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EFFECT OF HAND THINNING AND GIRDLING ON YIELD AND FRUIT CHARACTERISTICS OF DORSETT GOLDEN APPLES.

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ABSTRACT

The present research worked on hand thinning and girdling processes to indicate their effects on yield and fruit quality of Dorsett golden apples var. (*Malus domestica*, Beck.). Results of two successive seasons 1999 and 2000 revealed that hand thinning of fruitlets and girdling of trees three weeks after fruit set significantly increased fruit yield per tree. The yielded fruits from the treated trees comparing with the control ones were higher in weight, dimensions (diameter and length), TSS %, TSS/acid ratio and carotene pigments in fruit skin in both seasons of study. On the other hand, such fruits were recorded lower values for firmness, acidity % in fruit juice and total chlorophylls in fruit skin.

INTRODUCTION

Dorsett golden apple cv. is one of the considerable pollinators for Anna apple trees in Egypt. Its trees are widely cultivated in most Anna apple orchards and they occupy a part of each orchard. Consequently, it must taken an attention from pomologists to study the factors, which can be applied to increased quantitatively and qualitatively of fruit production per tree. This aims to produce fruit accepted by the consumers and marketable so that they can realize a considerable income to the growers.

Dorsett golden apple trees carry higher number of fruits per cluster (about 7-8 fruits/cluster) and they remain to harvest time. These fruits are characterized by small size and bad qualities specially skin colour along with late maturity.

Therefore, the need to improve its yield and fruit quality as well as getting fruit early is required for successful marketing and obtaining a considerable income for the producers.

Hand thinning and girdling are among the most common agricultural practices which effectively used in this respect (Peng and Rabe, 1996; Mostafa, 2000 and El-Beacy, 2001). So, this investigation was carried out to study the effect of hand thinning and girdling either solely or in combination on Dorsett golden trees yield and certain physical and chemical fruit characteristics of great importance for successful marketing.

MATERIALS AND METHODS

Tree material:

Dorsett golden apple trees, healthy apparently, almost uniform canopy size and 8-year-old on M.M. 106 rootstock were used in 1999 and 2000 seasons for the present investigation. Trees were grown in clay soil of a private orchard at Abo-Arsaa Village, near El-Mansoura city, Dakahlia Governorate, Egypt. Tree spacing was 4-5 m between-rows and 3-5 m in-row. All trees were received the normal orchard management usually practiced in the commercial apple orchards in this district.

Girdling procedures:

Girdling process was carried out using a Stanly Carpet knife to make double cut through the bark of 4 mm effective width around the main trunk at 30 cm above the bud-union. This process was carried out 3 weeks after fruit set.

Hand thinning:

Hand thinning was carried out at the same time of girdling. 4-5 fruitlets in each florescence were hand thinned to leave only 3 fruitlets.

Treatments in details were as follows:

T1- Control: untreated

T2- Hand thinning: to leave 3 fruitlets / florescence

T3- Girdling: complete girdling at 30 cm above bud union 3 weeks after fruit set.

T4- Hand thinning + girdling (T2 + T3)

Experimental design:

The treatments were arranged at a randomized complete block design, four treatments, 3 replicates, each two tree were used for each replicate. The method outlined as described by Gomez and Gomez (1984).

Fruit yield determination:

At harvest time in 1999 and 2000 seasons on 10 and 12 June, respectively. The total number of fruits per tree in each treatment were count, then ten fruits from each treated trees were picked from the different sides of tree and weighted. The results were expressed as average fruit weight / trees for each treatments under study.

Fruit physical and chemical properties:

At harvest time, 10 fruits per treated tree were taken for physical and chemical characteristics measurements as follow:

1- Weight of 10 fruit in g.

2- Fruit diameter in cm.

3- Fruit length in cm.

4- Fruit firmness by using Effegi penetrometer according to Harker *et al.* (1996). The results were expressed as Lb/In^2.

5- Total titratable acidity in fruit juice.
6- Total soluble solids percentage in fruit juice.
7- TSS/acid ratio.
8- Total chlorophyll and carotene pigments in fruit skin, they were determined using the method described by Machinny (1941). Pigments extracted using Methanolic HCl and the results were read by the use of spectrophotometer at 650, 665 nm for chlorophyll a and b, respectively and 452.5 nm for carotene pigments. The results were tabulated as the total chlorophyll and carotene in mg/g fresh weight of fruit skin.

