67
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BEHAVIOUR of "CANINO" APRICOT CULTIVAR GROWN IN THREE DIFFERENT SOILS

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ABSTRACT

The response of "Canino" apricot trees to different soils were studied in three different regions, in El-Menoufia Governorate (as a sand and clay soil) & Alexandria Governorate (as a calcareous soil) during the two successive seasons of 2010 & 2011. Evaluation included vegetative growth, flowering, fruit set, tree productivity and fruit characteristics. Chilling units as well as growing –degree hours were also estimated through the two studied seasons. Results indicated that the vegetative growth was the best in clay soil for shoot length, leaf area and leaf chlorophyll content. Concerning periods of flowering, fruit set and harvesting dates there were variations among the three types of soils. Sand soil was the earliest followed by clay and calcareous soils. Percentages of nitrogen, phosphorus and potassium were positively affected by soil type. Also, Fe, Mn and Zn were affected by soil type. "Canino" apricot trees produced earlier fruit yield with the better fruit quality in sandy soil, whereas clay soil type gave the greatest yield followed by sand and calcareous soils.

INTRODUCTION

Apricot is one of the stone fruit species with a remarkable adaptation to several environmental conditions, ranging from the mild winter climate of northern Africa where apricots have low chilling requirements, to the freezing winter climate of Russia and other Asian countries (**Faust *et al* 1998**).

Apricot is considered to be one of the most delicious of temperate fruits. It is preferable as fresh fruit, but a large portion of the worldwide production is presented primarily by drying. Although the apricot is a desirable fruit, apricot production is severely restricted by ecological conditions and it is wide spread geographically (**Layne *et al* 1996 and Jules, 2011).** Apricot planted area in Egypt was 20971 feddan in 2005 and reached 16113 in 2010. It is noticed that total area in old soil (as clay soil in El- Menoufia Governorate) was160faddans and 1808 feddans in reclaimed soils (as a sand soil in El-Menoufia Governorate) but in El –Alexandria, it was 40 feddans in 2009 **(Ministry of Agriculture Statistics*).**

"Canino" apricot trees are one of the most important deciduous adapted and grown under environmental conditions in Egypt with high economic potentiality. The existence of many of those apricot cultivars is threatened because they recently began to lose their economic importance. In recent years, several works have focused on the identification, collection, and characterization of apricot cultivars **(Khalil & El-Shikh, 2000, Krichen, 2001 and European Commission International Cooperation for Developed Countries, 2002)**, to elaborate a national core collection.

Several works have been published on apricot morphological diversity **(Badenes *et al* 1998; Krichen, 2001 and Balta *et al* 2002)**. Apricot tree need well drained soils for optimum health and production. The soil should be moderately fertile. It is best to thin the fruit early in the season to obtain maximize size and quality.

Soil plays an important role for apricot production, since, the proper chose of soil is important to get a high fruit quality. The most limiting edaphic factors are excessively heavy and calcareous soil with a high pH that causes asphyxia and iron-induced chlorosis **(Moreno *et al* 2008**). Apricots will produce larger crops and achieve better fruit size on deep, well-drained soils. It is possible to grow apricots on shallow or marginal soils but high

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yield and best fruit size will be difficult to obtain. Loamy- sand, sandy-loam, loam and clay loam soils have been successfully used in many areas **(Maxwell Norton *et al* 2012 and Maxwell & William, 2012). Almaliotis *et al* (2006)** cleared that yield was highly related to leaf mineral content of N,P, K , Ca , Mg , B , Mn ,Zn and Fe .Moreover, the nutrients K and Ca were identified as significant for yield prediction .

The aim of the present investigation was to declare the effect of soil on growth, yield and fruit quality of "Canino" apricot trees under different three types of Egyptian soils.

MATERIALS AND METHOD

The present investigation was conducted in two successive seasons (2010 and 2011) on 15 years old "Canino" apricot trees grown in three different soils. At El- Menoufia Governorate in El-Khatatba region (as a sandy soil) using drip irrigation, in El - Neanaaia - Ashmon region (as a clay soil) using under fluid irrigation as well as in Alexandria Governorate Borg El Arab region (as a calcareous soil) using drip irrigation. Fifteen trees of "Canino" apricot cultivar grafted on apricot seedling rootstocks nearly similar in growth vigor and fruiting, free from any visual infections and received regularly the recommended horticultural practices. They were planted at 5x 5m apart in sandy soil (No. 1) , 5 x5m apart in clay soil (No. 2) and 5x4m apart in calcareous (clay loam) soil (No. 3) . Soil characters are listed in **Table (1).**

Furthermore, each one was represented in three replicates and each replicate included five trees. In each tree four branches (two years old) in four directions were tagged to evaluate the efficiency of the tested region and soils on tree fruiting, fruit quality and vegetative growth of "Canino" apricot trees.

