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EFFECT OF TREE GIRDLING ON SOME VARIETIES OF CHINESE DATE (*ZIZIPHUS JUJUBA* MILL.)

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Abstract

Special production practices can be used to enhance yield and overall fruit quality. Trunk and branch girdling are known among those practices applicable to some wooden fruit species. For Chinese date (Ziziphus jujuba Mill.*) girdling was a common practice in traditional orchards with the aim to increase the fruit set. Short and deep wounds were usually made with an ax in the tree bark and phloem around the trunk. The paper presents the effect of girdling applied at the beginning of the flowering season on tree trunk and lateral branches. The girdled jujube trees increased their yield by improving fruit set, enlarged fruit size and advanced fruit maturity. Girdling effect was notable for some genotypes: larger fruit size by 3 to 5 mm in diameter, earlier harvest by 3 up to 10 days and reduced number of pickings at harvests. Varietal response to this practice, however, was quite variable. Preliminary results showed that the varieties response to girdling was substantial in some and almost unnoticeable in others.*

Key words*: trunk, branch, cambium, fruit yield.*

INTRODUCTION

The changing trends from agrochemical based production to green farming have made farmers to seek for practices that are less harmful to the environment and leave less or no chemical residue in fruit. Fruit producers are always looking for methods to reduce farm operation costs while maintaining high fruit quality.

An important cultural practice responsible for improving fruit setting, yield as well as physical and chemical properties of fruits is girdling.

Girdling is a manipulation practice for stimulating fruit trees into more productive usage, usually carried out by cutting through the phloem only as deep as the cambium layer and removing a strip of tissue. By girdling it stops or reduce the flow of sap via the phloem to the lower parts of the tree and to the roots and teoretically and practically carbohydrates are accumulated above the girdle.

A wide variety of fruit species are girdled to increase their yields, improve set, enlarge fruit size and advance maturity. Stem girdling has been widely used in apples, grapes, olives, oranges, grapefruits, peaches and has responded in at least one but not necessarily all of these areas (LaRue and Johnson, 1989; Goren et al., 2004). Girdling is a common practice in yellow flesh kiwifruit (*Actinidia chinensis*) to increase fruit size (Minchin et al., 2003, Woolley et al., 2005).

The best-known effects of girdling are presumably brought about by accumulation of assimilates above the girdle (Chun et al., 2003). Reported data showes that the ringing of trees can bring an increase in the size and sugar content of fruits and cause them to mature a few days to a week earlier (Onguso *et al.,* 2004; Hossain *et al.,* 2007; Hossain & Boyce, 2009). Rivas et al. (2008) reported that girdling few weeks before flowering reduced fruitlet abscission, increased leaf chlorophyll content and chlorophyll fluorescence.

The aim of the present study was to check the effects of girdling on inflorescence development, fruit set, yield and fruit quality of Chinese date under field conditions.

MATERIALS AND METHODS

Plant material and experimental site. The research was conducted at the University of Agronomic Sciences and Veterinary Medicine of Bucharest in the Experimental Field of the Horticulture Faculty. Eight Chinese date trees (*Ziziphus jujuba* Mill.) from different varieties

were used in the experiment. Each tree was approximately twenty years old.

Girdling. At the beginning of flowering season, girdling was performed for three genotypes: R1P8, R2P5 and R3P5 by removing a circular bark strip from around the trunk with a girdling knife (Figure 1).

Figure 1. Girdled trunk of jujube trees

The ring cut on the trunk was 2 cm wide at the deep of the cambium layer till the xylem, at 25 cm above ground. We used the same number of similar varieties/trees as controls.

Girdling was performed for five other genotypes: R2P10, R2P11, R3P9, R3P6 and R2P5 by removing a bark strip of 5 mm wide from lateral fruiting branches. The same number of similar ungirdled branches was used as control (Figure 2).

Figure 2. A) Control; B) Girdled branch

Observation and measurement of bio-physical parameters. Field observations were made each seven days interval. Inflorescence development of the branches was carefully monitorised. The growth of the trees was monitored by measuring lengths of selected terminal shoots per tree for the one year and respectively, four years old branches to girdled and non-girdled trees. Trunk and branch diameter for girdled and non-girdled variants was measured.

Fruit set (%) from the tagged branches on the experimental trees was calculated by reporting the number of fruit at seven days after anthesis and the number of fruit before harvesting.