RESULTS AND DISCUSSIONS

I. Effect of hand thinning and girdling treatments of fruits yield per tree.

The concerned results are presented in Table (1). From these results, it was cleared that, among the tested treatments, hand thinning plus girdling treatment was the most effective one in increase yield per tree followed by hand thinning treatment in both seasons of study. The yield per tree in the former treatment was 29.00 and 29.30 kg while in the latter one was 24.77 and 24.60 in 1999 and 2000, respectively. On the other hand, the untreated trees (control) gave the lowest yield pet tree (21.53 and 17.50 kg in 1999 and 2000, respectively) while girdling treatment was in between these two extremes 22.47 and 20.33 kg/tree in 1999 and 2000, respectively. These two treatments tabulated the values, 29.00 and 29.30 kg for the former treatment along with 24.27 and 24.60 kg for the latter one in 1999 and 2000 seasons, respectively. On the contrary, the untreated trees (control) were the least in this respect with the values of 21.53 and 17.50 kg. Girdling treatment was between these two extremes with the values of 22.47 and 20.33 kg.

Hand thinning and girdling processes which were super treatment in this research were the subjects of several previous studies and the obtained results analogical to our results herein (Bootsma, 1995; Osterreicher and Knol, 1998 and Abdel-Hamid, 1998). They all worked on apple trees of different cultivars and proved that fruits hand thinning had a significant effect in increasing fruits weight and fruit yield of the treated trees.

Concerning the effect of girdling effect, Hoying (1993) working on Mc Intosch and Mutsu apple trees as well as El-Beacy. (2001) with Floridaprince peach trees obtained results very similar to these presented in Table (1). They confirmed the effective role of girdling technique in producing high yield. In the same line Mostafa (2000) with Anna apple trees along with Glenn (2000) with Fairchild mandarines, throw further light on the time of girdling as an important factor in this respect. The latter investigators found that girdling in May improved yield by 49 %. Whereas, the corresponding increasing percentages of trees girdled in November was 141 % and in March was 217%.

II. Effect of hand thinning and girdling treatments on fruit characteristics

II.a- Physical characteristics

1- Fruit weight, length and diameter

Data in Tables (1 and 2) revealed that in both seasons, apple trees treated with hand thinning, girdling and hand thinning + girdling gave similar results as in the yield results for weight, length and diameter of fruit in comparison with control. Hand thinning + girdling treatment relatively was the best one to increase such characteristics comparing with hand thinning or girdling alone in both seasons study. These findings were in accordance with these obtained by Devilliers *et al.* (1990) on Culemborg peach trees, Mostafa (2000) on Anna apple trees and El-Beacy (2001) on Flordaprince peach trees.

Table (1): Effect of hand thinning and girdling alone or in combination on yield and fruit weight of Dorsett golden apple in 1999 and 2000 seasons.

Characteristics / Treatments	Yield/tree (kg)		10 Fruits weight (g)	
	1999	2000	1999	2000
Control (untreated)	21.53	17.50	595.7	556.0
Hand thinning	24.27	24.60	1015.8	1094.9
Girdling	22.47	20.33	944.4	834.4
Hand thinning + girdling	29.00	29.30	1186.1	1181.2
L.S.D. at 5%	2.54	1.23	109.7	152.1
L.S.D. at 1%	3.86	1.87	166.5	230.8

Table (2): Effect of hand thinning and girdling solely or in combination on fruit physical characteristics of Dorsett golden apple in 1999 and 2000 seasons.

Characteristics / Treatments	Fruit diameter (cm)		Fruit length (cm)		Fruit firmness (Lb/in^2)	
	1999	2000	1999	2000	1999	2000
Control (untreated)	4.31	4.41	3.30	3.82	17.3	15.6
Hand thinning	5.46	5.90	5.09	5.33	14.9	14.1
Girdling	5.45	5.13	4.84	4.75	14.0	14.7
Hand thinning + girdling	5.80	5.76	5.44	5.73	11.3	11.7
L.S.D. at 5%	0.69	0.63	0.56	1.22	1.1	1.2
L.S.D. at 1%	1.05	0.95	0.86	---	1.7	1.9

