

## **GIRDLING TYPES IN RELATION TO YIELD AND FRUIT QUALITY OF ANNA APPLE TREES**

**Mostafa, M.F.M.**

Pomology Dept., Fac. of Agric., Mansoura Univ.

### **ABSTRACT**

The present research was carried out during 1998 and 1999 seasons on 7-year-old trees of apples Anna cv. (*Malus domestica*, Bcek.) grown in a private orchard located near El-Mansoura City, Dakahlia Governorate, Egypt.

It was designed to study the effect of three girdling types made 4 weeks after fruit set on the trunk of the tested trees. The obtained results pointed to complete girdling type as the best one to increase yield and optimize certain physical and chemical characteristics of fruit quality.

### **INTRODUCTION**

Girdling process is of the most important horticultural practices that usually used to improve yield and fruit quality of most fruit trees. The main target for fruit producers now, is to get early maturity fruits with good quality accepted for exporting or even for the local marketing. Girdling is commonly used now for increasing fruit size and hastened fruit maturity. The mechanism through which girdling acts is not yet clearly understood changes in translocation and accumulation of carbohydrates but there also is evidence of changes in hormone contents in relation to girdling. Moreover, girdling as a form wounding may enhance ethylene production resulting in a promotion of ripening. These results are in conformance with those obtained by Dann *et al.* (1985), Hyodo (1991), Hoying (1993), Autio and Greene (1994), Bill Peacock (1996), Peng and Rabe (1996), Deng *et al.* (1997) and Carreno *et al.* (1998).

Therefore, the present investigation was carried out to try to improve the yield and fruit quality of Anna apple trees and also to compare three types of girdling.

### **MATERIALS AND METHODS**

The present experiment was carried out during 1998 and 1999 seasons on 7-year-old apple trees Anna cv. (*Malus domestica*, Bcek) budded onto M.M. 106 rootstock. Trees are grown in clay soil of a private orchard at Abo-Arsaa Village, near El-Mansoura City, Dakahlia Governorate, Egypt. The planting spaces were 4 m between rows and 3 m within them. All trees were received the normal orchard management usually practiced in the commercial orchards in this district.

The tested trees were 36, almost uniform in vigor and apparently diseases free. They divided into 4 equal groups and subjected to four treatments included three girdling types which carried out 4 weeks after fruit set. Such treatments were:

T<sub>1</sub> - Trees left without girdling to serve as control.

T<sub>2</sub> - Trees their trunks subjected to complete girdling at 30 cm above graft union.

T<sub>3</sub> - Trees their trunks subjected to half girdling at 30 cm above graft union.

T<sub>4</sub> - Trees their trunks subjected to scoring only at 30 cm above graft union.

#### **I- Effect of girdling types on yield**

At harvest time of 1998 and 1999 tested seasons (15 and 10 June, respectively) fruits of each of the treated trees along with the control ones were picked and weighed. The results were expressed as average fruit weight / trees in kg for each treatment under study according to Agenbag *et al.* (1992).

#### **II- Effect of girdling types on fruit quality (physical characteristics)**

This part of the study tested four physical characteristics measured on representative samples of fruits, 10 fruits each, at harvest time. Each treatment was represented by 3 samples (3 replications). These characteristics were:

1- Weight of 10 fruits in g.

2- Fruit diameter in cm.

3- Fruit length in cm.

4- Fruit firmness: It was measured in both red and green sides of fruit by the use of a hand Effgipenometer according to Harker *et al.* (1996). The results were expressed as Lb / In<sup>2</sup>.

#### **III- Effect of girdling types on fruit quality (chemical characteristics)**

It was concerned with four chemical characteristics determined on the same representative samples which used for physical ones. Such characteristics were:

1- Percentage of total soluble solids (TSS %): It was determined in fruit juice using a hand refractometer

2- Percentage of total titratable acidity: It was determined in fruit juice.

3- TSS / acid ratio: It was calculated from the results recorded for TSS % and acidity %.

4- Anthocyanin pigments were determined in fruit skin. The method described by Ranganna (1979) was adopted in this respect for pigments extraction (using ethanolic HCl) and reading the results (using spectrophotometer at 535 nm wave length).

The obtained results in this study were subjected to the statistical analysis of randomized complete blocks design according to the method outlined by Gomez and Gomez, (1984).

## **RESULTS AND DISCUSSION**

The present investigation was designed to test the effect of three modified girdling types on yield and fruit quality of apple trees Anna cv.. The obtained results can be presented as follows:

### I- Effect on yield

The concerned results in Table (1) clearly indicated that all girdling tested treatments significantly were succeeded to increase yield per tree if compared with the control. The best treatment in this respect was the complete girdling since the treated trees tabulated 33.0 and 30.5 kg / tree in 1998 and 1999 season, respectively. The corresponding values for the control were 17.8 and 17.9 kg / tree. As for the other two girdling treatments were recorded values were between these two extremes in both seasons of study.

