PHYSIOLOGICAL STUDIES ON "MARISOL" CLEMENTINE FRUITS: I- EFFECT OF ROOTSTOCK TYPES ON FRUIT GROWTH DEVELOPMENT AND MATURATION

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Abstract

Marisol is a new highly productive Clementine cultivar that has been introduced to the Egyptian Horticulture industry. This study was carried out during two successive seasons (2005&2006) at Hort. Res. Institute, Fruit Handling Department, Giza Governorate, to determine the behavior of Marisol cultivar fruits during development and maturation.

Marisol (*C. clementina* Hort. ex Tan.) trees grown in a private farm at Ismailia Governorate, grafted on Sour orange, Carrizo citrange, Cleopatra mandarin and Citrumelo rootstocks were selected for this study. Fruit samples were taken during fruit development at the first week of October and repeated at weekly intervals until commercial harvest. Fruit physical and chemical characteristics during development and maturation were determined.

Fruit weight, TSS contents and TSS/acid ratio significantly increased, while fruit firmness and total acidity decreased gradually and significantly during growth development. On the other hand, fruit volume, fruit gravity and juice content were nearly constant during the first maturation stages, and then began to decrease with the extension of fruit age, at over ripening stage. Fruit color changed directly from yellowish green to greenish-yellow to yellow with advanced fruit age. However, fruit coloration was poor at the earlier stages of maturation process and required to be degreened. Ascorbic acid content of fruit increased gradually and significantly until it reached the maximum nearly at the optimum maturity stage, then began to decrease with the increasing of fruit age.

Fruits produced from trees on Carrizo, Cleopatra and Citrumelo rootstocks were heavier, more volume, less gravity, more developed color, less firmness, less juice content, higher total soluble solid content, less total acidity content and higher total soluble solid/total acidity ratio than that produced from trees on Sour orange, while rootstock types had no effect on fruit contents of ascorbic acid.

Marisol fruit produced from trees on Carrizo and Citrumelo followed by that on Cleopatra rootstocks reached maturation one week earlier than that produced from trees on Sour orange when TSS / Acid ratio reached more than 9:1, (nearly after 168 - 175 days from full bloom, during the last week of October or the first week of November). While that on Sour orange reached maturation at one week later. Moreover, data also indicated that fruit quality deteriorated quickly with delaying harvesting process after reaching maturity stage.

INTRODUCTION

Citrus is one of the most important fruit crops in Egypt. The cultivated area is estimated to be 382 027 Faddan, producing 3 211 709 tons in 2006 season, while the exported quantity in 2005 reached 530 909 tons from all citrus species *(Egyptian Ministry of Agric., 2006)*. The concentration of the Egyptian local mandarin fruit production during a short period and its sensitivity to post harvest handling and management obligate the farmers to search about new varieties, especially early and lPate ones which have a good ability of marketing and handling process. New mandarin cultivars and hybrids have been introduced to the Egyptian Horticulture such as Hernandina, Clemenules, Marisol, Nova mandarin and Ellendale tangor and others. These cultivars have been spread in the private sector orchards. However, there is a lack of information about the behavior of these new cultivars under the Egyptian local weather concerning production, maturation and post harvest management.

Marisol Clementine is a mutation of "Oroval" Clementine detected in 1970 in Spain. The fruit maturation is very early and can be harvested from mid- September for degreening with green-orange coloration (*Zaragoza, 1993, Bono et al., 1995 and Goncalves, 1998). Pons, et al. (1989)* mentioned that, Marisol and Clemenules fruit become puffy and lose its gravity when harvesting is delayed. The same results were illustrated by *Zaragoza (1993).*

One of the most important issues in the cultivation of citrus trees is selecting a suitable rootstock, because rootstocks are effective on the quality of fruit, for instance the size, weight and the juice (*Alirezanezhad and Ramin, 2004*).

D'D'Hallewin et al. (1994) indicated that, rootstock significantly affected Avana mandarin fruit quality in terms of total acidity and ascorbic acid at harvest, but had no effect on total soluble solid contents . He also added that trees on Sour orange had the most uniform fruit size. It has been reported that, Fremont tangerine fruit on Sour orange, Rangpur lime and Carrizo citrange reached maturity earlier than fruits on Volkameriana. On the other hand, Fremont tangerine fruit weight on Volkameriana and Rangpur lime was higher than on Sour orange and Carrizo citrange. The highest fruit juice percentage and the best rind color were from Fremont fruits on Sour orange *(Ali, 2002)*. On the other hand, *Filho et al. (2007)* reported that fruit weight and juice content of "Fallglo" and "Sunburst" mandarins were not affected by the rootstock.

The purpose of this study is to determine the effect of four rootstock types (Sour Orange, Carrizo citrange, Cleopatra mandarin and Citrumelo) on Marisol Clementine fruits growth, development and maturation under the Egyptian conditions.

