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Cable-Tie Girdling of Peach Trees Approximates Standard Girdling Results

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Abstract

A new method for girdling peach trees, using plastic cable ties, was tested against standard complete ring-girdling of main scaffolds with a 5 mm girdling knife of 'Redglobe' peach (*Prunus persica* L. Batsch) on Guardian™ to determine if the new method would approximate yield, size and earliness results of the standard knife girdling technique. The use of one or two cable ties resulted in peach fruit of size and yield similar to or better than that of standard knife girdling. Fruit total soluble solids in all girdled treatments were higher than on non-girdled treatments. Fruit harvest was advanced by knife girdling and cable-tie girdling treatments.

Introduction

In stone fruit production, girdling of the trunks or scaffolds at the time of pit hardening, growth stage II (5, 6), is an accepted practice to increase fruit size (1, 2, 8, 16) and hasten fruit maturity (7). By modifying source-sink relationships within the tree, assimilate partitioning is altered (9), directing more photosynthate to the more competitive fruit sinks rather than otherwise competitive vegetative sinks without girdling (3). While knife girdling generally appears to have positive impacts for fruit production (14), it is intuitive that this invasive practice has the potential to negatively impact tree health by creating potential entry sites for insects and pathogens. With an increasing lesser peach tree borer (*Synanthedon pictipes*) problem in the southeastern US, due to changes in pesticides available to the stone fruit industry (4), a non-invasive method for tree girdling is desirable. This report addresses the usefulness of cable ties as a non-injurious girdling method for peach trees.

Materials and Methods

A two-year trial was undertaken in 2002 to examine whether application of common cable ties to tree scaffolds would be useful as a girdling technique on peach trees. In a randomized complete block design eight fourth and fifth leaf 'Redglobe' on Guardian™peach trees trained to an open vase system with four scaffolds each were used as single tree replicates. Each of the scaffolds on each treated tree received one of four girdling treatments: standard knife girdle, 1 cable tie, 2 cable ties, and no girdle. The cable tie treatments were applied when trees were fully dormant (ca. January 20, each year). One or two cable ties were tightly bound, using pliers to tighten the ties to individual scaffolds 10 to 15 cm above the tree crotch. Standard, 1.6 mm gauge cable ties of 34 kg tensile strength (Gardner Bender, Milwaukee, WI) were used. A single cable-tie treatment had two to three 20.3 cm long cable ties connected to one another in tandem prior to placement in order to have adequate cable tie length to encircle the scaffold. Cable ties were removed at or just after the last harvest (ca. June 25, each year). These treatments were compared to a non-girdled control and a scaffold completely girdled with a 5 mm knife applied approximately 10 days before completion of pit hardening (ca. May 10, each year). Trees selected had scaffolds of similar cropping potential. All scaffolds were pruned and thinned similarly in the trial. The trees received standard summer pruning as

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thinning cuts to open up the tree canopy and spring pruning to maintain proper tree architecture with an average one-year-old limb spacing of one per 20 cm of branch or scaffold length. Fruit were thinned when they were 1 to 2.5 cm in diameter to an average of one fruit per 15 cm of shoot length. Trees were fertilized and sprayed according to the Southern Peach, Nectarine and Plum Pest Management and Culture Guide (15). Weeds were managed by a combination of Fusilade™, Surflan™, simazine, and glyphosate (after careful sucker removal). The herbicide strip was maintained weed free with paraquat. Microsprinkler irrigation was used as needed to provide 100% replacement of evapotranspired moisture. Two new shoots were selected on each scaffold and monitored for total number of flower buds and fruit set. In the 2002 trial, fruiting shoots were generally ca. 46 cm long but lengths were more variable in the second year. Fruit were harvested when commercially mature (ca. 6 kg firmness and ca. #5 Clemson Color Chip), counted and weighed. For all analyzed data, means were separated by Duncan's multiple-range test (11).

Results and Discussion

At harvest, not all fruit were of marketable size. However, in the first year of the trial, significant differences in yield, fruit weight and total soluble solids (TSS) were apparent between girdling treatments and the non-girdled control (Table 1). There was a trend toward increased fruit numbers on girdled scaffolds. Yield of girdled limbs were from 81% to 97% greater and fruit weight was 64% to 68% more than the non-girdled control. Fruit TSS of the knife girdled and 2 cable-tie girdled treatments were 16.5% and 7% greater, respectively, than the non-girdled

Table 1. Yield, fruit weight, fruit number, % TSS, % red overblush and pruning mass for each girdling treatment in 2002 and 2003 on 'Redglobe' on Guardian™ peach trees.