The follow measurements were carried out.

Data of both flowering and vegetative growth were recorded during the growing seasons (2010 and 2011) as follows:-

Dates of both beginning of flowering and beginning of fruit set including the periods of flowering and fruit set as well as date of harvesting at the end of the season were calculated. Chill units from leaves defoliation till beginning of flowering were recorded as follows:-

i) Number of hours at ≤ 7.2 ^{0}C.

ii) Number of hours at ≤ 10 ^{0}C.

Growing –degree hours were also estimated for fruit growth from beginning of flowering till harvest date according to **Shallenberger et al (1959)** as the follow equation:-

$$GDH = \sum 2\ (tm - 4.4)\ 12,$$

when tm = temperature at a given hour in the day and 4.4 ^{o}C = base temperature.

Vegetative growth

At the end of the growing season, four shoots of two years old, in four directions on each tree were selected and labeled for measuring all vegetative growth parameters. Current shoots which developed on these branches were tested to leaf chlorophyll content using Minol to chlorophyll meter SPAD-502) (Minol to camera.Co,LTD Japan) at the field in mid- August. The average of ten readings were taken on the middle of leaves from all over the tree circumference, according to **Yadava (1986),** length of shoot (cm), diameter of shoot (cm) and leaf area (cm^2) were also measured.

Leaf mineral content

Leaf minerals content were determined in mid-July of both seasons. Samples of 30 leaves /tree were taken at random from the previously tagged shoots of each tree. Leaf samples were washed with tap water, oven dried at 70 ^{o}C to a constant weight and then ground .The ground leaf samples were digested with sulphoric acid and hydrogen peroxide according to **Evenhuis and Dewaard (1980)** Total nitrogen and phosphorus were determined calorimetrically according **to Evenhuis (1978) and Murphy & Riley (1962)** , respectively. Potassium was determined by a flame Photometer model E.E/L. (**Jackson, 1967**) .Whereas, available Fe, Mn and Zn were extracted by DTPA ammonium bicarbonate according to **Soltanpour (1985**). Fe, Zn and Mn were determined by perking –Elmer atomic absorption spec2trophotometer model 2380 Al, according to **Jackson and Ulrich (1959)** and **Yoshida *et al* (1972).**

Tree fruiting

Fruit set percentage

Total numbers of flowers at blooming stage (8 Marsh) were counted on four shoots selected randomly at four directions. Then after month, number of fruits were computed and recorded to calculate fruit setting and before harvest the yield (15 May) number of fruits were counted and recorded to calculate final fruit setting.

Table 1. Physical and chemical properties of the studied soils.

a) Particle size distribution (%)

Soil No.	*Coarse sand %*	*Fine sand %*	*Silt %*	*Clay %*	*Textural class*
1-El-Khatatba	11.30	80.20	5.30	3.20	Sand
2-El-Neanaaia	6.00	20.30	18.30	55.40	Clay
3- Borg El-Arab	4.20	16.30	39.60	39.90	Clay Loam

b) Chemical analysis

Soil No.	*Sp*	*pH 1-2.5*	*Total CaCO3 %*	*EC Ds/m-1*	*O.M %*	*Cations (mmolc L -1)*				*Anions (mmolc L -1)*			
						Ca2+	Mg2+	Na+	K+	$CO3^-$	HCO2-	Cl-	SO4 -
1-El Khatatba	22	8.04	1.49	1.56	0.35	3.24	2.81	7.61	0.24	2.67	1.21	9.22	3.47
2-El-Neanaaia	55	7.70	2.90	1.52	1.70	3.99	3.00	6.41	0.60	4.90	1.60	8.31	4.09
3-Borg El Arab	45	8.61	27.03	3.06	0.74	9.13	8.54	10.91	0.11	1.80	3.00	15.30	10.39

c) Macro-nutrients and micro- nutrients (mg /kg soil -1)

Soil No.	*N*	*P*	*K*	*Fe*	*Mn*	*Zn*
1- El-Khatatba	75	7.5	110	2.67	0.30	0.8
2-El-Neanaaia	100	5.5	122	4.90	1.00	1.8
3-Borg El-Arab	65	3.0	60	1.80	0.65	0.40

Yield

At harvest time in both seasons the yield of selected trees from three different soils was determined as Kgs /tree.