MATERIALS AND METHODS

This investigation was carried out during two successive seasons (2005 & 2006) at Hort. Res. Institute, Fruit Handling Department, Giza. Trees were grown in a private farm at "Wady El-Mullak" region, Ismailia Governorate. During February 2005, 36 Marisol trees (*C. clementina* Hort. ex Tan.) grafted on Sour Orange, Carrizo citrange, Cleopatra mandarin and "Swingle" citrumelo rootstocks were selected for this study (9 trees for each rootstock). Trees were 7 years old, healthy, uniformed in vigor growth, planted at 2×5 m (400 trees/faddan) under drip irrigation system and subjected to all agricultural practices as Ministry Agriculture recommendations.

Fruit samples were taken during fruit development starting at the first week of October and repeated at weekly intervals until commercial harvest for the determination of fruit physical and chemical characteristics. Each sample had 3 replicates, each replicate had 10 fruits. Fruit weight (g) and volume (cm^3) were determined and then gravity (g/cm^3) was calculated. Fruit firmness was measured in 6 fruits (3 readings per each fruit) by Lfra texture analyzer instrument using a penetrating cylinder of 1 mm in diameter to a constant distance 5 mm inside the skin of fruits and by a constant speed 2 mm per sec. and the peak of resistance was recorded (g/cm^2). Fruit color was measured by a Hunter colorimeter type (Dp-9000) for estimation of "L", "a" and "b" values, then color values as Hue angle were calculated according to *Mc-Gjuire (1992.*

In addition, a rotary extractor was used to obtain the juice, and the percentage (w/w) of juice was calculated. The TSS percentage of juice was measured by abbe refractometr, total acidity and ascorbic acid (Vit.C) contents were determined according to *A.O.A.C.* (*1995*), then TSS/acid ratio was calculated.

Data for all fruit parameters were analyzed as a complete randomized design with factorial treatments as described by *Snedecor and Cochran (1980).*

RESULTS AND DISCUSSION

A- Physical characteristics

1- Fruit weight

Data presented in Table (1) clearly indicated that Marisol Clementine fruit weight increased gradually and significantly during fruit development to reach the maximum weight at the optimum maturity stage nearly after 168-175 days of full bloom and then decreased again with the progress of advanced age.

Data also indicated that there were no significant differences among fruits produced from trees on Sour orange, Carrizo, Cleopatra and Citrumelo rootstocks in

this respect. However, fruits produced from trees on Citrumelo, Carrizo and Sour orange were the heaviest during the first season, while fruits produced from trees on Citrumelo and Carrizo were the heaviest during the second season. On the other hand, fruits produced from trees on Cleopatra were the least fruit weight during the two seasons of the work.

These results are in line with those obtained by *Bal and Chohan (1987)* and *Bassal (2001)* who reported that Clementine fruit weight increased gradually till reached the maximum at maturity stage then decreased with the advance of age.

Also these results agree with the finding of *Ali (2002)* who found that Fremont mandarin fruits produced from trees on Volkameriana and Rangpur lime were heavier than those on Sour orange and Carrizo citrange. In addition, these results partially agree with *Jacquemond et al. (1994)*, they mentioned that mandarin fruits weight were different due to rootstock type.

Table 1 . Effect of rootstock type (a) and fruit age (b) on "Marisol" Clementine fruits weight (g) during growth and at maturation.

First season (2005)						Second season (2006)					
Fruit age (days)	Rootstock types					Fruit age (days)	Rootstock types				
	1	2	3	4	Means		1	2	3	4	Means
147	117.9	111.3	94.2	110.4	108.4	147	128.0	130.0	110.3	150.6	129.7
154	108.8	124.0	102.4	119.3	113.6	154	124.3	140.6	107.8	142.8	128.8
161	119.9	124.6	109.6	122.9	119.2	161	126.8	156.4	110.2	144.0	134.3
168	138.0	139.3	143.9	152.1	143.3	168	136.4	141.8	109.6	145.5	133.3
175	151.1	131.0	138.7	139.3	140.1	175	146.6	134.9	123.6	140.3	136.4
182	139.9	143.4	138.6	137.9	139.9	182	147.2	145.2	120.9	161.3	143.6
189	130.8	130.8	138.0	130.6	132.6	Means	134.9	141.5	113.7	147.4	
Means	129.5	129.2	123.6	130.4		1 = Sour orange			2 = Carrizo,		
LSD Values at 5 % level						3 = Cleopatra			4 = Citrumelo		

Factor	A	B	a*b	a*b=Interaction
Values	N.S.	8.61	19.25	

Factor	A	B	a*b	a*b=Interaction
Values	N.S.	9.41	21.05	

2- Fruit volume

According to data shown in Table (2) it is clear that fruit volume slightly increased during the early maturation period (during October), then began to increase significantly nearly at the second week of November with the extension of fruit age.

