98	49.58
Tiryntos	30.05	44.42	37.06	47.05
Ninfa	33.52	55.98	41.54	58.38
<b>LSD at 5 %</b>	<b>N.S.</b>	<b>N.S.</b>	<b>N.S.</b>	<b>N.S.</b>

seasons earlier than other cultivars (**Table 3**).

**d) Opening percentages of vegetative and flower buds:**

Results show that there is no significant difference between cultivars under study in the first and second seasons concerning opening percentages of vegetative and flower buds (**Table 4**).

In this respect, Massai (2010) mentioned that variations between years in apricot behavior could be so large to induce an unpredictable response of the trees to the changes in climate. This aspect became more significant and dangerous for many new cultivars characterized by self-incompatibility for which the need for the right pollinators is essential to guarantee an economical yield. The unpredictable blooming time, because of climatic variations, could induce a very poor fruit set in the years

following a mild winter. Furthermore, as highlighted by Pennone et al., (2006), making an accurate field evaluation of new cultivars in different regions to guarantee proper income to growers is crucial.

*Heat requirements*

There were different stages of flowering and fruit growth in relation to heat units (H.U.) in the form of GDDs accumulated at each stage from flower bud opening until fruit maturity. These results are presented in **Tables 5** and **Tables 6** for two seasons under the study. It is obvious that the cultivar Ninfa required less heat units as compared with the other two apricot cultivars in the two seasons under study. Consequently, it is obvious that the accumulated GDDs from time of flower bud break until fruit maturity was low in early-matured cultivar.


**Table 5 :** Heat units required for different stages of flower bud opening until fruit maturity of selected new apricot cultivars in 2013 season

Cultivar	Dates of D.S	Burst bud		Pink balloon		Advance pink balloon		Full bloom		Petal full		Initial fruit set		Final fruit set		Maturity	
		Days	G.D.D	Days	G.D.D	Days	G.D.D	Days	G.D.D	Days	G.D.D	Days	G.D.D	Days	G.D.D	Days	G.D.D
		after D.S		after D.S		after D.S		after D.S		after D.S		after D.S		after D.S		after D.S	
Antonio Errani	1/03	7	96	10	142.2	12	169.25	14	193.6	16	217.95	18	245.35	22	316.5	93	1338.85
Tiryntos	1/03	8	128	10	142.2	11	155.3	12	169.25	18	245.75	19	260.8	22	316.5	93	1414.55
Ninfa	28/2	6	100.75	8	134.5	11	178.0	12	191.95	14	214.65	16	240.65	18	268.05	87	1031.29

D. S. = Dome shape of flower bud

G.D.D. = Growing degree days

**Table 6 :** Heat units required for different stages of flower bud opening until fruit maturity of selected new apricot cultivars in 2014 season

Cultivar	Dates of D.S	Burst bud		Pink balloon		Advance pink balloon		Full bloom		Petal full		Initial fruit set		Final fruit set		Maturity	
		Days	G.D.D	Days	G.D.D	Days	G.D.D	Days	G.D.D	Days	G.D.D	Days	G.D.D	Days	G.D.D	Days	G.D.D
		after D.S		after D.S		after D.S		after D.S		after D.S		after D.S		After D.S		After D.S	
Antonio Errani	6/3	11	130.95	16	199.35	20	245.65	25	306.15	28	346.75	31	394	38	494.8	93	1315.85
Tiryntos	1/1	8	112.75	12	160.95	15	195.45	19	240.35	22	277.1	32	397.75	40	512.7	102	1349.3
Ninfa	22/2	5	53.75	17	70.8	12	134.55	17	207.05	26	311.15	31	369.0	36	428.8	80	1176.9

D. S. = Dome shape of flower bud

G.D.D. = Growing degree days

In this respect, Rodrigo and Herrero (2002) mentioned that previous studies have examined the influence of climate on fruiting with different results. In apricots, a negative effect of warm pre-blossom temperatures (25°C) on fruit set and yields was detected. Ruml et al., (2010) referred that the effect of GDD thresholds on the harvest time of apricots is very important for each apricot producing region. The authors also reported that daily maximum temperatures were the most influential temperature variable for the ripening time of apricots.

#### Vegetative growth

The effect of cultivar on parameters related to vegetative growth and development namely shoot length (cm), leaf area (cm<sup>2</sup>) and trunk circumference (cm) are tabulated in (Table 7).