Fruit characteristics

Samples of fruits were collected from each treatment (60 fruits/ tree) for determining fruit characteristics at the picking date.

At picking date

Fruit physical properties

i-e fruit weight (g), volume (cm^3), length (cm), diameter (cm) and fruit firmness was estimated by Magness and Taylor pressure tester which has a standard 5/16 of inch plunger and recorded as $lb/inch^2$ were determined and recorded.

Fruit chemical properties

i-e total soluble solids (%) were estimated using hand refract meter, total juice acidity (%) was determined (as malic acid) by titration with 0.1 ormal sodium hydroxide with phenolphthalein as an indicator, according to **A.O.A.C (2005)** and TSS/ acidity were determined .

Data in this study were statistically analyzed according to the method of **Snedecor and Cochran (1990)** in each season L.S.D at 5% level and Duncan multiple range test **(Waller and Duncan 1969)** were used for comparison among means of each treatment.

RESULTS and DISCUSSION

Flowering growth

Beginning of flowering , beginning of fruit set and flowering periods for " Canino" apricot trees under three different soils are being cleared in **Table (2)** as follow:-

Table 2. Behaviour of flowering growth of "Canino" apricot cv. in different soils during 2010/2011 seasons

Soil	*beginning of flowering*		*beginning of fruit set*		*flowering Period (day)*	
	Season1	Season2	Season1	Season2	Season1	Season2
Sand	3/5	3/5	3/12	3/15	15 b	17 b
Clay	3/10	3/8	3/20	3/18	20 a	20 a
Calcareous	3/8	3/7	3/18	3/17	17 a	20 b

Means within each column followed by the same letter(s) are not significantly different at 5% level.

There were differences in the beginning of flowering in the different soils, with 5 to 3 days during the two studied seasons (2010&2011) in sand soil. Beginning of flowering occurred early in 5 March in both seasons while it was late at March 10 & 8 in 2010 and at March 8&7 in 2011 for clay and calcareous soil, respectively.

Length of flowering period was between 15-17 days in sand soil followed by 20 days in clay soil and 17-20 days in calcareous soil, respectively. Herein, it may be noticed that the longest flowering period significantly was recorded with clay and calcareous soils in first season and clay soil in second season. It may be due to their demand of their chilling requirements in different soils and weather.

Beginning of fruit set was delayed to (3/12&3/15) in sand soil followed by (3/17&3/18) in calcareous, and (3/20& 3/18) in clay soil in both seasons 2010&2011, respectively. **Burgos *et al* (2004)** mentioned that there are different aspects related to flower biology have a close link to fruit set failures in apricot and other fruit trees. However, other authors did not observe an influence of chilling on flower bud drop in apricot cultivars (**Vitir Monteleone, 1991 and Alburquerque *et al* 2003**).

Accumulated chill units

Table (3) shows accumulated chill units at the three different locations calculated by two different methods (≤ 7.2 ^{0}C.or ≤ 10 ^{0}C) in two successive seasons. It is evident that there is a large difference in the calculated chilling units. It was noticed that a large accumulated chill units ≤ 7.2^{0}C.or ≤ 10^{0}C were (183 &314 ≤ 7.2^{0}C and 569 & 794 ≤ 10^{0}C) in sand soil followed by (30&113 ≤ 7.2^{0}C and 378 & 636 ≤ 10^{0}C in clay soil and calcareous soil they were 0 & 52 ≤ 7.2^{0}C and 202 & 477 ≤ 10^{0}C). Herein, the earliest flowering in sand soil was due to the accumulation of the chilling units' required in the two seasons under studied (2009/2010 & 2010/2011). Weather conditions influence the fruiting process because pollination, stigma receptivity, ovule fertility, ovule longevity and fruit set are directly related with each other (**Ruiz and Egea, 2008**).

Table 3. Accumulated chill units for different locations during two seasons 2009/2010 and 2010/2011.