Data also indicated that fruits produced from trees on Citrumelo, Carrizo and Cleopatra rootstocks had higher volume than that produced from trees on Sour orange during the first season, while during the second one, fruits produced from trees on Carrizo and Citrumelo rootstocks were higher in volume than those on Cleopatra and Sour orange. However, these differences were not significant during the two seasons.

These results are in harmony with those obtained by *Bal & Chohan (1987) and Bassal (2001)*, who mentioned that mandarin fruit volume increased significantly with the extension of fruit age. Also, these results partially agree with the finding of *D'Hallewin et al. (1994)*, as they indicated that mandarin fruit size was affected by rootstock type during fruit development.

Table 2. Effect of rootstock type (a) and fruit age (b) on "Marisol" Clementine fruits volume (cm^3) during growth and at maturation.

First season (2005)						Second season (2006)					
Fruit age (days)	Rootstock types					Fruit age (days)	Rootstock types				
	1	2	3	4	Means		1	2	3	4	Means
147	122.9	126.3	102.1	122.9	118.5	147	127.9	140.3	116.3	157.7	135.5
154	116.3	139.8	113.5	141.0	127.6	154	129.3	155.0	120.0	150.3	138.6
161	132.4	149.9	124.9	142.6	137.5	161	134.2	175.0	121.7	157.5	147.1
168	161.4	172.9	173.2	190.0	174.4	168	147.1	167.9	125.8	162.9	150.9
175	185.0	181.7	174.3	180.0	180.2	175	165.8	159.6	146.3	167.1	159.7
182	180.2	198.9	183.2	189.6	188.0	182	172.3	174.2	148.2	200.7	173.8
189	171.7	184.2	192.6	183.3	182.9	Means	146.1	162.0	129.7	166.0	
Means	152.8	164.8	152.0	164.2		1 = Sour orange			2 = Carrizo,		
LSD Values at 5 % level						3 = Cleopatra			4 = Citrumelo		
Factor	A	B	a*b	a*b=Interaction		Factor	A	B	a*b	a*b=Interaction	
Values	N.S.	11.35	25.38			Values	N.S.	11.14	24.92		

3- Fruit gravity

Data presented in Table (3) reveal that Marisol Clementine fruit gravity significantly decreased with the extension of fruit age. On the other hand, the gravity of fruits produced from trees on Sour orange was significantly higher than those on other rootstocks without significant differences among them, during both seasons. Also data indicated that, there was a significant interaction among fruit age and rootstock effect on fruit gravity during the two seasons.

These results are in harmony with those obtained by *Bassal (2001)* who mentioned that Hernandina, Marisol and Clemenules Clementine fruit gravity decreased with the advance of fruit age. Also, these results were supported by the

findings that mandarin fruits become puffy and lose its gravity when harvest process is delayed (*Pons, et al., 1989* and *Zaragoza, 1993).*

Table 3. Effect of rootstock type (a) and fruit age (b) on "Marisol" Clementine fruits gravity (g/cm^3) during growth and at maturation.

First season (2005)						Second season (2006)					
Fruit age	Rootstock types					Fruit age	Rootstock types				
(days)	1	2	3	4	Means	(days)	1	2	3	4	Means
147	0.96	0.88	0.92	0.90	0.915	147	1.00	0.93	0.95	0.95	0.958
154	0.94	0.89	0.90	0.85	0.893	154	0.96	0.91	0.90	0.95	0.929
161	0.91	0.83	0.88	0.86	0.869	161	0.94	0.89	0.91	0.91	0.915
168	0.86	0.81	0.83	0.80	0.823	168	0.93	0.84	0.87	0.89	0.884
175	0.82	0.72	0.80	0.77	0.777	175	0.88	0.85	0.85	0.84	0.854
182	0.78	0.72	0.76	0.73	0.745	182	0.85	0.83	0.82	0.80	0.827
189	0.76	0.71	0.72	0.71	0.725	Means	0.93	0.88	0.88	0.89	
Means	0.86	0.79	0.83	0.80		1 = Sour orange			2 = Carrizo,		
LSD Values at 5 % level						3 = Cleopatra			4 = Citrumelo		
Factor	A	B	a*b	a*b=Interaction		Factor	A	B	a*b	a*b=Interaction	
Values	0.028	0.033	0.073			Values	0.026	0.028	0.064		

4- Fruit color (as Hue angle)

Data in Table (4) show that Marisol fruit color changed directly from greenish yellow (Hue angle more than 100°) to yellow (Hue angle around 75°) with the increasing of fruit age. Fruits produced from trees on Carrizo, Citrumelo and Cleopatra had the lowest Hue angle value (more color development) in comparison with that produced from trees on Sour orange during the two seasons. Moreover, there was a significant interaction between these factors under this study.

These results agree with those mentioned by *Bassal (2000)* who found that Clementine fruits (Hernandina, Marisol and Clemenules cultivars) were dark green at the early developmental stages, then changed directly to light green to greenish-yellow, to yellow and red orange according to cultivars at maturity stage.