The forecited results are in line with Hoying and Robinson (1991), who worked on apple trees cv. Mutsu. They found that ring girdling increased yield and reduced fruit drop. Similar study carried out by Hoying (1993) with McIntoch and Mutsu apple trees. They tested the effects of different cultural techniques evaluated nicking, notching, ringing and girdling. The obtained results confirmed the superiority of such techniques in producing high yields. Also similar results obtained by Bill- Peacock (1996), he reported that the girdling in Thompson seedless and Flame seedless grapes table increased berry weight and reduced post harvest shatter.

The results of Jensen *et al.* (1981) grapevines also strengthened the present findings. They reported that complete girdling of the grapevine trunk is the best to get full response from girdling process.

**Table (1): Effect of three girdling types on yield and fruit quality (physical characteristics) of Anna apples in 1998 and 1999 seasons.**

Treatments	Yield /tree (kg)	Fruit physical characteristics				
		Weight of 10 fruits (g)	Fruit diameter (cm)	Fruit length (cm)	Fruit firmness Red Green (Lb / In <sup>2</sup> )	
<b>1998</b>						
T <sub>1</sub> - No girdling (control)	17.8	1063.4	6.0	6.4	11.6	11.4
	33.0	1954.1	7.5	8.1	12.3	11.8
T <sub>2</sub> -Complete girdling	22.4	1312.5	6.3	6.9	11.3	11.6
T <sub>3</sub> - Half girdling	22.8	1343.7	6.9	7.5	11.2	11.4
T <sub>4</sub> - Nicking	3.6	182.2	0.3	0.6	0.5	N.S
LSD at 5 %						
<b>1999</b>						
T <sub>1</sub> - No girdling (control)	17.9	984.6	5.8	6.3	11.9	11.9
	30.5	1910.5	7.5	8.3	12.5	12.4
T <sub>2</sub> -Complete girdling	23.4	1518.9	6.1	6.5	11.7	12.0
T <sub>3</sub> - Half girdling	23.8	1576.5	7.1	7.2	11.8	12.0
T <sub>4</sub> - Nicking	3.2	307.6	0.4	0.3	N.S	N.S
LSD at 5 %						

### II- Effect on fruit physical characteristics

The concerned results in Table (1) showed results very similar to those of yield / tree. Once again the girdling treatments had the upper hand over the control and the superiority was to the complete girdling. This trend was true for weight of 10 fruits, fruit diameter and fruit length. These findings

agreed with those of Bill -Peacock (1996) on Thompson seedless and Flame seedless grapevines. He found that girdling increased berry weight and reduced post harvest shatter. In addition, he reported that girdling is necessary for most grape cultivars to produce large berries (high diameter). Also, Agenbag *et al.* (1992) found that girdling 34 days after full bloom in sunlite nectarines resulted in largest fruits on both years.

With respect to fruit firmness characteristic in red and green sides of fruit, data in the same table showed that among the tested girdling forms the complete girdling was the best one to give the greater record specially in the first season. This was true only in case of red side of fruits (12.3 Lb/In<sup>2</sup>). Otherwise, all tested girdling forms showed insignificant effect on fruit firmness at the green side if compared to each other or to the control in the 2 experimental seasons.

### III- Effect on fruit chemical characteristics

The results of such characteristics were presented in Table (2). From this table, it was clear that complete girdling as well as nicking on the trunk were the best types to increase fruit juice TSS % compared with the control in both season of study. As for half girdling treatment, it was tabulated values located between these two extremes.

The tabulated values for fruit acidity % and TSS / acid ratio indicated a similar trend to that of complete girdling and nicking in the first season with the former characteristic and in both season for the latter one. Once again the complete girdling and nicking forms were the best to minimize fruit acidity % and maximize TSS / acid ratio in fruits.

Concerning the effect of girdling forms studied on anthocyanin pigments in fruit skin, the obtained results in the same table confirmed the superiority of complete girdling as well as nicking form in this respect. Since they significantly tabulated in both seasons of study the highest values of anthecyanin content if compared to those recorded for either half girdling or the control.