The increasing effect of thinning or/and girdling processes on fruits yield and physical characteristics tested was greatly strengthened by the explanations of Sharples (1968) who reported that thinning of apple flower or fruit clusters stimulates cell division and cell expansion of the fruits that remain on the tree and consequently increase their size at harvest time, which enhances their commercial value. Palmer *et al.* (1991) with Cox's Orange Pippin apple trees found also at harvest time a linear relationship between fruits weight per tree and leaf area per fruit. In other words, reducing the number of fruits per tree by thinning increased the leaf area per fruit which, in turn, increased fruit weight. Recently Glenn (2000) stated that flower and fruit

thinning in deciduous fruit trees protect the remained fruits from competitive sinks on the available nutrients and such eliminate of competition is one of the primary methods for improving fruit size.

2- Fruit firmness.

Data presented in Table (2) revealed that firmness fruit at harvest time was declined by hand thinning or/and girdling. This finding was in agreement with those obtained by Mostafa (2000) with Anna apple trees, who found that girdling process was declined fruit firmness. In the same line, Sharples (1968) and Johnson (1992 and 1994) with Cox's Orange Pippin apple trees, who attributed this declination of fruit firmness to that the larger fruits which produced by thinning trees are more susceptible to various physiological disorders such as bitter pit, senescent breakdown and core flush. Moreover, they related some of these adverse effect of thinning to unbalanced state in minerals nutrition of the resulted fruits, in particular, a higher K and lower Ca status. In other point of view Bartley and Knee (1982) related the enhanced rate of softing in fruits from the thinned trees to an advanced states of fruit maturity at harvest time.

II. Chemical characteristics

1- Fruit juice acidity %, TSS %, and TSS/acid ratio

The concerned results presented in Table (3) tabulated data for acidity % was indicated a significant decrease in fruit juice of hand thinning or/and girdling trees if compared with these of the untreated control in both seasons under study. On the contrary, TSS % was significantly increased. Tabulated values for TSS/acid ratio indicated a similar trend with hand thinning and hand + girdling treatments only. The best treatment, in this respect was hand thinning + girdling. It maximized TSS/acid ratio in fruit juice over the other treatments tested in both seasons of study. The obvious effect of hand thinning in the present study is in harmony with the findings of Jhonson (1995) who mentioned that hand thinning process increased the total soluble solids content. El-Beacy (2001) on Flordaprince peach trees also found that hand thinning of fruits greatly reduced total acidity percentage in fruit juice, whereas total soluble solids in the same fruit juice are increased compared with fruit juice from fruit of untreated control trees.

As for TSS/acid ratio data, similar results were obtained by Mostafa (2000), who worked on Anna apple trees and El-Beacy (2001) on Floridaprince peach trees. Moreover, Johnson (1994) reported that the increasing effect of thinning in this respect due to that this process partially increased the amount of dry matter in the developed fruits. The same investigator (1992, 1995) indicated that higher soluble solids content in fruits of the thinned trees mean that higher photosynthates were accumulated in them. This reflects an advanced state of maturity. In other words, the increasing effect of thinning process on soluble solids content in fruits in indicated an enhancement maturity of fruits.

Table (3): Effect of hand thinning and girdling alone or in combination on chemical characteristics of Dorsett golden apple fruits in 1999 and 2000 seasons.

Characteristics	TSS%		Acidity %		TSS/acid ratio	
Treatments	1999	2000	1999	2000	1999	2000
Control (untreated)	11.7	11.2	0.95	1.00	12.3	11.2
Hand thinning	14.0	14.7	0.70	0.63	20.0	23.3
Girdling	12.7	12.3	0.70	0.65	18.1	18.9
Hand thinning + girdling	15.5	15.2	0.55	0.50	28.7	31.6
L.S.D. at 5%	0.77	0.85	0.17	0.19	6.98	7.00
L.S.D. at 1%	1.16	1.30	0.26	0.29	10.59	10.63

The attempts to explain the functioning and mechanism of girdling were indicated in different researches based on changes in translocation and accumulation of carbohydrates (Fisher *et al.*, 1983; Wallerstein *et al.*, 1978 and changes in hormones concentration such as gibberllins (Wallerstein *et al.* (1973), IAA (Dann *et al.*, 1985) and Cytokinins (Cutting and Lyne, 1993). Augsti *et al.* (1998) also indicated that fruits from ringed branches trees initiated ethylene before untreated ones. In same line, Autio and Greene (1994) reported that girdling may be enhanced ethylene production in apple fruit.

