

EFFECT OF HAND THINNING ON YIELD AND FRUIT QUALITY OF "MURCOTT " TANGOR

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ABSTRACT

This study was carried out during the seasons of 2011- 2012 and 2012 - 2013 to evaluate the effect of hand thinning on yield and fruit quality of 'Murcott' tangor. In this respect, hand thinning was carried out three times, at the last week of July (after fruit drop), and the other two dates at one month intervals (August and September). The treatments included trees thinned once, twice, thrice and un-thinned trees as a control. All hand thinning treatments materially reduced both average number of fruits and yield per tree than the control. Also, these treatments increased both average fruit weight and size than the control. Carrying out hand thinning twice or three times reduced average number of fruits and yield/tree considerably than thinning once or left without hand thinning. All thinning treatments improved fruit quality in terms of increasing fruit weight and size, carotene content in peel and SSC/acid ratio in fruit juice but decreasing total acidity.

Keywords: Hand thinning – Murcott Tangor – Total carotenoids – fruit quality

INTRODUCTION

Murcott is most likely a tangor which is a cross between tangerine and sweet orange. At the present time, it is the most widely grown in Florida. The fruit is marketed under the name honey tangerine; however, its official variety name is Murcott (Figueiredo, 1991).

The Murcott trees are moderately vigorous and the fruits have medium size, averaging from 2.5-3 inches in diameter and have a shape typical of may be yellow orange in warmer winter. The skin is smooth and can be peeled by hand but somewhat more difficult to peel than a tangerine. The flesh is rich with orange color. The fruit matures during January to March which makes it the latest maturing tangor type fruit and it has excellent qualities for the fresh fruit market.

The fruits are produced on the end of the branches with the blossom end directed upward and this may result in sunburn of the exposed portions of the fruit (Stephen & Jackson, 2003). The importance of fruit size as a parameter of quality of citrus fruits has increased markedly in recent times. The consumers marked preference for large fruit cause huge differences in price between large and small fruit to the point that the income from the smaller fruit is often less than picking and hauling costs (Guardiola & Garcia-Luis, 2000).

To increase fruit size beyond the limits, this may be obtained through the optimization of standard cultural practices (fertilization, irrigation, pruning) (Zaragoza *et al.*, 1992 and Morales & Davies, 2000). Fruit thinning is defined as the removal of certain flowers or clusters of flowers or individual fruitlets after fruit set and natural dropping have occurred. It improves fruit yield, quality and return bloom for the flowering year. There are three types of thinning namely, chemical, mechanical and hand thinning (Ouma, 2012).

Chemical thinning compounds can be used in citrus to reduce heavy crop loads by reducing the number of fruitlets on a tree; hence, chemical thinning normally reduced crop loads by 20-30 % and should only be considered for trees bearing a heavy crop load (Gallasch, 1988 and Sandra & Steven, 2008).

Hand thinning is the manual removal of fruit and is one management tool to reduce crop load to increase fruit size before harvest. Higher value varieties, such as mandarins are often able to achieve economic gain from hand thinning.

Murcott trees bear very large crops and the growers should be aware to thin the fruits by pruning to reduce crop load to an acceptable level to prevent breaking of branches and damage of trees. This pruning might require several light mechanical cuts or heavy mechanical cut (Jackson & Frederich, 1999). Hand thinning is normally undertaken after natural fruit drop has finished at the beginning of the stage fruit growth period (cell expansion). Thinning as early as possible will have the best effect on fruit size, but later thinning slightly will allow small and scarred fruits to be more easily identified and subsequently removed (Bevington & Khurshid, 2002 and Falivene & Itardy, 2008).

The present investigation was undertaken to study the effect of hand thinning at different times and load on yield and fruit quality of 'Murcott' tangor grown under Egyptian conditions.

MATERIALS AND METHODS

This study was undertaken in a private orchard at El-Khatatba, Monifia Governorate, Egypt during two successive seasons 2011-2012 and 2012-2013 on four years old 'Murcott' tangor grown in sandy soil at 3x4m apart under drip irrigation system. Thirty six trees nearly uniform in size and vigor were chosen for this study which received the same horticultural management in the orchard.

The experiment was designed as a randomized complete block design with three replicates; each replicate was represented by three trees to receive one of the following treatments:

T1: Un-thinned trees (Control).

T2: Trees thinned once (after natural fruit drop at the last week of July).