**a) Shoot length:** Ninfa cultivar had the significant shoot length in the first season. However, in the second season there is no significant difference ( $p=0.05$ ) between cultivars shoot length.

**b) Leaf area:** In the first season, there is no significant difference ( $p=0.05$ ) of leaf area between cultivars. Meanwhile, Ninfa cultivar showed the best significant

value ( $p=0.05$ ) in the second season than Antonia Errani and Tiryntos cultivars.

**c) Trunk circumference:** In both seasons under study, there is no significant difference ( $p=0.05$ ) on trunk circumference between cultivars under study (Table 7).

**d) Dates of leaf drop:** The leaf drop of Antonio Errani was intermediate while Tiryntos showed earlier leaf drop while, the cultivar Ninfa started leaf drop lately in the two seasons (Table 8). In this respect, Szalay and Molnar (2004) showed a good compatibility of the *Prunus armeniaca* L. seedlings with the many apricot cultivars and tree health status which was moderately better or the best.

#### Flowering of cultivar

**Duration of flower bud opening from bud swelling until fruit set:** The dates of different stages of flower bud opening, petal fall and fruit set varied from cultivar to cultivar (Tables 9 and 10). The cultivar in the two seasons under study which showed the earliest swelling bud burst stage. In the full bloom stage Ninfa bloomed on the same date as Tiryntos cultivar in the first season. However, in the second season Ninfa was the earliest



**Table 7 :** Shoot length, leaf area and trunk circumference of selected new apricot cultivars in the years 2013 and 2014 seasons

Cultivar	Shoot length (cm)		Leaf area (cm <sup>2</sup> )		Trunk circumference (cm)	
	2013	2014	2013	2014	2013	2014
	Antonio Errani	45.00	48.33	34.29	30-May	29.00
Tiryntos	48.33	52.00	43.57	31.88	31.00	32.67
Ninfa	53.33	62.33	36.57	38.73	30.67	34.00
<b>LSD at 5 %</b>	<b>2.63</b>	<b>N.S.</b>	<b>N.S.</b>	<b>4.25</b>	<b>N.S.</b>	<b>N.S.</b>

**Table 8 :** Dates of Leaf drop of selected new apricot cultivars in the years 2013 and 2014 seasons

Cultivar	Dates of Leaf drop	
	2013 season	2014 season
Antonio Errani	Dec .15	Dec.9
Tiryntos	Dec.1	Dec. 5
Ninfa	Dec.22	Dec.19

**Table 9 :** Dates of different stages of flower bud opening, petal full and fruit set of selected new apricot cultivars in 2013 season

Cultivar	Swelling bud	Burst bud	Pink balloon	Advanced pink balloon	Full bloom	Petal fall	Initial fruit set	Final fruit set
Antonio Errani	Mar. 5	Mar.7	Mar.9	Mar.11	Mar.13	Mar.15	Mar.17	Mar.21
Tiryntos	Mar. 5	Mar.8	Mar.9	Mar.10	Mar.11	Mar.17	Mar.18	Mar.21
Ninfa	Mar.2	Mar. 5	Mar.7	Mar.10	Mar.11	Mar.13	Mar.15	Mar.17

cultivar. As for fruit set, Ninfa was earlier by 4 days when compared with Tiryntos and Antonio Errani in the first season. Moreover, in the second season, Ninfa was earlier than Antonio Errani by 8 days and earlier than Tiryntos by 5 days. These results agree with Sottile et al., (2006) who mentioned that Ninfa apricot early production, so considered one of the most important cultivars in Italy. Massai (2010), in his work, mentioned that the average blooming time of Antonio Errani and Ninfa cultivars in Italy were Mar. 13 and Mar. 8 in 2006 and 2007 seasons at Imola; Ancona and Matera regions. Massai (2010) found that the blooming time of Antonio Errani was delayed by 5 days when compared with the Ninfa cultivar. Legave and Clauzel (2006) recorded the high sensitivity of Antonio Errani and Ninfa cultivars to the environmental conditions.

### Fruiting

**Percentage of fruit set:** on the percentage of fruit set and fruit drop are tabulated in (Table 11). In the fruit set percentage there is no significant difference ( $p=0.05$ ) between cultivars under the study in the first season. However, in the second season the cultivar Ninfa reached the highest significant fruit set percentage. Meanwhile, Antonio Errani and Tiryntos had no significant difference ( $p=0.05$ ) in the fruit set. Regarding the fruit drop percentage, there is no significant difference among cultivars during the two seasons.