Location	*Seasons*	*Accumulated chilling units*	
		≤ 7.2^{0}C	≤ 10 ^{0}C
Sand soil	2009/2010	183	569
	2010/2011	314	794
Clay soil	2009/2010	30	378
	2010/2011	113	636
Calcareous	2009/2010	0	202
soil	2010/2011	52	477

Growing degree hours (G.D.H)

Table (4) shows accumulated growing degree hours at three different locations in two successive seasons 2009/2010 and 2010/2011. The highest amount of accumulation G.D.H were recorded in sand soil condition (26307&31949) followed by those in clay soil (26350 & 28517) and (27107 & 28949) in calcareous soil for the two seasons under study (2009/2010 &2010/2011), respectively.

Results obtained from the two consecutive seasons of the three locations under study reflected a good indicator that sand soil (El-Khattaba) had the highest accumulated chill units and growing degrees hours (G.D.H) followed by the clay and calcareous soil, respectively**.**

Table 4. Accumulated G.D.H for different locations during two seasons 2009/2010 and 2010/2011

Locations	*Seasons*	*Period*		*G.D.H*
		From	To	
Sand soil	2009/2010	10March	30May	26307
	2010/2011			31949
Clay soil	2009/2010	5March	25May	26350
	2010/2011			28517
Calcareous	2009/2010	8March	2 June	27107
soil	2010/2011			28949

Vegetative Growth

Shoot length, shoot diameter, leaf area as well as leaf chlorophyll content at the end of the growing season for "Canino" apricot trees under the three different soils were measured during the two experimental seasons (2010/2011) as being cleared in **Table (5).**

It is obvious that shoot length gave the tallest significant shoots in clay soil (56.09&56.85 cm). Shoot diameter was highest significant under sand soil conditions in the first season. In the second season sand and clay soils gave higher significant values than calcareous soil condition.

However, leaf area (cm^2) showed significant difference among three soil types in the first_season but in the second season clay soil had highest significant value .Leaf chlorophyll content was significant with clay soil. It is noticed that clay soil gave the best results in leaf area and content of chlorophyll compared with the other soils.

Leaf mineral content

Leaf macro-elements content

Table (6) illustrates the effect of different soils on the leaf macro-elements contents (N, P and K). Data showed that there was a significant increase in N and K in leaves of trees grown in a clay soil followed by sand and calcareous soils respectively. The increment may be due to the high content of nutrient elements in clay soil .Whereas, it is noticed that there was an increase in P especially in sand soil compared with the other soils. This increment may be due to the addition of Phosphoric acid to the drip irrigation system in the farm.

Table 5. Behaviour of vegetative growth and leaf Content of chlorophyll in "Canino " apricot cv. grown in different soils during 2010 / 2011seasons

Soil	*Shoot length (cm)*		*Shoot diameter (cm)*		*Leaf area (cm^2)*		*Leaf chlorophyll Content*	
	Season 1	Season 2	Season1	Season 2	Season1	Season 2	Season1	Season 2
Sand	44.70 b	46.69 b	0.63 a	0.65 a	33.93 a	38.95 b	38.89 b	42.09 b
Clay	56.09 a	56.85 a	0.46 b	0.57 a	39.01 a	42.19 a	44.93 a	47.63 a
Calcareous	37.10 b	39.33 c	0.43 b	0.45 b	28.94 a	24.47 c	35.96 c	38.67 b

Means within each column followed by the same letter(s) are not significantly different at 5% level

Table 6. Leaf macro-elements contents of "Canino" apricot cv .grown in three different soils during 2010 / 2011 seasons

Soil	*N (%)*		*P (%)*		*K (%)*	
	Season1	Season2	Season1	Season2	Season1	Season2
Sand	1.75b	1.93a	0.38a	0.40a	1.76a	1.81b
Clay	2.03a	2.03a	0.21b	0.22b	1.83a	1.90a
Calcareous	1.66c	1.66b	0.18c	0.19c	1.45b	1.52c

Means within each column followed by the same letter(s) are not significantly different at 5% level

Leaf micro-elements content

It could be observed from **Table (7**) that leaves content of micro- elements were higher significant value in clay soil in comparison with the other types of soils in both seasons. It may be due to the high content of clay soil of nutrient elements. Our date agreed with **Krichen (2001); Balta *et al* (2002); Moreno *et al* (2008) and Jules (2011)** on their studied they mentioned that apricot trees need a suitable soil and weather in their environment for good growth, yield and fruit quality.