Table 4. Effect of rootstock type (a) and fruit age (b) on "Marisol" Clementine fruits color (Hue angle) during growth and at maturation.

First season (2005)						Second season (2006)					
Fruit age (days)	Rootstock types					Fruit age (days)	Rootstock types				
	1	2	3	4	Means		1	2	3	4	Means
147	114.7	114.0	112.3	115.3	114.1	147	111.5	105.0	110.8	109.5	109.2
154	114.6	108.0	110.8	105.7	109.8	154	109.7	103.6	107.3	107.5	107.0
161	110.0	102.9	106.2	103.9	105.7	161	109.6	102.4	100.1	97.8	102.5
168	104.1	94.6	105.4	101.8	101.5	168	100.8	89.5	92.8	95.6	94.7
175	100.9	91.1	91.8	96.9	95.2	175	98.1	75.1	86.4	82.3	85.5
182	99.6	83.6	90.8	81.8	88.9	182	91.2	70.6	82.7	79.4	81.0
189	84.3	69.6	74.3	74.3	75.6	Means	103.5	91.1	96.7	95.4	
Means	104.0	94.8	98.8	97.1		1 = Sour orange			2 = Carrizo,		
LSD Values at 5 % level						3 = Cleopatra			4 = Citrumelo		
Factor	A	B	a*b	a*b=Interaction		Factor	A	B	a*b	a*b=Interaction	
Values	3.14	3.71	8.30			Values	4.27	4.68	10.47		

Also these results are in harmony with those demonstrated by *Ali (2002)* who mentioned that Fremont tangerine fruit on Sour orange rootstock had the best rind color in comparison with that on Rangpur lime, Volkameriana and Carrizo citrange rootstocks.

5- Fruit firmness

Fruit firmness significantly decreased with the increasing of fruit age during the two seasons of this study (Table, 5). It is clear that fruits produced from trees on Carrizo and Citrumelo rootstocks had significantly less firmness than those on Sour orange during the both seasons. Data also indicated that there was a significant interaction among all factors under study.

6- Fruit juice content

According to data presented in Table (6) fruit juice content was nearly constant during maturation stage, and then began to decrease with the extension of fruit age (over ripening stage). Although, fruits produced from trees on Sour orange and Cleopatra had higher juice content than the other rootstocks during the first and the second seasons, respectively, data cleared that rootstocks had no significant effect on fruit juice content during fruit growth development and maturation in the two seasons. Data also indicated that there was a significant interaction among all factors under study.

Table 5. Effect of rootstock type (a) and fruit age (b) on "Marisol" Clementine fruits firmness (g/cm^2) during growth and at maturation.

First season (2005)						Second season (2006)					
Fruit age (days)	Rootstock types					Fruit age (days)	Rootstock types				
	1	2	3	4	Means		1	2	3	4	Means
147	129.8	92.9	109.4	99.2	107.8	147	145.2	131.3	140.9	132.6	137.5
154	108.2	98.5	100.7	98.9	101.6	154	132.4	121.9	127.3	123.7	126.3
161	100.5	91.6	96.1	89.9	94.5	161	126.9	117.8	121.7	113.9	120.1
168	97.5	88.7	91.1	90.5	92.0	168	118.9	111.5	110.0	110.8	112.8
175	92.6	86.7	90.9	85.1	88.8	175	108.4	95.0	101.1	103.3	102.0
182	88.6	78.5	83.5	82.9	83.4	182	100.2	90.4	91.2	97.9	94.9
189	88.4	77.8	77.2	76.9	80.1	Means	122.0	111.3	115.4	113.7	
Means	100.8	87.8	92.7	89.1		1 = Sour orange			2 = Carrizo,		
LSD Values at 5 % level						3 = Cleopatra			4 = Citrumelo		
Factor	A	B	a*b	a*b=Interaction		Factor	A	B	a*b	a*b=Interaction	
Values	5.48	6.49	14.51			Values	7.59	8.31	18.58		

Table 6. Effect of rootstock type (a) and fruit age (b) on "Marisol" Clementine fruits juice (%) content during growth and at maturation.

First season (2005)						Second season (2006)					
Fruit age (days)	Rootstock types					Fruit age (days)	Rootstock types				
	1	2	3	4	Means		1	2	3	4	Means
147	52.6	48.5	45.0	48.6	48.7	147	53.9	53.7	50.7	51.1	52.4
154	52.7	45.6	52.5	42.9	48.4	154	52.8	47.6	54.3	55.3	52.5
161	51.8	47.5	53.6	54.4	51.8	161	50.5	50.0	54.5	53.8	52.2
168	51.2	48.6	51.6	48.3	49.9	168	50.9	50.9	53.0	45.7	50.1
175	50.2	51.5	51.4	47.8	50.3	175	52.2	52.2	53.9	51.9	52.6
182	48.3	49.0	49.8	45.6	48.2	182	50.7	46.2	49.1	46.3	48.1
189	47.0	46.5	49.0	42.6	46.3	Means	51.8	50.1	52.6	50.7	
Means	50.53	48.19	50.41	47.16		1 = Sour orange			2 = Carrizo,		
LSD Values at 5 % level						3 = Cleopatra			4 = Citrumelo		
Factor	A	B	a*b	a*b=Interaction		Factor	A	B	a*b	a*b=Interaction	
Values	N.S.	3.06	6.83			Values	N.S.	3.08	6.88		