Fruit length and diameter was measured using a Vernier digital calliper. At harvesting, final fruit diameter, fruit number and weight were recorded.

RESULTS AND DISCUSSIONS

Inflorescence development and fruit set. Girdling significantly reduced the time needed for inflorescence emergence and the duration of flowering. Results showed that the flowering duration was 9 days for R3P6 in girdled variant, whilst it took 14 days in control.

The same behavior after girdling was shown by R2P5 genotype with 15 days of flowering in comparison with 19 days of flowering in control treatment (Table 1).

Girdling treatment had a significant effect on tree fruit set capacity.

All the girdling treatments determined higher fruit set values compared to the control. In the case for R3P6, the highest fruit set percentage per branch was of 65%, while the lowest was of 37% (Table 1).

Average fruit weight (g). The data on fruit weight showed significant positive results after girdling. The increase in weight was nearly with one gram per fruit. Fruit weight of 19,01 g was registered for R2P10 in girdled variant and 18,20 g in the control. Lowest average fruit weight of 5,73 g produced by R2P5 genotype in girdled variant and 4,90 g was found in control (Table 1).

Fruit size (length & diameter). Promising results related to girdling effect on the fruit size expressed in fruit length and diameter, were obtained when compared with the untreated control branches. The fruit diameter increased from 3 mm for R2P11 to up to 5 mm for R3P9 genotype on girdled branch compared with control.

As can be seen in the Table 1, average fruit size (length and diameter) was significantly influenced by girdling compared to control.

Table 1. Effects of girdling on fruit set and fruit characteristics at Chinese date (*Ziziphus jujuba*) (*Control -non girdled)

Genotypes	Inflorescence development (days)	Fruit set (%)	Fruit weight (g)	Fruit lenght (cm)	Fruit diameter (cm)
R2P5	15	48	5.73	2.90	1.67
R2P5*	19	37	4.90	2.50	1.45
R2P10	13	61	19.01	3.85	2.78
R2P10*	17	52	18.20	3.30	2.28
R2P11	11	58	18.81	3.94	2.65
R2P11*	16	42	17.90	3.62	2.35
R3P6	9	65	12.70	2.60	1.94
R3P6*	14	37	11.89	2.24	1.54
R3P9	12	59	10.80	3.80	1.76
R3P9*	17	48	9.78	3.10	1.24

Number of fruits. In this study we observe during a monitored period of 7, 14 respectively 21 days after treatment, that girdling had significant effects on the number of fruits on girdled branches compared with the control.

From the results we found out that fruits of the different girdled branches produced more total number of fruits (Figure 3).

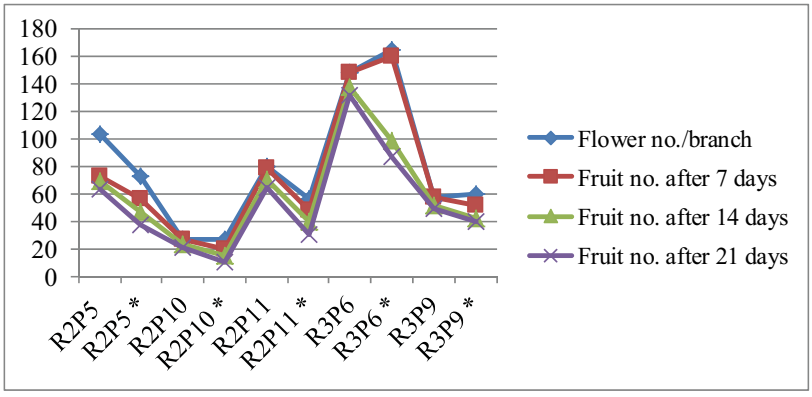

Figure 3. Total number of flowers per branches and total number of fruits per branches as affected by girdling after 7, 14 and 21 days after treatment (*Control - non girdled)

Tree growth. Monitoring the vegetative growth after girdling we noticed that the shoot length of the girdled trees, particularly for the one year branches, increased, being slightly higher than the control (Figure 5). That can indicate that young shoots were particularly active under girdling treatment, assimilates were delivered to the tissues and engaged in shoot elongation (Table 2).

All the girdled branches developed thick callus above the girdle (Figure 4), but there were no significantly differences in branch diameter growth for girdled branches compared with control.