Table 7. Leaf micro-elements contents of "Canino" apricot cv. grown in different soils during 2010/ 2011 seasons

Soil	Fe (ppm)		Mn (ppm)		Zn (ppm)	
	Season1	Season2	Season1	Season2	Season1	Season2
Sand	62.67 b	75.00 c	55.33 b	57.33 b	30.00 b	32.00 b
Clay	81.00 a	85.00 a	59.00 a	59.33 a	34.00 a	35.00 a
Calcareous	67.33 b	80.33 b	53.33 c	55.67 c	22.33 c	24.33 c

Means within each column followed by the same letter(s) are not significantly different at 5% level

Fruiting growth

Fruit set percentage

It was highest significant with clay soil in the first season but in the second season sand and clay soils gave higher significant values than third one.. It is clear that the highest percentage of fruit set was in sand soil followed by clay and calcareous soils as shown in Table8. Our data agreed with **Abd El-Rzek *et al* (2011) and Fathi *et al* (2008)** in their study on apricot.

Retained fruits percentage

Concerning the percentage of retained fruits, it is clear from **Table (8)** that apricot trees grown in clay soil gave the highest significant percentage of retained fruits in the two seasons under study (2010 & 2011).

Tree yield

Differences were found between yields were due to differences in soils, **Table (8).** Regarding yield/tree as (kgs) it can be noticed that trees grown in clay soil reflected highest significant yield during the two seasons 2010/2011 under study.

Harvest date and period

Data indicated that the fruit harvest date began early 5/23&5/27 in sand soil in both season respectively. Whereas, in clay soil it began on 5/29&5/30 and late in calcareous soil 6/2 &6/5, respectively in the two seasons under study (2010-2011). Harvest period, it was longer significant with sand soil compared with calcareous soil in the first season but in the second season sand soil recorded longest significant period of harvest. "Canino" apricot tree is early ripening and produced regular yields of fruits, and would extend the harvesting season in sand soil followed by trees in clay and calcareous soils **(Table 8).**

Table 8. Behaviour of fruit set (%), retained fruit (%) and yield (Kg/tree) of "Canino" Apricot cv. grown in different soils during seasons 2010/2011.

Soil	*Fruit set (%)*		*Retained fruit (%)*		*yield(Kg/tree)*		*Date of harvest*		*Period of harvest (day)*	
	Season1	Season2	Season1	Season2	Season1	Season2	Season1	Season2	Season1	Season2
Sand	33.45a	34.10 a	23.17 b	27.80 b	41.67 b	46.08 b	5/23	5/27	19.00a	20.00 a
Clay	30.17b	32.36 a	29.05 a	30.49 a	56.34 a	61.00 a	5/29	5.30	16.00ab	15.00 b
Calcareous	27.67c	28.27 b	16.50 c	16.27 c	43.63 b	48.33 b	6/2	6/5	15.00b	15.00 b

Means within each column followed by the same letter(s) are not significantly different at 5% level

Physical Fruit properties

Data in **Table (9)** shows the physical fruit properties of "Canino" apricot during 2010 and 2011 seasons. Fruit weight, volume and length recorded higher significant value with sand and clay soils than third one in both seasons. Fruit diameter ,sand and clay soils showed higher significant values than third one in the first season but in the second season first one had highest significant value..

It can be concluded that fruits of higher weight, volume, polar equator and fruit firmness were obtained in sand soil followed by clay soil.

Fruit chemical properties

With regard to chemical characteristics of "Canino" apricot fruits higher significant TSS % of the juice was obtained of trees grow in a clay and calcareous soils than sand one, in the 1th season under study, but there was significant differences in the 2nd season in all types of soil under study.

Acidity % of the juice as compared in both seasons 2010&2011 for the three types of soils were shown in **Table (10).** The highest significant value of acidity was recorded in the juice from fruits grown in clay soil (1.92 &1.93 %) followed by sandy soil (1.04 &1.04 %) and calcareous soil (0.86 &0.86 %), respectively. These results were reflected on TSS/acidity ratio, whereas the highest significant values were obtained in the "Canino" apricot fruits from calcareous soil followed by sand and clay soil.