These results are in accordance with the findings of juice percentage of Clementine fruits which gradually increased during fruit developmental stages until reached the maximum during the early fruit maturation then slightly decreased at the last stage of maturation *Bassal (2000).* In addition, these results are in agreement with those obtained by *Ali (2002)* who mentioned that Fremont fruit on Sour orange rootstock had the highest juice content in comparison with that on the other rootstocks.

B- Chemical properties

1- Fruit juice total soluble solid (TSS), total acidity contents and TSS/acid ratio

TSS content and TSS/total acidity ratio of fruit (Tables, 7 and 8) significantly increased while total acidity (Tables, 9) decreased with the increasing of fruit age during the two seasons. Data also cleared that fruits produced from trees on Carrizo, Cleopatra and Citrumelo had significantly higher TSS content, TSS/acid ratio and significantly lower total acidity as compared with those on Sour orange during both seasons. Data also indicated that there was a significant interaction between these factors under study during the two seasons.

Table 7. Effect of rootstock type (a) and fruit age (b) on "Marisol" Clementine fruits T.S.S (%) content during growth and at maturation.

First season (2005)						Second season (2006)					
Fruit age (days)	Rootstock types					Fruit age (days)	Rootstock types				
	1	2	3	4	Means		1	2	3	4	Means
147	9.0	9.5	8.7	9.4	9.2	147	8.8	9.3	9.3	9.0	9.1
154	9.1	9.2	9.2	9.3	9.2	154	9.1	9.5	9.2	9.8	9.4
161	9.3	9.9	9.3	9.8	9.6	161	9.2	9.5	9.4	9.1	9.3
168	9.2	9.9	9.5	9.6	9.5	168	9.2	9.2	9.7	9.8	9.5
175	9.7	9.6	10.5	10.1	10.0	175	9.1	9.4	9.6	9.7	9.5
182	9.6	10.0	10.1	9.0	9.7	182	9.1	9.3	9.4	9.2	9.2
189	9.7	9.2	9.7	9.5	9.6	Means	9.1	9.4	9.4	9.4	
Means	9.4	9.6	9.6	9.5		1 = Sour orange			2 = Carrizo,		
LSD Values at 5 % level						3 = Cleopatra			4 = Citrumelo		
Factor	A	B	a*b	a*b=Interaction		Factor	A	B	a*b	a*b=Interaction	
Values	0.18	0.21	0.48			Values	0.19	0.21	0.47		

Table 8. Effect of rootstock type (a) and fruit age (b) on "Marisol" Clementine fruits acidity percentage during growth and at maturation.

First season (2005)						Second season (2006)					
Fruit age (days)	Rootstock types					Fruit age (days)	Rootstock types				
	1	2	3	4	Means		1	2	3	4	Means
147	1.13	1.00	1.03	0.94	1.03	147	1.25	1.04	1.16	1.06	1.13
154	1.09	0.98	0.93	0.80	0.95	154	1.14	1.06	1.04	1.04	1.07
161	1.00	0.90	0.95	0.88	0.93	161	1.12	0.96	0.99	1.01	1.02
168	0.95	0.88	0.92	0.87	0.91	168	1.01	0.93	0.96	0.95	0.96
175	0.92	0.84	0.94	0.86	0.89	175	0.97	0.91	0.90	0.94	0.93
182	0.94	0.88	0.83	0.90	0.89	182	0.95	0.90	0.90	0.90	0.91
189	0.99	0.95	0.98	0.96	0.97	Means	1.07	0.97	0.99	0.98	
Means	1.00	0.92	0.94	0.89		1 = Sour orange			2 = Carrizo,		
LSD Values at 5 % level						3 = Cleopatra			4 = Citrumelo		
Factor	A	B	a*b	a*b=Interaction		Factor	A	B	a*b	a*b=Interaction	
Values	0.048	0.056	0.126			Values	0.067	0.073	0.163		

Table 9. Effect of rootstock type (a) and fruit age (b) on "Marisol" Clementine fruits TSS/total acid ratio during growth and at maturation.