In this respect, Sottile et al., (2006) highlighted that high fruit set cultivar Ninfa is confirmed as being very sensitive to fruit thinning. Furthermore, Legave (1978) mentioned that the lack of winter chilling hours is also



**Table 10 :** Dates of different stages of flower bud opening, petal full and fruit set of selected new apricot cultivars in 2014 season

Cultivar	Swelling bud	Burst bud	Pink balloon	Advanced pink balloon	Full bloom	Petal fall	Initial fruit set	Final fruit set
Antonio Errani	Mar.10	Mar.16	Mar.21	Mar.25	Mar.30	Apr.02	Apr.05	Apr.12
Tiryntos	Mar.06	Mar.08	Mar.12	Mar.15	Mar.19	Mar.22	Apr.01	Apr.09
Ninfa	Feb.24	Feb.26	Feb.28	Mar.05	Mar.10	Mar.19	Mar.24	Apr.04

**Table 11 :** Fruit set and fruit drop percentage of selected new apricot cultivars in the years 2013 and 2014 seasons

Cultivar	Fruit set (%)		Fruit drop (%)	
	2013	2014	2013	2014
Antonio Errani	30.56	21.67	50.00	66.67
Tiryntos	31.39	32.06	38.89	72.22
Ninfa	44.60	53.19	25.07	29.83
<b>LSD at 5 %</b>	<b>N.S.</b>	<b>21.16</b>	<b>N.S.</b>	<b>N.S.</b>

an important factor for increasing flower bud abscission. At the same time, Balta et al., (2007) found that the yield in apricot production is closely associated to fruit set and fruit drop. Regular high fruit set and low fruit drops are desired outcomes for apricot growing. There exists a limited information on fruit set and drops in apricots in the references although they affect the yield. Moreover, Albuquerque et al., (2004) argues that the irregularity of yield is one of the main problems among apricot varieties which is often erratic. Climatologically events prior to and during flowering are considered as the main determinant for fruiting success. However, problems related to poor yields are more pronounced in apricot than in other fruits and the causes are poorly defined. It is well known that many factors come into play before flowering and these influence productivity. One of these is the number of flower buds produced.

#### Dates of fruit maturity and harvest period

The dates of fruit maturity and the harvest period for the apricot cultivars in the years 2013 and 2014 are tabulated in (Table 12). The maturity and harvest date of Ninfa was earlier than Antonio Errani and Tiryntos in both seasons. In this respect, Sottile et al., (2006) mentioned that Ninfa short fruit development period, early-ripening and harvest (Lo Bianco et al., 2010). These results are in harmony with those obtained by Massai (2010) who found that ripening time of Ninfa was (20-30 May), while Antonio Errani was (14- 16 June) and Tiryntos (12 May) (Oguzhan et al., 2012).

#### Yield weight per tree

There is no significant variation among cultivars under

study in fruit number and yield weight per tree in the two seasons (Table 12). In this respect, LicznarMalanczuk and Sosna (2009) found that the apricot trees started cropping in the third year after planting and the significantly highest crop per tree and largest fruit were recorded with cultivar "Hargrand". Also, LicznarMalanczuk and Sosna (2013) mentioned that flowering, fruit set and yield of apricot trees influenced by weather conditions and genetic component of cultivar.

#### Fruit physical and chemical properties

The physical and chemical properties of Antonio Errani, Tiryntos and Ninfa apricot cultivars are tabulated in **Tables 13** and 14. **Figure 1a, 1b and 1c** also supports the above properties showing pit, flesh and mature fruits of each cultivar used for the study.

#### Physical properties

**Fruit weight:** Results indicate that the different cultivars varied in their fruit weight at maturity. The cultivar Tiryntos gave the highest and significant values both during the two seasons.

**Fruit size:** Cultivar Tiryntos show the significantly highest values ( $p = 0.05$ ) in fruit size for both seasons (**Table 13 and Table 14**).

**Flesh diameter:** In the first season, there is no significant difference between all cultivars under study. However, in the second season Antonio Errani gave the highest and significant value ( $p = 0.05$ ) followed by Tiryntos.