T3: Trees thinned twice (after natural fruit drop and 4 weeks later).

T4: Trees thinned three times (after natural fruit drop and at 4 week intervals).

The first time of thinning was carried out at the last week of July after fruit drop when fruits reached about 2.5-3.5 cm in diameter by removing small fruits which was about 40% of total fruit. Yet, the second thinning was carried out 4 weeks later at the last week of August by removing sunburned fruits. The third thinning was undertaken 4 weeks later at the last week of September to remove sunburned fruits.

Number of fruits on each tree were counted and multiplied by average weight of fruit to determine the average yield per tree. Samples of ten fruits from each replicate were harvested when soluble solids/acid ratio was around 12-15 (Pinheiro *et al.*, 2011) at 16 and 20 February during the first

and second seasons, respectively and then transported to the laboratory of Pomology Department, Mansoura university to determine the following characteristics:

- 1- Average fruit weight (g).
- 2- Average fruit size (cm³).
- 3- Average fruit height and diameter (cm).
- 4- Average peel weight (g) and thickness (mm).
- 5- Percentage of juice (AOAC, 1994).
- 6- Total carotenoids (mg/100gm F.W) in fruit peel were determined according to the methods of Mackinny (1941).
- 7- Soluble solids content (SSC) percentage in fruit juice was measured by using a hand refractometer.
- 8- Total acidity in the fruit juice expressed as (g citric acid/100 ml juice) according to AOAC (1994).
- 9- SSC/acid ratio in the fruit juice.

The obtained data were statistically analyzed according to the procedure outlined by Snedecor & Cochran (1982), using the statistical package software SAS (SAS Institute Inc. Cary, NC, USA). Comparisons between treatment means were made by using the least significant differences test (LSD) at 5% level of probability as mentioned by Waller & Duncan (1969).

RESULTS AND DISCUSSION

Effect of hand thinning on fruit number and yield per tree of 'Murcott' tangor:

Data in Table 1 clearly show that hand thinning application significantly reduced the number of fruits per tree. Hence, the reduction in number of fruits ranged from 40.77 to 61.06% than the control which left without hand thinning. Moreover, trees thinned once time gave a higher significant number of fruits than those thinned twice or three times. In this respect, trees which thinned three times gave the lowest number of fruits per tree than those thinned once or twice. The reduction in fruit number per tree due to this treatment reached 61.04% than the control as mean of the two seasons.

Table (1): Effect of hand thinning on fruit number and yield per tree (kg) of 'Murcott' tangor during 2012 and 2013 seasons.

Treatment	Average fruit number/tree				Average Yield / tree (kg)			
	2012	2013	Mean of both seasons	Reduction % over control	2012	2013	Mean of both seasons	Reduction % over control
Un-thinned (control)	154.6	205	179.8	-----	17.53	22.65	20.09	-----
Thinned once	87.0	126	106.5	40.77	13.18	19.02	16.10	19.86
Thinned twice	71.0	103	87.0	51.61	12.90	18.07	15.49	22.90
Thinned three times	57.0	84	70.05	61.04	13.28	20.16	16.72	16.77
LSD at 5%	7.89	9.38	-----	-----	1.26	1.98	-----	-----

Concerning to the effect of hand thinning on yield/tree, the data in the same table show that all hand thinning treatments significantly reduced

average yield/tree (kg) than the control. Hence, the reduction in yield ranged from 19.86 to 22.9 % than the control. The data also reveal that the reduction in yield/tree was almost lower than the reduction in fruit number per tree. That is may be due to that hand thinning produced a higher size than those left without hand thinning. Our data go in the same line with those reported by Sandra & Steven (2008) who found that chemical thinning compounds can be used in citrus to reduce heavy crop by reducing the number of fruit tree.

Effect of hand thinning on fruit weight and size of ‘Murcott’ tangor:

Data in Table 2 clearly show that all hand thinning treatments produced a higher and larger fruits than the control. The data also showed that trees which thinned three times gave the highest fruit weight and the largest size compared to the other treatments during both seasons. In this respect, the larger Murcott fruits produced a higher income than the lower one.

In this respect, hand thinning is one of management tool to reduce crop load to increase fruit size. Murcott trees bear very large crop, so the grower should be aware to thin the fruits to reduce crop load to prevent breaking of branches damage (Jackson & Frederich, 1999). Also, Bevington *et al.* (2003) presented that, hand thinning after natural fruit drop has finished gave the best effect of fruit size, but slightly later produced small fruit than those carried out early.