First season (2005)						Second season (2006)					
Fruit age (days)	Rootstock types					Fruit age (days)	Rootstock types				
	1	2	3	4	Means		1	2	3	4	Means
147	8.0	9.5	8.4	10.0	9.0	147	7.0	8.9	8.0	8.5	8.1
154	8.4	9.3	9.9	11.7	9.8	154	8.0	8.9	8.8	9.5	8.8
161	9.3	11.0	9.8	11.2	10.3	161	8.2	9.9	9.5	9.0	9.1
168	9.6	11.3	10.3	11.1	10.6	168	9.1	9.9	10.1	10.4	9.9
175	10.5	11.5	11.2	11.8	11.2	175	9.4	10.4	10.7	10.3	10.2
182	10.2	11.3	12.1	10.1	10.9	182	9.5	10.3	10.4	10.2	10.1
189	9.9	9.7	9.9	9.9	9.8	Means	8.5	9.7	9.6	9.6	
Means	9.4	10.5	10.2	10.8		1 = Sour orange			2 = Carrizo,		
LSD Values at 5 % level						3 = Cleopatra			4 = Citrumelo		
Factor	A	B	a*b	a*b=Interaction		Factor	A	B	a*b	a*b=Interaction	
Values	0.28	0.33	0.74			Values	0.58	0.64	1.43		

These results are in agreement with those illustrated by *Bassal (2000)* who indicated that TSS and TSS/acid ratio of Hernandina, Marisol and Clemenules mandarin cultivars fruits increased while total acidity content of fruit juice decreased with the advance of fruit age. Furthermore, these results were supported by the finding that rootstock types had an obvious effect on Clementine fruits juice content of TSS, total acidity and TSS/acid ratio and ascorbic acid during fruit growth development and maturation (*Fallahi and Rodney, 1992*). Also these results partially agree with those reported by *D'Hallewin et al. (1994)* who mentioned that rootstocks significantly affected Avana mandarin fruit quality in terms of total acidity and ascorbic acid at harvest but had no effect on total soluble solid content.

2- Ascorbic acid (V.C) content

Ascorbic acid content of fruits (Table, 10) increased gradually and significantly with the increasing of fruit age during the two seasons until fruit content of ascorbic acid reached the maximum nearly at 175-182 days of age, then began to decrease gradually and significantly with the increasing of fruit age.

Data also cleared that fruits produced from trees on Carrizo, Cleopatra and Citrumelo rootstocks had ascorbic acid content significantly higher than that produced from trees on Sour orange during both seasons.

Table 10. Effect of rootstock type (a) and fruit age (b) on "Marisol" Clementine fruits V.C content (mg/100 ml juice) during growth and at maturation.

First season (2005)						Second season (2006)					
Fruit age (days)	Rootstock types					Fruit age (days)	Rootstock types				
	1	2	3	4	Means		1	2	3	4	Means
147	8.3	8.6	8.6	9.8	8.8	147	10.1	11.9	11.8	10.8	11.2
154	9.0	10.3	9.7	9.0	9.5	154	13.0	13.4	14.2	16.2	14.2
161	10.9	16.7	13.7	14.8	14.0	161	15.9	18.5	20.3	18.3	18.2
168	13.2	14.3	14.2	15.8	14.4	168	20.7	18.8	16.8	17.2	18.4
175	20.8	21.5	22.1	22.3	21.7	175	24.2	25.8	26.2	23.5	24.9
182	26.0	23.3	23.1	23.0	23.8	182	18.1	17.9	18.5	19.2	18.4
189	17.5	17.3	19.3	16.9	17.8	Means	17.0	17.7	18.0	17.5	
Means	15.1	16.0	15.8	15.9		1 = Sour orange			2 = Carrizo,		
LSD Values at 5 % level						3 = Cleopatra			4 = Citrumelo		
Factor	A	B	a*b	a*b=Interaction		Factor	A	B	a*b	a*b=Interaction	
Values	0.50	0.59	1.13			Values	0.44	0.48	1.08		

These results are in agreement with those illustrated by *Bassal (2000)* who mentioned that ascorbic acid increased during the early developmental stages while decreased with delaying harvesting process. Furthermore, these results were supported by the finding that rootstock types had an obvious effect on Clementine fruit juice content of ascorbic acid during fruit development and maturation (*Chohan, 1985, and Fallahi and Rodney, 1992).*

C- Fruit maturity stage

From previous illustrated data especially that related to fruit juice quality and that presented in Table (11), it could be concluded that Marisol fruits produced from trees on Carrizo and Citrumelo followed by that on Cleopatra rootstocks reached maturation one week earlier than those on Sour orange (nearly after 175-182 days from full bloom during the last week of October or the first weak of November). Moreover, data also indicated that fruit quality deteriorated quickly with delaying harvesting process after reaching maturity stage.