**Table (2): Effect of three girdling types on fruit quality (chemical characteristics) of Anna apples in 1998 and 1999 seasons.**

Treatments	Fruit chemical characteristics			
	TSS (%)	Acidity (%)	TSS / acid ratio	Skin anthocyanins
<b>1998</b>				
T <sub>1</sub> - No girdling (control)	10.9	0.825	13.3	21.8
T <sub>2</sub> -Complete girdling	12.6	0.570	22.5	30.9
T <sub>3</sub> - Half girdling	11.1	0.750	14.9	22.3
T <sub>4</sub> - Nicking	12.3	0.670	18.4	28.2
LSD at 5 %	0.5	0.153	4.3	5.6
<b>1999</b>				
T <sub>1</sub> - No girdling (control)	10.9	0.775	15.1	15.1
T <sub>2</sub> -Complete girdling	12.6	0.675	38.9	38.9
T <sub>3</sub> - Half girdling	11.5	0.800	23.9	23.9
T <sub>4</sub> - Nicking	12.4	0.670	34.3	34.3
LSD at 5 %	0.9	N.S	N.S	3.9

The forecited results of fruit quality (chemical characteristics) are in complete girdle in agreement with those reported by Peng and Rabe (1996) who found that girdling process significantly improved fruit colour, total soluble solids level and TSS / acid ratio in juice of Mihoease Satsumas (*Citrus unshim*). Deng *et al.* (1997) and Gao Meixiou (1997) with Peach trees came to the same results. They reported that girdling increased fruit soluble solids. More recent, Carreno *et al.* (1998) with grapevines found that trunk girdling caused an obvious increase in berry juice soluble solids and berry colour along with a decrease in titratable acidity.

According to the results obtained in the present research, it could be concluded that complete girdling on trunk of Anna apple trees at 4 weeks post fruit set has a positive effect on increasing yield and optimizing fruit quality (physical and chemical characteristics). Nicking type was the next in this respect. This super effect of complete girdling can be explained according to the attribution of Roper and Williams (1989) and Winkler (1974) to that such girdling form makes an interruption in the movement of food materials produced in the leaves through the trunk phloem. Since ringing was performed often the cell division stage therefore results to enhancement of cell enlargement, with the mesocarp resuming its growth earlier or at a faster rate.

Girdling has been related to changes in translocation and accumulation of carbohydrates (Wallerstein *et al.*, 1974) and changes in hormones concentration both gibberellins (Wallerstein *et al.*, 1973), IAA (Dann *et al.*, 1985) and cytokinins (Cutting and Lyne, 1993). All these effects may lead to modified source sink relationships and partitioning of the dry weight between different plant organs (Schechten *et al.*, 1994). Also, Agusti *et al.* (1998) stated that fruit from ringed branches initiated the ethylene climateric before fruit from untreated trees. Further, ringing enhanced fruit colour, red skin colour increased whereas yellow decreased in both peach and nectarin fruit. Moreover, girdling as a form of wounding may be enhance ethylene production resulting in a process of ripening in apple fruit (Autio and Greene, 1994).

## REFERENCES

- Agenbag, H.; M.C. Prince and I. Du Toit (1992). Influence of girdling on the fruit quality of Sunlite nectarines. *Deciduous fruit Frower* (1992) 42 (3): 88 - 91 [En, Af, 7 ref., 6 col. pl] Fruit and Fruit Technology Research Institute, Stellenbosch, South Africa, Hort. Abst. 8536, 1994.
- Agusti, I.; M. Andreu; V. Juani; U. Almela and L. Zacarias (1998). Effect of ringing branches on fruit size and maturity of peach and nectarine cultivars. *Journal of Horticultural Science & Biotechnology*, 73 (4): 537 - 540.
- Agusti, M.; V. Almela; J.R. Aliaga and B. Pascual (1992). The use of Figron to promote colour development and fruit size in peaches. *Acta Horticulturae*, 315, 13 - 21.