Treatment	Yield (kg)	Fruit wt (gm)	Fruit no.	% soluble solids	% red overblush	Pruning mass
			2002 Season			
Non-girdled control	17.0 b[z]	96 b	178	9.7 b	70	3.7
1 Cable tie	31.0a	157 a	197	10.4 ab	68	4.6
2 Cable ties	29.4a	160 a	184	10.6 ab	72	4.6
Knife girdle	33.6 a	161 a	209	11.3 a	69	3.8
			2003 Season			
Non-girdled control	16.4c	100 b	164 ab	8.7 b	81	4.6 ab
1 Cable-tie	21.4 b	160 a	134 b	10.1 a	77	5.5 a
2 Cable ties	32.0 a	160 a	200 a	10.4 a	74	5.5 a
Knife girdle	23.2 bc	161 a	144 b	10.8 a	78	3.4 b

[z]Means in the same column for the same year not followed by a letter in common differ significantly at $P \leq 0.05$ by Duncan's multiple-range test.

control. In 2002, all girdled treatments achieved 50% of the non-girdled control treatment total yield three to six days ahead of the non-girdled control (Fig.1).

In 2003, significant differences in yield, fruit weight, TSS and fruit number, as well as pruning mass (Table 1) were apparent. Yield of girdled scaffolds was 30% to 95% greater than the non-girdled scaffold. Among the girdled treatments, the 2 cable-tie girdled scaffolds yielded 49% and 39% more fruit than the 1 cable-tie girdled and knife girdled scaffolds, respectively. Again in 2003, the TSS of harvested fruit was 16% to 24% greater in girdled treatments than the non-girdled treatment. This occurred in a season in which no irrigation was employed, when rainfall levels were 86% greater than the ten-year average: 45.5 cm in 2003 versus 24.4 cm average rainfall for the previous 10 year period, between March 1 and June 30 (Fruit and Tree Nut Laboratory weather station, USDA-ARS, Byron, GA). The cumulative harvest was greatest for the 2 cable-tie treatment, intermediate for the 1 cable-tie and knife girdled treatments and lowest for the non-girdled control (Fig. 1). No increase in pit-splitting in these fruit was observed with any of the girdling techniques relative to the non-girdled control.

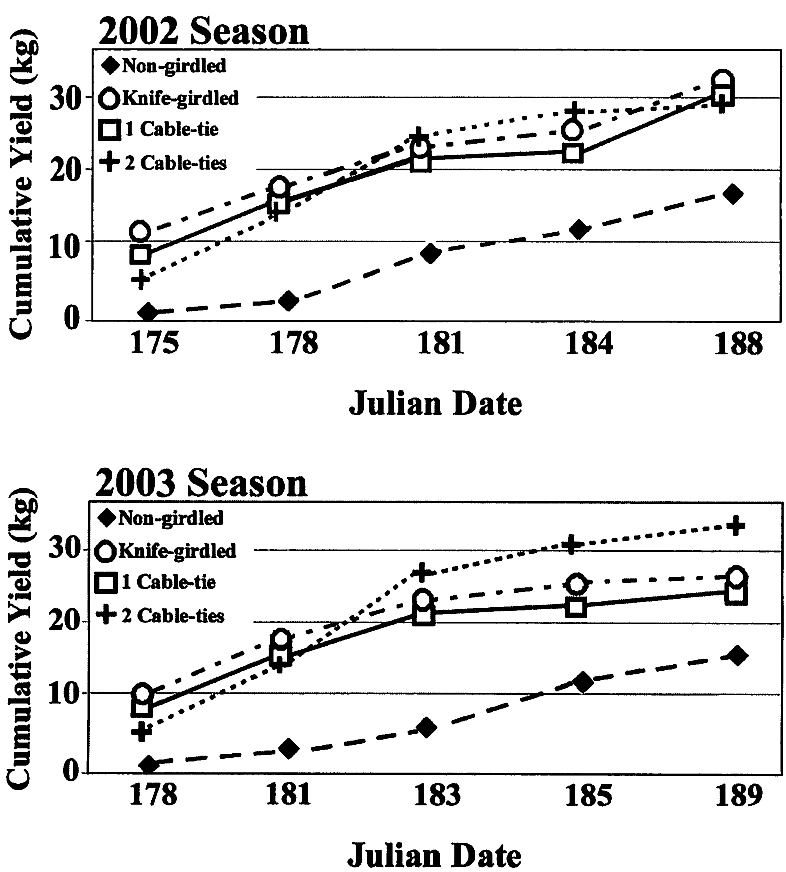

Figure 1. Accumulated yield of girdled and non-girdled control scaffold limbs of 'Redglobe' peach from Julian date 178 to 188, 2002 and 175 to 189, 2003.