Table (2): Effect of hand thinning on fruit weight(g) and size(cm³) of ‘Murcott’ tangor during 2012 and 2013 seasons.

Treatment	Fruit weight (g)				Fruit size (cm ³)			
	2012	2013	Mean of both seasons	Increase % over control	2012	2013	Mean of both seasons	Increase % over control
Un-thinned (control)	113.33	110.53	111.93	-----	101.50	104.70	103.10	-----
Thinned once	151.66	151.10	151.38	35.25	143.40	151.53	147.47	43.04
Thinned twice	181.66	175.56	178.61	59.57	192.76	184.96	188.86	83.18
Thinned three times	233.33	239.96	236.65	111.43	248.30	237.53	242.92	135.62
LSD at 5%	11.33	7.84	-----	-----	19.76	17.61	-----	-----

Effect of hand thinning on fruit height and diameter of ‘Murcott’ tangor:

It clear from the data in Table 3 that the effect of hand thinning on both fruit height and diameter was almost similar to those obtained on fruit weight and size. Hence, all hand thinning treatments produced fruit with higher height and diameter than the control. That is not astonishing; hence, the increment in average fruit weight and size may be due to the increment in both fruit height and diameter. Likewise, Ouma (2010) reported that fruits from light cropping trees in all cases have larger cells than small ones from heavy cropping trees and time of thinning also affects the number of cells ; hence, the early hand thinning after full bloom had slightly more larger cells than did later.

Table (3): Effect of hand thinning on fruit height (cm) and diameter (cm) of 'Murcott' tanger during 2012 and 2013 seasons.

Treatment	Fruit height (cm)				Fruit diameter(cm)			
	2012	2013	Mean of both seasons	Increase % over control	2012	2013	Mean of both seasons	Increase % over control
Un-thinned (control)	4.61	4.65	4.63	-----	6.18	6.15	6.16	-----
Thinned once	5.06	5.31	5.19	12.09	6.98	6.63	6.81	10.55
Thinned twice	5.65	5.76	5.71	23.33	7.18	7.06	7.12	15.58
Thinned three times	6.60	6.16	6.38	37.79	8.36	8.25	8.31	34.90
LSD at 5%	0.89	0.39	-----	-----	0.61	0.54	-----	-----

Effect of hand thinning on peel weight and thickness of 'Murcott' tanger:

Data in Table 4 clearly show that hand thinning increased both peel weight and thickness than those left without hand thinning.

Table (4): Effect of hand thinning on peel weight (g) and thickness (mm) of 'Murcott' tanger during 2012 and 2013 seasons.

Treatment	Peel weight (g)				Peel thickness (mm)			
	2012	2013	Mean of both seasons	Increase% over control	2012	2013	Mean of both seasons	Increase% over control
Un-thinned (control)	32.36	31.60	31.98	-----	10.00	10.50	10.25	-----
Thinned once	42.00	40.76	41.38	29.39	11.26	11.41	11.34	10.63
Thinned twice	45.93	42.20	44.07	37.80	13.33	13.59	13.46	31.31
Thinned Three times	54.53	60.76	57.65	80.27	15.33	15.34	15.34	49.66
LSD at 5%	3.09	2.48	-----	-----	1.75	1.82	-----	-----

Trees which thinned twice or three times produced fruit with larger weight and thickness of peel than those trees which thinned once time or those left without hand thinning. From these data it clear that fruit which has higher peel thickness are more marketing value and can be stored for a longer time.

Effect of hand thinning on fruit juice % and total carotenoids of 'Murcott' tanger:

Data in Table 5 obviously revel that all hand thinning treatments increased juice % than the control. Hence, trees which thinned three times produced the highest juice percentage than the other two thinning treatments and the control. Carrying out thinning thrice recorded 49.02% compared to 36.55% for the control as a mean of both seasons under this study.

Furthermore, the same table indicate that all hand thinning treatments produced fruits with high carotene content than the control. The obtained data also presented that trees which thinned three times produced fruits with higher carotene content than those thinned once or twice. In this respect, Westwood (1993) mentioned that fruit thinning is carried out to

increase fruit size, improve color and quality and stimulate floral initiation for next year's crop.