Figure 4. Callus formation above the girdle area after two months from girdling

Total fruit production. The most encouraging results related to the fruit yield was in case of the girdled trees which showed a total fruit production increase with more than 50% over the non-girdled (control) trees. The total fruit production of girdled tree in R1P8 genotype was 16.31 kg per tree comparing with the control - 7.24 kg per tree. Yield increase expressed as percentage for all girdled trees was substantial: 51.40% for R1P8, 46.57% R2P5 and 58.00% for R3P5 (Table 3).

Table 2. Effects of girdling on shoot length and branch diameter of Chinese date (*Ziziphus jujuba* Mill.) (*Control - non girdled) (Ø1 - below the girdle, Ø2 - above the girdle)

Treatment	Genotype	Diameter Ø1 (cm)	Diameter Ø2 (cm)	Shooth length (cm)			
				1 year old branch	2 year old branch	3 year old branch	4 year old branch
Girdled	R2P5	1.50	1.55	23.53	24.00	19.93	9.16
	R2P10	0.75	0.90	29.11	23.00	51.00	36.50
	R2P11	1.10	1.25	20.33	22.85	23.00	10.50
	R3P6	2.70	2.75	18.18	9.50	20.80	-
	R3P9	1.10	1.75	23.00	21.50	20.00	-
Non-Girdled	R2P5*	1.45	-	17.75	13.75	18.00	-
	R2P10*	0.90	-	19.52	28.5	13.60	36.23
	R2P11*	1.00	-	31.25	16.00	-	-
	R3P6*	2.57	-	16.72	12.37	21.50	47.12
	R3P9*	1.00	-	22.80	18.00	19.00	-

Table 3. Effect of girdling on yield and harvesting date of some Chinese date (*Ziziphus jujuba* Mill.) genotypes

Treatment	Genotype	Fruits harvesting date					
		3.10	8.10	13.10	17.10	22.10	Yield (kg/tree)
Girdled	R1P8	10.71	-	5.60	-	-	16.31
Non-girdled		3.60	3.64	-	-	-	7.24
Girdled	R2P5	-	7.57	-	2.27	2.57	12.41
Non-girdled		-	-	-	1.17	4.61	5.78
Girdled	R3P5	8.00	4.00	-	0.69	-	12.00
Non-girdled		4.91	2.05	-	-	-	6.96

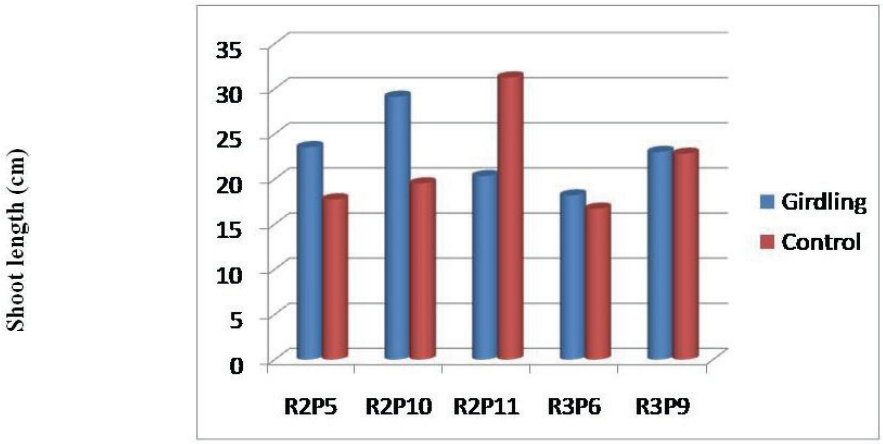

Figure 5. The girdling effect on the shoot length, particularly on one year old branches

CONCLUSIONS

From our preliminary results it has been showed that girdling treatments significantly reduced the flowering time and enhanced inflorescence development for the studied Chinese date genotypes. Similar observations have been reported by Khandaker et al. (2011) in wax apple and Arakawa et al. (1997) in apple.

The fruit weight on girdled branches was slightly higher than on control ones. Girdling can be an effective technique for improving fruit weight.

The girdling improved substantially some fruit characteristics (size and weight) beside fruit set percentage and ripening period.

Girdling determined a fruit diameter increase by 3 to 5 mm, earlier harvest by 3 up to 10 days.

and a reduced number of pickings because of a more synchronized fruit maturation.

The results related to the effect on the total yield was the most encouraging: an increase in fruit production of more than 50% was registered on girdled trees.

Varietal response to this practice, however, was quite variable. Preliminary results showed that almost all varieties showed some response: substantial in some and almost unnoticeable in others.

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