Table 9. Physical fruit properties of “Canino” apricot cv. grown in different soils during 2010/ 2011 seasons

Soil	Fruit weight (g)		Fruit volume (cm^3)		fruit length (cm)		Fruit diameter(cm)		*Fruit firmness* (lb / $Inch^2$)	
	Sea-son1	Sea-son2	Sea-son1	Sea-son2	Sea-son1	Sea-son2	Sea-son1	Sea-son2	Sea-son1	Sea-son2
Sand	47.47a	47.67a	46.47a	45.53a	4.07 a	4.17 a	4.17 a	4.27 a	10.03 a	14.27 a
Clay	45.05a	48.14a	44.17a	46.73a	4.07 a	4.07 a	4.17 a	4.03 b	8.60 b	10.18 b
Calcareous	41.83b	41.05b	39.88b	39.10b	3.63 b	3.63 b	3.50 b	3.46 c	8.55 b	9.85 b

Means within each column followed by the same letter(s) are not significantly different at 5% level.

Table 10. Chemical fruit properties of “Canino” apricot cv.grown in different soils during 2010 / 2011 seasons.

	Season1	Season2	Season1	Season2	Season1	Season2
Sand	11.67 b	14.17 a	1.04 b	1.04 b	11.22 b	13.63 b
Clay	13.79 a	14.17 a	1.92 a	1.93 a	7.18 c	7.349 c
Calcareous	13.60 a	13.67 a	0.86 c	0.86 c	15.81 a	15.89 a

Means within each column followed by the same letter (s) are not significantly different at 5% level.

CONCLUSION

Generally, results indicated that there were positive effects for type of soil on growth, yield and fruit quality of “Canino” apricot trees. Sandy soil is the earliest and increased fruit set (%) and fruit quality .These increment could be explained as the well conditions for grown Canino apricot trees. Trees grown in clay soil gave the best vegetative growth (shoot length, leaf area and chlorophyll content) compared with the other soil types, that was due to clay soil content of the nutrient elements that trees require it. Apricot trees require nitrogen, potassium and phosphorus. Therefore, fertilizing would be important for the care of apricot trees. They normally obtained their demand of elements from the soil. So it is important that when you plant the tree you make sure the soil is suitable for growth roots. This study contains two parts, the first part aimed to evaluate “Canino” apricot trees under different Egyptian conditions.

Evaluation was focused on vegetative growth, flowering, fruit set, yield and fruit characteristics. The second part is to investigate the suitable soil type for producing a good yield with a high quality. It was noticed that Canino apricot tree grew well under sand soil with a good yield and quality.

REFERENCES

Abd El-Rzek, E., Abd El-Migeed, M.M.M. and Abd El-Hamid, N. (2011). Effect of spraying garlic extract and olive oil on flowering behavior yield and fruit quality of "Canino" apricot trees. **American–Eurasian, J. Agric. & Environ. Sci., 11(6): 776-781.**

Almaliotis, D., Velemis, D., Bladenopoulou, S. and Karapetsas, N. (2006). Apricot yield in relation to leaf nutrient levels in northern Greece. **Acta Hort (ISHS), 701:669-673.**

Alburquerque, N., Burgos, L. and Egea, J. (2003). Apricot flower bud development and abscission related tochilling, irrigation and type of shoots. **Sci. Hortic. 98: 265-276.**

A.O.A.C. (2005). Official Methods of Analysis. Published by the A.O.A.C. Washington DC, USA.

Badenes, Martinez-Calvo, J. and Llàcer, G. (1998). Analysis of apricot germplasm from the European ecogeographical group. **Euphytica 102: 93–99.**

Balta, F., Kaya, T., Yarelgaç, T., Kazankaya A., Balta, M.F. and Koyuncu, M.A. (2002). Promising apricot genetic resources from the

Lake Van region Genet**. Resources Crop Evol., 49: 411–415**.

Burgos. L., Alburquerque, N. and Egea, J. Review (2004). Flower biology in apricot and its implications for breeding. **Spanish Journal of Agricultural Research, 2(2): 227-241.**

European Commission International Cooperation for Developed Countries (2002). Prospection, characterization assessment of apricot genetic resources in the Mediterranean region for the production in arid and semi-arid areas (**Centre International de Hautes Etudes Agronomiques Méditerranéennes (CIHEAM), Institute Agronomique Méditerranéen de Sarragosse (IAMZ) Audergon, Spain).**

Evenhuis, B. (1978). *Simplified methods for foliar Analysis***" Koninklijk Institaut voorde tropen . Inst., Amsterdam, pp. 1-17.**

Evenhuis, B. and Dewaard, P.W. (1980). *Principles and practices in plant analysis* **Inst., Amsterdam Paper, 15: 152-163**.