Table 11. Fruit properties of "Marisol" Clementine fruits at maturity stage in 2005 and 2006 seasons.

fruit properties*	First season (2005)				Second season (2006)			
	Rootstock types				Rootstock types			
	1	2	3	4	1	2	3	4
fruit age (days)	168:175	175:182			168:175	175:182		
fruit weight (g)	138.0	139.3	143.9	152.1	146.6	134.9	123.6	140.3
fruit gravity (g/cm^3)	0.86	0.81	0.83	0.80	0.88	0.85	0.85	0.84
(Color) Hue Angle	104.1	94.6	105.4	101.8	98.1	75.1	86.4	82.3
Fruit firmness (g/cm^2)	97.5	88.7	91.1	90.5	108.4	95.0	101.1	103.3
juice %	51.2	48.6	51.6	48.3	52.2	52.2	53.9	51.9
T.S.S	9.2	9.9	9.5	9.6	9.1	9.4	9.6	9.7
Acidity %	0.95	0.88	0.92	0.87	0.97	0.91	0.90	0.94
TSS / Acid ratio	9.6	11.3	10.3	11.1	9.4	10.4	10.7	10.3
V.C (mg/ 100ml)	13.2	14.3	14.2	15.8	24.2	25.8	26.2	23.5
1 = Sour orange	2 = Carrizo		3 = Cleopatra		4 = Citrumelo			

* =The above fruit properties recorded at 168 days of fruit age during the first season and at 175 days of fruit age during the season.

These results are in line with those obtained by *Cohen (1985), Ball and Chohan (1987), Jiang and Jiang (1996) and Ali (2002)* as they indicated that rootstock types had an obvious effect on maturity stage of Clementine fruits.

REFERENCES

1. Ali, G. M. 2002. Effect of four citrus rootstocks on fruit quality and storability of Fremont tangerine. *The second Inter. Conf. Hort. Sci, 10-12 Sep, Kafr El- Sheikh, Tanta Univ., Egypt. 312-326.*
2. Alirezanezhad, A. and A. A. Ramin. 2004. The effect of eight citrus rootstocks on fruit quality of Ruby Red and Marsh grapefruit. *Abst. Of 10th ISC congress. Agadir, Morocco, 15-20 Feb, 2004. Abst. No: 63.*
3. Association of Official Analytical Chemists (A. O. A. C.) 1995. Official methods of analysis, *14th ed. Benjamin Franklin Station. Washington D.C. 20044, U.S.A. Pp. 490-510*
4. Bal, J.S. and G.S. Chohan. 1987. Studies on fruit quality at maturity and ripening of Kinnow mandarin on different rootstocks. *Ind. J. Hort., 44:1-2, 45-51.*
5. Bassal, M.A. 2000. Studies on the fruit quality of some new citrus cultivars in Egypt. *Annals of Agric. Sci. Moshtohor, 38(4): 2493-2515.*
6. Bassal, M. A. 2001. A comparative study between some new citrus cultivars in Egypt. *Annals of Agric. Sci. Moshtohor, 39(2): 1165-1182.*
7. Bono, R., J. Soler y L. Fernández de Córdova 1995. Variedades de clementina cultivadas actualmente en España. *Levante Agricola 331: 89-93.*
8. Cohen, E. 1985. The effects of growing area, rootstocks, harvest time, waxing and storage temperatures on post harvest quality of Murcott mandarin fruit. *Hassadeh. 66 (1)70 -74. (CAP Abstract).*
9. Fallahi, E. and D.R. Rodney. 1992. Tree size, yield, fruit quality, and leaf mineral nutrient concentration of Fairchild mandarin on six rootstocks. *J. Amer. Soc. Hort. Sci. 117 (1): 28-31.*
10. Filho, F. A. A. M., E. Espinoza-Núñez, E. S. Stuchi and E. M. M. Ortega. 2007. Plant growth, yield, and fruit quality of 'Fallglo' and 'Sunburst' mandarins on four rootstocks. *Scientia Horticulturae 114: 45–49.*
11. Goncalves, A. S. 1998. Caracteristicas y desarrollo de las principales variedades de citrícos producidas y comercializadas en España - 1ª parte. Variedades de Mandarino: Satsumas, Clementinas e Híbridos. *Levante Agricola, 342: 4-20.*
12. D'Hallewin, D. G., D. Mura, A. Piga, M. Pala, G. Lovicu and P. Sass. 1994. Rootstock effects on postharvest physiological and pathological behavior of Avana

mandarin. *Int. symposium on postharvest treatment of hor. crops, Kecskemet, Hungry, 30 Aug-3 Sep. 1993. Acta Hort., 368: 395-402.*

13. Jacquemond, C., S. D. Rocca and S.D. Rocca. 1994. Citrus rootstocks selection in Corsica for 25 years. *Proc. Int Soc. Citr. 7th Int. Citrus Congress, Acireale, Italy, 8-13 March, 1992. (1):246-251.*

14. Jiang, J. H. and J. H. Jiang. 1996. Xiecheng, a promising rootstock for extra early mandarin cultivar. *South China Fruits, 25: 4, 20*

15. McGuire, R.G. 1992. Reporting of objective colour measurements. *HortScience, 27(12): 1254-1255.*

16. Pons. J., M. Agusti y V. Almela. 1989. Caracteristicas del desarrollo y la maduracion del fruto de la mandarina Marisol (*Citrus reticulate* Blanco.) *Fruits, 44: 73- 79.*