**Fruit length and diameter:** Tables 13 and 14 show that in



**Table 12 :** Dates of fruit maturity; harvest period and yield per tree of selected new apricot cultivars in the years 2013 and 2014 seasons

Cultivar	Dates of fruit maturity		Harvest period (days)		Yield / Tree			
					No. of fruit		Weight (kg)	
	2013	2014	2013	2014	2013	2014	2013	2014
Antonio Errani	May 21- June 9	June 7- June 17	20	10	238.00	268.67	4.47	5.52
Tiryntos	May 19-June 9	June 7- June 17	18	10	241.67	277.67	5.49	5.62
Ninfa	May 7- May29	May 17- June4	22	18	281.67	318.00	4.85	5.73
<b>LSD at 5%</b>	-	-	-	-	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>

**Table 13:** Fruit physical and chemical properties of selected new apricot cultivars in 2013 season

Cultivar	Fruit	Fruit Size	Flesh	Fruit		Color		Seed	Fruit			
	Weight	(cm <sup>3</sup> )	Diame-ter	Length	Diameter	Fruit	Flesh	Adher-ence	Firmness	T.S.S	Acidity	
	(g)		(cm)	(cm)	(cm)	b*	L*					
Antonio Errani	20.58	17.53	0.80	3.67	3.50	20.61	41.53	Yellow redish	Free stone	7.36	21.33	1.27
Tiryntos	20.30	21.50	0.67	3.80	3.57	28.70	47.51	Yellow redish	Free stone	3.14	17.83	1.45
Ninfa	18.03	17.60	0.60	3.13	3.50	23.53	42.98	Yellow	Free stone	2.56	14.50	0.92
LSD at 5 %	1.12	1.51	0.06	0.31	N.S	1.02	2.25	-	-	1.10	0.58	N.S

NS : Not significant at 5% probability level

**Table 14 :** Fruit physical and chemical properties of selected new apricot cultivars in 2014 season

Cultivar	Fruit weight	Fruit Size	Flesh di-ometer	Fruit		Color		Seed	Fruit			
	(g)	(cm <sup>3</sup> )	(cm)	Length (cm)	Diameter (cm)	Fruit	Flesh	Adherence	Firmness	T.S.S	Acidity	
						b*	L*					
Antonio Errani	18.87	16.57	0.77	3.63	3.57	20.86	41.54	Yellow redish	Free Stone	6.75	20.33	1.31
Tiryntos	22.58	22..30	0.80	3.43	3.50	28.95	48.34	Yellow redish	Free Stone	2.23	17.50	1.57
Ninfa	17.04	16.27	0.67	3.27	3.40	27.85	41.69	Yellow	Free Stone	3.48	14.17	0.93
LSD at 5 %	2.84	1.91	N.S	N.S	N.S	1.41	1.78	-	-	1.27	0.94	0.12

NS : Not significant at 5% probability level

the first season there is no significant variation among cultivars in fruit length. Meanwhile, in the second season fruit length increased significantly (0.05) with Antonio Errani and Tiryntos more than Ninfa. On the other hand, fruit diameter in the two seasons, showed no significant difference ( $p=0.05$ ) among cultivars under study.

#### Colour

**Fruit surface colour (b\*):** An increase in skin colour occurred with Tiryntos cultivar in both two seasons (Table 13 and Table 14).

**Fruit Surface lightness (L\*):** Results revealed that the

cultivar Tiryntos gave the lightness in the two seasons. On the other hand, Antonio Errani and Ninfa cultivars were recorded the lowest lightness both in two seasons. Fruit flesh colour: Yellow radish cultivar included Antonio Errani and Tiryntos cultivars. Ninfa was yellow in colour. Seed adherence: All cultivars under the study were free-stone (Table 13 and Table 14).

#### Chemical properties

**Fruit firmness:** The highest significant fruit firmness occurred in cultivar Antonio Errani. Meanwhile, Tiryntos and Ninfa cultivars were equal in low fruit firmness in the two seasons (Table 13 and Table 14).



Total soluble solids: The cultivar Antonia Errani showed the highest significant values of TSS followed by Tiryntos. Meanwhile, Ninfa cultivar showed the lowest significant values in both two seasons.

**Acidity:** In the first season, the cultivar Tiryntos gave the highest significant acidity followed by Antonio Errani and Ninfa. In the second season, there was no significant difference ( $p=0.05$ ) among cultivars.