Fathi M.A., Hussein, S.M. and Eman, A.K. (2008). Effect of some endo-dormancy breaking agents on flowering, yield and fruit quality of "Canino" apricot. **Egypt J. Appl. Agric. Res. (NRC), 1(2): 211-223.**

Faust, M., Suranyl, D. and Nyujto, F. (1998). Origin and dissemination of apricot. **Hort. Rev. (Amer. Soc. Hort. Sci.) 22: 225–266**.

Jackson, N.L. (1967). Soil chemical analysis. Prentice-Hall Inc. Englewood Cliffs, NS.

Jackson, N.L. and lrich, A.U. (1959). *Analytical methods for use plant analysis*. **Coll. of Agric., Exp. State Bull. 766:35.**

Jules, J. (2011). Origin and dissemination of prunus crops Peach, Cherry, Apricot, Plum and Almond.**ISHS, 9.2011. (ISBn978-90-6605-436)**.

Khalil, Bahan M. and El-Sheikh, A.A. (2000). A comparative study between two apricot cultivars in relation with protein profile. **J. Agric. Sci. Mansoura Univ., 25(6): 3559-3568.**

Krichen, L. (2001). Prospection et identification des variétés autochtones d'abricotier (Prunus armeniaca L.) à Testour, Ras Jbel et Kairouan (Diplôme d'Etudes Approfondies (DEA), **Institut Nationa Agronomique de Tunis, Ariana, Tunisia).**

Layne, R.E.C., Bailey C.H. and Hough I.F. (1996). Apricots.. In: Janick and J.N. Morre (eds.). **Fruit breeding. Vol. 1. pp. 79-111 Willey. New York USA.**

Maxwell, N. and William, C. (2012). Growing Apricots in California: **An Overview. The Apricot Producers of California can becontacted at http://ApricotProducers.com or 209/632-9777 and the California Apricot Council at htt:// califapricot.com. March 2012.**

Maxwell, N., Benito A., Santa, C. and William, C. (2012). Growing Apricots in California: **An Overview. The Apricot Producers of California contacted at http://Apricot Producers.com or 209/632-977 and the California Apricot Council at htt://califapricot. com. March 2012.**

Ministry of Agriculture Statistics (2009). **Agriculture Directorates of Governorates.** Publisher: Economic Affairs Sector.

Moreno, M.A., Gogorcena, Y. and Pinochet, J. (2008). Mejora.y seleccion de patrones prunus tolerantes a estreses a bioticos.. in-La adaptacion al ambiente ylos estreses abioticos en la mejora vegetal. **Junta de Andalucía pp. 449 - 475,** Sevilla.

Murphy, S. and Riley, J.P. (1962). A modified single solution method for the determination of phosphate in natural water. **Anal. Chem. Acta, 27: 31-36.**

Ruiz, D. and Egea, J. (2008). Analysis of the variability and correlations of floral biology factors affecting fruit set in apricot in a Mediterranean climate'. **Scientia Horticulturae, 115: 154-163.**

Shallenberger, R.S., Labell, R.L., Mattic, L.R. and Noyes, J.C. (1959). How ripe should apple be to make fancy **?Farm res., New York State Agric. Stn. Quart. Bull. 25(37).**

Soltanpour, P.N. (1985). Use of ammonium bicarbonate DTPA soil tests to evaluate elemental availability and toxicity. **Soil Sci. Plant Anal., 16: 318-323.**

Yadava, Y.L. (1986). A rapid and non - destructive method to determine chlorophyll in intact leaves**. Hort. Science, 21: 1449–1450.**

Yoshida, S., Forno, D.A., Cock, J.H. and Gomez K.A. (1972). Laboratory manual for synthesis. **J. Plant Physiol., 59: 569-573**.

Snedecor, G.W. and Cochran, G.W. (1990). Statistical Methods. 7th (Ed). The Iowa State Univ. Press, Ames, Iowa , USA. 593p.

Vitir., M.P. (1991). Observations on flower bud growth in some Low yield varieties of apricot. **Acta. Hort., 293: 319-326**.

Waller, R.A. and Duncan, D.B. (1969). A Bays role for the symmetric multiple comparison Problem. **Amer. State. Assoc. J., 1485-1503**.