17. Snedecor, G.W. and W.G. Cochran. 1980. Statistical methods. Oxford and J.B.H. Publishing Com. 7th Edition.

18. Zaragoza, S. 1993. Basado y presente de la citricultura Espanola. *82 p. Generalitat Valenciana conselleria d, Agricultura y pesca . Valencia.*

دراســـات فسيـــولوجيـــة على ثمـــار الكليمنتين صـــنـــف "ما رى سول"

١- تأثير نوع الأصل على تطور الثمار ووصولها إلى اكتمال النمو

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تعتبر الموالح من المحاصيل التصديرية الهامة بالنسبة للدخل القومي المصري و يزرع فـــى مصر حوالي ٣٨٢٠٢٧ فدان من الموالح (إحصاء ٢٠٠٦) بينما تصل المساحة المثمرة منهـــا إلـــى ٣٤١٧١٨ تنتج حوالي ٣٢١١٧٠٩ طن وهناك فرصة كبيرة لزيادة المصدر مـــن المـــوالح غيـــر التقليدية إلى السوق الأوروبية.

أجريت هذه الدراسة بمعهد بحوث البساتين – قسم معاملات ما بعد الحصاد- القاهرة بالتعاون مع قسم البساتين بكلية الزراعة- جامعة قناة السويس بالاسماعيلية عامى ٢٠٠٥ و ٢٠٠٦ وتهدف هذه الدراسة إلى تحديد تأثير نوع الأصل على تطور ثمار الكليمنتين صنف "مـــارى ســـــــول" ووصولها إلى اكتمال النمو تحت الظروف المصرية.

جمعت الثمار دوريا كل أسبوع من أشجار عمر ٧ سنوات منزرعة بمنطقة وادي المـــلاك بحافظة الإسماعيلية و مطعومة على أصول كل من النارنج – اليوسفي كليوباترا – الكاريزو سترانج – سوينجل سترومیلو ابتداء من شهر أكتوبر ولمدة ســـبـــعة أسابيع فى الموســـم الأول وســـتـــــة أسابيع فقط فى الموسم الثاني. تم فحص الثمار لدراسة التغيرات فى الخواص الطبيعية والكيميائيـــة للثمار.

وقد تبين من الدراسة ما يلي:-

زاد وزن وحجم الثمار تدريجيا بتقدم الثمار فى العمر وكذلك نسبة المواد الصلبة الذائبة ونسبة المواد الصلبة الذائبة إلى نسبة الحموضة ومحتوى الثمار من العصير ومن فيتامين ج وعلى العكس من ذلك نقصت الكثافة النوعية للثمار وكذلك صلابة الثمار ومحتوى الثمار من الأحماض الكلية.

ظهر أيضا من الدراسة تغير لون الثمار من الأخضر الداكن إلى الأخضر الفاتح ثم الأصـــفر المخضر إلى الأصفر مع زيادة عمر الثمار ومع هذا لم يكن تلون الثمار جيدا في المراحل المتقدمـــة من اكتمال النمو و إنما كانت بحاجة إلى إجراء عملية تحســـين التلوين لنجاح العملية التسويقية .

كذلك لوحظ انخفاض وزن الثمار والانخفاض الشديد فى كثافة الثمار مع تأخر جمع الثمار بعد الوصول إلى مرحلة اكتمال النمو. كذلك تبين أيضا ان ثمار الكليمنتين صنف مارى سول المطعومة على اصل الكاريزو أو السترومیلو متبوعة بتلك المطعومة على اصل اليوسفي كليوباترا تصل مبكرا إلى النضج مقارنة بالمطعومة على اصل نارنج بفترة قد تصل إلى أسبوع.

يمكن اعتبار ثمار اليوسفي مارى سول مكتملة النمو خلال الأسبوع الأخير من شهر أكتوبر أو الأسبوع الأول من شهر نوفمبر عندما تتجاوز نسبة المواد الصلبه الذائبه الى الحموضه الى اكبر من ٩ الى ١ وذلك بعد حوالي ١٦٨ - ١٧٥ يوما من التزهير الكامل وذلك بالنسبة لثمار الأشجار المطعومة على أصل الكاريزو و السترومیلو واليوسفي كليوباترا بينما تصل ثمار الأشجار المطعومة على أصل النارنج إلى اكتمال النمو خلال الأسبوع الثاني من شهر نوفمبر وذلك بعد ١٧٥: ١٨٢ يوما من التزهير الكامل.

خلصت الدراسة إلى أهمية الإسراع من حصاد ثمار اليوسفي كليمنتين صنف مارى سول بعد وصولها إلى اكتمال النمو حتى لا تتعرض خصائص الجودة للتدهور نتيجة نقص المحتوى من العصير وكذلك فيتامين ج وكذلك لب الثمار (اللحم) وانفصال القشرة عن اللحم وانتفاخ الثمار (نقص الكثافة النوعية).