2- Total chlorophyll in fruit skin.

Effect of the tested treatments on total chlorophyll pigment in fruit skin was cleared from the data in Table (4). A significant response to all treatments on chlorophyll skin level comparing with fruit skin from untreated control trees was detected. The tested treatments tabulated significantly lower content of total chlorophyll in fruit skin. The most decreasing effect was resulted in skin of fruits from trees under hand thinning + girdling treatment in both seasons of study. It respectively recorded the values of 0.123 and 0.124 mg/g fresh weight.

3- Carotene in fruit skin.

Data in Table (4) cleared that skin carotene pigments were significantly increased by all treatments studied in comparison with untreated control. Hand thinning + girdling treatment had much better than either hand thinning or girdling alone, as well as untreated control in both seasons. It recorded highest values of carotene pigments content in fruit skin (0.695 and 0.752 mg/g fresh weight). These findings were in accordance with those obtained by Johnson (1995) with apple trees, who found that fruit skin from thinned trees increased yellowesh and reduced greenesh. This is evidence to a higher rate of maturation and ripening. Moreover, Peng and Rabe (1996) reported that girdling was significantly decreased leaf chlorophyll content in Mihowase satsumas. Also, Mostafa (2000) found that girdling of Anna apple trees resulted in a significant increase in anthocyanine pigment in fruits skin. Furthermore, El-Beacy. (2001) mentioned that hand thinning and/or girdling gave significantly increase in anthocyanine pigments of Flordaprince peach than untreated control.

Table (4): Effect of hand thinning and girdling alone or in combination on pigments content of Dorsett golden apple fruits in 1999 and 2000 seasons.

Characteristics / Treatments	Total chlorophyll (mg/g F.W.)		Total carotene (mg/g F.W.)	
	1999	2000	1999	2000
Control (untreated)	0.261	0.258	0.140	0.155
Hand thinning	0.176	0.171	0.457	0.561
Girdling	0.101	0.158	0.397	0.366
Hand thinning + girdling	0.123	0.124	0.695	0.752
L.S.D. at 5%	0.067	0.025	0.197	0.114
L.S.D. at 1%	0.102	0.038	0.299	0.173

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تأثير الخف اليدوى والتحليق على محصول وصفات الثمار علـــى أشـــجار التفـــاح صنف دورست جولدن.

محسن فهمى محمد مصطفى

قسم الفاكهة ــ كلية الزراعة ــ جامعة المنصورة

أقيمت تجربة لدراسة تأثير الخف اليدوى والتحليق على محصول وصفات الثمار علـــى أشـــجار التفاح صنف الدورست جولدن المطعم على أصل مولينج ١٠٦.

ويمكن تلخيص النتائج كما يلى:

١ــ أظهر الخف اليدوى مع التحليق بعد ثلاث أسابيع من العقد أعلى زيادة معنوية فى المحصول للشجر عند الجمع بالمقارنة بباقى المعاملات الأخرى حيث أعطت ٢٩,٠٠ ، ٢٩,٣٠ كجم /للشـــجر خـــلال عـــامى الدراسة.

٢ــ إجراء الخف اليدوى أو التحليق أو الاثنان معا حقق زيادة واضحة ومعنوية فـــى وزن الثمـــار وطولـــها وعرضها عن الكنترول غير المعامل.

٣ــ وجد أن الخف اليدوى والتحليق أو الاثنان معا أدى إلى نقص الثمار خلال الموسمين.

٤ــ وجد أن معاملات الخف اليدوى أو التحليق أو الاثنان معا أعطى فروق معنوية فى المواد الصلبة الذائبـــة الكلية والحموضة فى عصير الثمار كذلك نسبة المواد الصلبة الذائبة الكلية إلى الحموضة فى كلا موسمى الدراسة.

٥ــ أدى الخف اليدوى والتحليق أو الاثنان معا أدى إلى نقص الكلوروفيل فى قشر الثمار بينما زادت صبغـــة الكاروتين بفروق معنوية خلال موسمى الدراسة.