Table (5): Effect of hand thinning on fruit juice (%) and total Carotenoids (mg/100 gm F.W) of 'Murcott' tangor during 2012 and 2013 seasons.

Treatment	Fruit juice (%)				Total carotenoids (mg/100 gm F.W)			
	2012	2013	Mean of both seasons	Increase% over control	2012	2013	Mean of both seasons	Increase% over control
Un-thinned (control)	35.16	37.94	36.55	-----	2.52	2.72	2.62	----
Thinned once	40.70	40.71	40.71	11.38	3.34	3.29	3.32	26.72
Thinned twice	42.40	43.73	43.07	17.84	3.18	3.67	3.43	30.92
Thinned Three times	49.30	48.73	49.02	34.12	3.8	3.77	3.79	44.66
LSD at 5%	5.85	3.87	-----		0.87	0.79	----	-----

Effect of hand thinning on SSC, Acidity and SSC/acid of 'Murcott' tangor:

It is evident from the obtained data in Table 6 that all thinning treatments significantly improved quality in terms of increasing SSC and SSC/acid and reducing total acidity comparing to the control treatment. The promotion was significantly associated with increasing intensity of thinning from one to three times. The best results with regard to quality of the fruits were obtained with carrying out hand thinning three times. Under such promised treatment SSC, total acidity and SSC/acid reached 12.2, 0.78 and 15.64 as a mean of two seasons, respectively but unfavorable effects on fruit quality recorded in control.

Table (6): Effect of hand thinning on SSC, Acidity and SSC/acid ratio of 'Murcott' tangor during 2012 and 2013 seasons.

Treatment	SSC (%)			Acidity (%)			SSC/acid ratio		
	2012	2013	Mean of both seasons	2012	2013	Mean of both seasons	2012	2013	Mean of both seasons
Un-thinned (control)	11.90	11.60	11.75	1.02	0.97	0.99	11.66	11.72	11.69
Thinned once	12.00	11.93	11.97	0.96	0.91	0.93	12.5	13.11	12.81
Thinned twice	12.13	12.10	12.12	0.78	0.80	0.79	15.55	15.13	15.34
Thinned three times	12.20	12.20	12.20	0.78	0.78	0.78	15.64	15.64	15.64
LSD at 5%	0.29	0.27	-----	0.06	0.04	-----	0.73	1.34	-----

From this data, it is clear that carrying out thinning two or three times produced less number of fruits and lower yield/tree but enhanced different fruits characteristics of 'Murcott' tangor which was preferable for consumers and marketing with high prices than un-thinning.

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تأثير الخف اليدوى على المحصول وجودة ثمار الماركوت تانجور

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أجريت هذه الدراسة خلال موسمی ٢٠١١-٢٠١٢ و ٢٠١٢-٢٠١٣ لتقييم تأثير الخف اليدوى على المحصول وصفات الجودة لثمار الموركيت تانجور. و فى هذا المجال أجرى الخف اليدوى خلال ثلاث مواعيد، الأول فى الاسبوع الأخير من شهر يوليو بعد التساقط الطبىعى للثمار والثانى بعد شهر من الأول (أغسطس) والثالث بعد شهر من الثانى (سبتمبر). و قد تضمنت المعاملات أشجار تم خفها فى الموعد الأول ، أشجار تم خفها فى الموعدین الأول و الثانى، أشجار تم خفها خلال الثلاثة مواعيد و أشجار لم يتم خفها ممثلة للكنترول. ولقد أوضحت النتائج أن جميع معاملات الخف اليدوى أدت إلى خفض متوسط عدد الثمار على الشجرة و كذلك محصول الأشجار مقارنة بالكنترول، و لكن أدت هذه المعاملات إلى زيادة متوسط وزن وحجم الثمار عن الكنترول. كما أوضحت النتائج أيضاً أن الأشجار التى أجرى لها الخف فى موعدین أو ثلاثة مواعيد أدت إلى نقص عدد الثمار والمحصول للأشجار مقارنة بتلك التى أجرى لها الخف مرة واحدة فقط وكذا تلك التى لم يجرى لها خف يدوى. وعلى كل حال فإن تلك المعاملات أدت لزيادة وزن وحجم الثمار وكذا زيادة محتوى قشرة الثمار من الكاروتين وكذا نسبة المواد الصلبة الذائبة للحموضة فى عصير الثمار.