In addition to increased size and yield and small increases in percent TSS, compared to the non-girdled control, it appears that girdling advanced the mean harvest date in 2003 (Fig. 1). The non-girdled treatment reached 50% of its total yield on Julian date 183. All girdling treatments reached 50% of non-girdled control total yield on Julian date 178, five days earlier than the non-girdled control. Differences in advancement of the 50% of control harvest date by girdling between years 1 and 2 may be due not only to a cumulative impact of increasing stored carbohydrates in the upper portion of the tree (above the girdling point), but more because of the climatological differences in the first and second year of the trial. Heavy rains throughout 2003 may have interacted with increasing carbohydrate status in girdled treatments to cause advancing increase in harvest date for all girdled treatments in that year.

The first year's data raised a concern, in that the pruning mass in late summer appeared to be numerically greater in cable girdled scaffolds than non-girdled or knife girdled controls, creating a potential increase in management cost over the knife girdle method. However, in the second year, despite similar statistical differences in pruning mass, there was an accompanying apparent increase in fruiting wood based on the increased number of fruit per shoot after thinning to a consistent fruit spacing. Crop density was based on shoot length, i.e., trees were thinned to one fruit per 15 cm of shoot length. Although shoot length was not measured, the number of fruit/shoot post-thinning indicated that the shoots of the two cable girdled treatments were 14-23% and 39-50% longer that the non-girdled and knife girdled treatments, respectively. The number of fruit/shoot that remained after thinning were 2.25 to 2.75 fruit during the first year of the trial. However, during the second year with reapplication of the same treatments to the same scaffolds, the fruit number/shoot tended to indicate a trend toward increasing length of fruiting wood, ranging from 2.25 fruit/shoot in the knife girdled treatment to 3.38 fruit/shoot in the cable tie treatment (data not shown). The apparent increase in tree growth of cable-tie girdled trees relative to the knife girdled control (Table 1) may have occurred because of the absence of scaffold bleeding in the cable-tie treatments during 2002. The 2003 season was characterized by record high rainfall levels (86% greater than the previous ten year average). With excessive rain, it stands to reason that there is an increasing opportunity for leaching of carbohydrates from the phloem wounds of knife girdled scaffolds. These lost carbohydrates might otherwise be available for fruit sizing and tree or fruit wood growth to support the 2004 crop. A 2004 trial was just begun to access carbohydrate partitioning and fate under these girdling treatments. This apparent increase in fruiting wood quality may not have been as notable in an earlier harvested cultivar [*e.g.*, 'Flordadawn', 'Flordaking', 'Flordacrest' with ca. 60 to 75 days from bloom to maturity (13)] in which little competition exists between fruitwood growth and developing fruit (9, 12). Additional study is needed to assess whether non-injurious girdling of peach scaffolds will increase cropping capacity by improving fruiting wood quality and length in cultivars of different seasons. Study using earlier maturing cultivars is necessary and underway in 2004. Further study also may establish that this non-injurious method may provide direct improvements over knife girdling by increasing cropping capacity of cable-tie girdled scaffolds through improved fruiting wood quality, while limiting entry sites for insects or pathogens.

Conclusions

The initial two-year study on a mid-season peach cultivar suggests that cable ties for scaffold girdling can be used to increase fruit size, yield, and earliness and may improve TSS. Additionally, the study provides preliminary evidence that fruit number may be increased due to improved fruiting wood quality of cable-tie girdled trees. Key to the effectiveness of this technique is the removal of the cable ties just after harvest. Even with the mid-season cultivar, 'Redglobe', no injury and only negligible indentation was noted on the wood. The following January no evidence of the bark indentation was apparent.

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Reorientation of Shoots to Horizontal Influences Sugar Metabolism of Lateral Buds and Shoot Internodes of Japanese Pear (*Pyrus pyrifolia* Burm.) Nak.

The authors studied the effects of reorienting shoots 60° from vertical to horizontal on carbohydrate concentration and enzyme activity in lateral buds and shoot internodes of 'Kosui' Japanese pear. The study was conducted to determine the changes in sugar metabolism induced by shoot orientation which is known to accelerate flower bud formation. Concentrations of sorbitol and sucrose in the lateral buds on horizontal shoots temporarily decreased on 3 d after shoot reorientation (DAR), but did not differ from controls at 7 DAR. Sorbitol and sucrose concentrations of the central internode of horizontal shoots were higher at 30 DAR than in control shoots. Glucose and fructose levels were unaffected by reorientation. Activity of NAD-dependent sorbitol dehydrogenase (NAD-SDH), SADP dependent sorbitol dehydrogenase, and soluble acid invertase, increased in lateral buds at 20 and 30 DAR whereas NAS-SDH in the shoot internodes decreased at 30 DAR. The authors suggest that these changes may increase the sink capacity of the bud relative to shoot tissue, thereby stimulating bud growth. From Ito, A., H. Yoshioka, H. Hayama, and Y. Kashimura. 2004. J. Hort. Sci. and Biotech. 79:416-422.