In this respect, Sottile et al., (2006) found that Ninfa cultivar has early production together with acceptable fruit quality. Sensorial properties for apricot fruit are influenced principally by the sugars, and volatile compound contents, colour, size, texture (Ruiz and Egea, 2008), firmness, attractiveness and taste (Gurrleri et al., 2001). Visual characteristics, firmness and balanced fruit flavor are currently the predominant characters in fresh apricot markets (Madrau et al., 2009). Also, Kader (1999) considered the mean values of T.S.S. over 10% as the minimum value for consumer acceptance for apricots which is the case in our cultivars.

## Conclusion

The results of this study clearly demonstrate that calculating chilling hours temperature at or below 15°C was more suitable than temperature at or below 7.2°C and 10°C. The chilling requirement and heat units of "Ninfa" cultivar less than "Antonio Errani" and "Tiryntos". "Ninfa" early ripening and harvest while "Antonio Errani" and "Tiryntos" are late thus can be fulfilling the demands the Egyptian market. The results also confirm that there is variation among cultivars under study in fruit quality; fruit weight, size, colour, firmness, TSS and acidity. Generally, it as the case in our apricot cultivars which acceptable to Egyptian consumer. The study demonstrated that "Antonio Errani", "Tiryntos" and "Ninfa" cultivars suitability to Khatatba region, Egypt. Therefore, it could be recommended cultivate these cultivars under the same conditions.

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## Conflict of Interests

The authors hereby declare that there are no conflicts of interest.

## References

Albuquerque, N., Burgos, I. and Egea, J. (2004). Influence of flower bud density, flower bud drop and fruit set on Apricot productivity. *Scientia Horticulturae*, 102: 397 – 406.

A.O.A.C., (1970). Official method of analysis of the Association of official agricultural chemists Washington D.C., USA.

Azza, I. M. (1995). Evaluation of some new introduced peach cultivars. M. Sc. Thesis, Faculty of Agriculture - Home - Ain Shams University, Cairo, Egypt.

Balta, M.F., Muradoglu, F., Askin, M.A. and Kaya, T. (2007). Fruit sets and fruit drop in Turkish apricot (*Prunus armeniaca* L.) varieties grown under ecological conditions of Van, Turkey. *Asian Journal of Plant Sciences*, 6: 298 – 303.

Benedikova, D. (2004). The importance of genetic resources for apricot breeding in Slovakia. *Journal of Fruit and Ornamental Plant Research Special ed.*, 12: 107- 113.

Campoy, J.A., Ruiz, D. and Egea, J. (2010). Effect of shading and thidiazuron + oil treatments on dormancy breaking, blooming and fruit set in apricot in warm – winter climate. *Scientia Horticulturae*, 125: 203 – 210.

Duncan, D. B. (1955): Multiple ranges and multiple tests. *Biometrics*, 11: 1 - 24.

Gilreath, P.R. and Buchanan, D.W. (1981). Rest prediction model for low – chilling 'Sun gold' Nectarine. *American Society for Horticultural Science*, 1061 (4): 426 – 426.

Guerriero, R. and Bartolini, S. (1991). Main factors influencing cropping behavior of some apricot cultivars in Coastal areas. *Acta Horticulturae*, 293: 229 – 243.

Gurrleri, F., Audergon, J. Albognac, G. and Reich, M. (2001). Soluble sugars and carboxylic acids in ripe apricot fruit as parameters for distinguishing different cultivars. *Euphytica*, 117: 183 – 189

Kader A. A. (1999). Fruit maturity ripening and quality relationships. *Acta Horticulturae*, 484: 203 – 208.

Legave, J.M. (1978). Aspects of floral Necrosis before of lowering in apricot. *Annales de L'amelioration des plant.*, 28: 333 – 340.

Legave, J.M. and Clauzel, G. (2006). Long – term evolution of flowering time in apricot cultivars grown in southern France: which future impacts of global warming? *Acta Horticulturae*, 717: 47 – 50.

Licznar-Malanczuk M. and Sosna L. (2009). Preliminary results of the possibility of using pumiselect rootstock for apricot tree cultivation. *Zeszyty Problemowe Postępow Nauk Rolniczych (Polish)*, 536: 143 – 148.