- Autio, W.R. and D.W. Greene (1994). Effect of growth retarding treatments on apple tree growth fruit maturation and fruit abscission. *Journal of Horticultural Science*, 69, 653 – 664.
- Bill-Peacock (1996). A Review of Girdling Wlpeacock @ucdavis - edu (Cable Computer System). Jensen, F.; D. Luvisi; F. Swanson; G. Leavitt; G. Mitchell and G. Mayer (1976). Effects of complete and incomplete girdles on Thompson Seedless and Ribier table grapes. *Am. J. Enol. Viticult.*, 27: 65 - 67.
- Carreno, J.; S. Faraj and A. Martine (1998). Effect of girdling and covering mech on ripening colour and fruit characteristics of "Italia" grapes. *J. of Hort. Sci. & Biotechnology* 73 (1): 103 - 106.
- Cutting, J.G. and M.C. Lyne (1993). Girdling and reduction in shoot xylem sap concentrations of cytokinins and gibberellins in peach. *J. of Hort. Sci.*, 68, 619 – 629.
- Dann, I.R.; P.H. Jerie and D.J. Chalmers (1985). Short-term changes in cambial growth and endogenous IAA concentration in relation to phloem of peach (*Prunus persica*). *Australian J. of Plant Physiology*, 12, 395 – 402.
- Deng feng chan; Gauo xianfeno; Li Zicun and Han Kang Min (1997). Effect of girdling on the growth and bearing of Chunlei peach variety. *Journal of fruit science* 14 Supplement 40 - 4 [Ch, 3 ref] Shaanxi Fruit Research Institute, Yalag. Shaanxi, China, Hort. Abst. Vol. 68; 7493, 1998.
- Gao Meixiou (1997). Effect of girdling on the extra - early peach variety "Chunlei". *Journal of Fruit Science* 14 (2): 117 - 118 [Ch, 2 ref] Zhengzhou Fruit Research Institute, CAAS. Zhengzhou, Henan, China. Hort. Abst., 68; 4777, 1998.
- Gomez, K.A. and E.A. Gomez (1984). *Statistical procedures for Agricultural Research*. John Willey and Sons. Inc. New York.
- Harker, F.R.; J.H. Maindonald and P.J. Jackson (1996). Penetrometer measurement of apple and Kiwi fruit firmness oprator and instrument differences. *J.Amer. Soc. Hort. Sci.*, 121 (5): 927 - 936.
- Hoying S.A. (1993). Benefits and pitfalls of nicking, notching, ringing, girdling and root pruning apple trees. *Compact fruit tree* 26: 66 - 68; 36th Annual IDFTA Conference, Wenatche, Washington, USA, 21 - 25 Feb., (Cable computer research).
- Hoying, S.A. and T.L. Robinson (1991). Effect of chain saw girdling and root pruning of apple trees. First international symposium on training and pruning of fruit trees, Shepherdstown, West Virginia, USA, 16 - 20 July (1991). *Acta Horti. Culturae* No. 322, 167 - 172; (Computer research).
- Hyodo, H. (1991). Stress /wound ethylene. In: *The plant hormone ethylene*. (Mattoo, A.K. and J.C. Suttler, Eds) CRC Press. Boca Raton, USA.
- Jensen, F.; H. Andris and R. Beede (1981). A comparison of normal girdles and knife-line girdles on Thompson seedless and Cardinal Grapes. *Am. J. Enol. Viticult.*, 32: 65 - 67.
- Peng, Y. and E. Rabe (1996). Effect of summer trunk girdling on fruit quality, neturation, yield, fruit size and tree performance in "Mihowase" satsumas. *J. of Hort. Sci.*, 71 (4): 581 - 589.

Ranganna, S. (1979). Manual analysis of fruit and vegetable products, Central Food Technological Research Institute Mysore. Publishing Company Limited New Delhi, pp. 634.

Roper, T. and L. Williams (1989). Net CO<sub>2</sub> assimilation and carbohydrate partitioning of grapevine leaves in response to trunk girdling and gibberellic acid application. *Plant Physiol.*, 89: 1136 - 1140.

Schechten, I.; J.T. Proctor and D.C. Elfving (1994). Apple fruit removal and limb girdling affected fruit and leaf characteristics. *Journal Of American Society for Horticultural Science*, 199: 157 – 162.

Winkler, A.J.; J.A. Cook; W.M. Kliewer and L.A. Linder (1974). *General viticulture*. 710 pp. University of Calif. Press, Berkeley and Los Angeles.

## علاقة بعض طرز التحليق بالمحصول وصفات جودة الثمار على أشجار التفاح صنف "آنا"

محسن فهمي محمد

قسم الفاكهة - كلية الزراعة - جامعة المنصورة

- أقيمت تجربة لدراسة تأثير ثلاث طرز من التحليق (حلقة كاملة - نصف حلقة - الحز) على المحصول وصفاته على أشجار التفاح صنف آنا مطعوم على مولنج ١٠٦. ويمكن تخليص النتائج كما يلي:
- ١- ظهر واضحا أن التحليق الكامل زاد من المحصول بدرجة معنوية عن الأشجار غير المحلقة خلال موسمي ٩٨ ، ٩٩.
  - ٢- كذلك أن التحليق الكامل كان له نفس التأثير على الخواص الطبيعية للثمار ، فقد كان له تأثير جيد على وزن الثمار وطول وقطر الثمار كذلك الصلابة في الجانب الأخضر من الثمار وخصوصا في الموسم الأول. أما بقية المعاملات فلم يظهر لها تأثير معنوي على الصفات.
  - ٣- أظهر البحث أيضا أن التحليق الكامل والحز لهم تأثير على المواد الصلبة الذائبة الكلية في عصير الثمار، كذلك الحموضة والمواد الصلبة الذائبة الكلية إلى الحموضة خصوصا في الموسم الأول.
  - ٤- يظهر من البحث أن التحليق الكامل والحز لهما تأثير جيد على صبغة الأنثوسيانين في جلد الثمار.