- Licznar-Malanczuk M. and Sosna L., (2013). Growth and yielding of the several apricot cultivars on the "Somo" seedling and vegetative rootstock pumiselect. *Acta Scientiarum Polonorum Hortorum Cultus*, 12 (5), 85 – 95.
- Lo Bianco, R.; Farina, V.; Indelicato, S.G.; Filizzola, F. and Agozzine, P. (2010). Fruit physical, chemical and aromatic attributes of early, intermediate and late apricot cultivars. *Journal of the Science of Food and Agriculture*, 90 (60): 1008 – 1019.
- Madrau, M.A.; piscopo, A.; Sanguinetti, A.M.; Del caro A; poiana, M.; Romeo, F.V. and piga, A. (2009). Effect of drying temperature on polyphenolic content and antioxidant activity of apricots. *European Food Research and Technology*, 228 (3): 441 – 448.
- Massai, R. (2010). Variability of Apricot cultivars traits inside the list of recommended fruits varieties project. *Acta Horticulturae*, 862:129-136.
- McGuire, R.G. (1992). Reporting of objective colour measurements. *HortScience*, 27 (12): 1254 – 1255.
- Ministry of Egyptian Agriculture (2013). Economic Agriculture, Dept. of Agriculture Economic and Statistics. Vol.2: 11.
- Oguzhan, C., Safder, B. and Ahmer, S. (2012). Fruit quality and phytochemical attributes of some apricot (*Prunus armeniaca* L.) cultivars as affected by Genotypes and seasons. *Notulae Botanicae Horti Agrobotanici*, 40 (2): 284 – 294.
- Pennone, F., Guerriero, R., Bassi, G., Borraccini, G., Conte, L., De Michele, A., Mattatelli, B., Ondradu, G., Pellegrino, S. and Pirazzini, P. (2006). Evaluation of the apricot industry in Italy and the national program (MIPAF – Regions) 'list of recommended fruits varieties'. *Acta Horticulturae*, 701: 351 – 354.
- Rodrigo, J. and Herrero, M. (2002). Effects of pre – blossom temperatures on flower development and fruit set in apricot. *HortScience*, 29:125 – 135.
- Ruiz, D. and Egea, J. (2008). Phenotypic diversity and relationships of fruit quality traits in apricot (*Prunus armeniaca* L.) germplasm. *Euphytica*, 163: 143 – 158.
- Ruml, M., Vukovic A. and Milatovic D. (2010). Evaluation of different methods for determining growing degree – day thresholds in apricot cultivars. *International Journal of Biometeorology*, 54: 411 – 422.
- Shallenberger, R.S.; Labelle, R.L.; Mattic, L.R. and Noyes, J.C. (1959). How ripe should be to make fancy sauce? *Farm Res., New York Sta. Agric. Stn. Quart. Bull.* 25, No. 37. (Cited by Mostafa, E. A. M., & Saleh, M. M. S. (2006). Influence of spraying with gibberellic acid on behavior of Anna Apple trees. *Journal of Applied Sciences Research*, 2(8), 477-483).
- Sherman, W.H. and Lyrene, P.M. (1989). "Forda star" peach. Fruit crops Department, IFAS, University of Florida, Gainesville, FL. 32611. *HortScience*, 24 (2): 395.
- Snedecor, G.W. and Cochran, W.G. (1990). *Statistical methods* 7 th ed. The Iowa state Univ. Press, Ames, Iowa, USA, 593.
- Sottile, F., Monte, M. and Impallari, F. (2006). Vegetative and reproductive behavior of young apricot trees cv. 'Ninfa' as affected by rootstock. *Acta Horticulturae*, 717: 79-82.
- Szalay, L. and Molnar, B.P. (2004). The effect of rootstock on the tree size of apricot cultivars. *International Journal of Horticultural Science*, 10 (3), 57 – 58.
- Tapor, E. (2002). The adaptation of some apricot varieties from North America in south – east part of Romania. *Horticulture – Supplement. Abstr. XXVIth International Horticulture, Congress Toronto*: 338.
- Vachun Z., Krška B., Sasková H. (1995). Results of apricot research and breeding programme at the Horticultural Faculty in Lednice na Morawie. *ZAHRADNICTVÍ*, 22(3): 95-98.
- Weinberger, J.H. (1950). Chilling requirements of peach varieties. *American Society for Horticultural Science*, 56: 122 – 128.