Effect of Pruning Technique on *Leucostoma* Infection and Callus Formation over Wounds in Peach Trees

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ABSTRACT

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Peach trees were pruned annually for 3 yr to leave branch stubs, flush cuts, or the branch collar. The consequences of the pruning techniques were assessed each year by measuring incidence of visible necrosis and infection by *Leucostoma* spp., gum formation, and wound closure on tissue pruned the previous year. Trees pruned to leave the branch collar showed less gumming at wounds than flush cuts and yielded fewer isolates of *Leucostoma* spp. than both flush and stub cuts. Visible callus surrounded a greater portion of the wound circumference of flush cuts than of collar cuts. Stub cuts developed no visible wound callus on the cut surface.

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Peach canker, caused by *Leucostoma cincta* (Pers. ex Fr.) Höhn (anamorph = *Cytospora cincta* (Pers.) Fr.) and *L. persoonii* (Nits.) Höhn (anamorph = *C. leucostoma* (Pers.) Fr.) is a major factor limiting peach production in the northern portion of the North American temperate tree-fruit growing region. These fungi are facultative parasites and initiate infections in wounded tissues. Common infection sites include pruning wounds, leaf scars, and sites of winter injury. Willison (8) reported that approximately one-third of all new infections occurred at pruning wounds.

Until recently, the consensus on pruning fruit trees, including peaches, has been to cut smaller branches "flush" or parallel with the larger subtending limb. This practice was known from experience to promote rapid wound closure, particularly when compared with the previous alternative practice of leaving branch stubs (2). Many researchers believe that *Leucostoma* cankers originate in the dead or dying tissues of pruning stubs, although there are few published quantitative studies providing support for this belief (9).

Recent reports by Shigo and coworkers (1,3) have shown the presence of cytological barrier zones around the bases of naturally pruned branches. These zones are rich in phenolics or other antifungal compounds and thus may prevent entry of organisms into subtending limbs (10). Shigo (6) suggested that fruit growers take advantage of the natural protective barrier by avoiding flush cuts that disrupt this tissue. Shigo (4) proposed a new type of pruning cut, the "collar cut," to utilize the tree's natural defenses. Using the collar-cut technique, Wilson et al (9) demonstrated, with data from 1 yr, that when compared with flush cuts and stubs, collar cuts resulted in reduced *Leucostoma* infection, external dieback, and internal discoloration in peach trees in West Virginia. They recommended additional studies to evaluate the long-term effect of the collar-cut method on peach canker development. The present study was designed to evaluate the effect of pruning technique over a 3-yr period on disease incidence, gum formation, and callus formation in peach trees.

MATERIALS AND METHODS

The experiment was initiated in 1984 and repeated in 1985 and 1987 in a nine tree × nine tree block of 6-yr-old cv. Redhaven peaches on seedling rootstock in an experimental orchard at Jordan Station, Ontario (referred to as Niagara). Treatments were arranged in a randomized complete block design with 20–30 pruning cuts per tree, three trees per treatment, and with four blocks. Guard rows were located between blocks and around the orchard perimeter. The three types of pruning cuts evaluated (described and illustrated by Wilson et al [9]) included flush cuts, collar cuts, and branch stub cuts (approximately 1–2 cm long). All pruning cuts on wood up to 4 yr old were made with a long-handled lopping shear and were marked with white latex paint on a portion of branch adjacent to the cut. In 1984 and 1987, pruning treatments were made in late April before bloom. In 1985, treatments were applied in mid-May during bloom. Two additional sites in 5-yr-old commercial orchards of cvs. Cresthaven and Canadian Harmony in the Essex-Kent County region of southwestern Ontario were included in 1984. Treatments were arranged in a completely randomized design with 20 cuts per tree and 10 trees per treatment. Only flush cuts and collar cuts were included at these locations.

Pruning wounds were examined in May of each succeeding year for visible necrosis (present or absent), gumming (present or absent), and the shape of the visible callus around each cut. Callus shape was rated on a 0–4 scale, with 0 = no callus, 1 = callus on one side, 2 = callus on two sides, 3 = callus on three sides, and 4 = callus around the entire pruning wound perimeter. After the visual assessments, bark chips (about 0.5 × 0.5 × 0.1 cm) for laboratory isolation of fungal pathogens were taken systematically from the proximal margin of all the pruning cuts. Chips were surface-sterilized in 1% sodium hypochlorite for 60 sec, rinsed briefly in sterile distilled water, placed on 2% malt agar, and incubated for 5 days at room temperature. The percentage of bark chips yielding *Leucostoma* spp. was recorded as percentage infection.

Data from Niagara on percentage of visible necrosis, percentage of wounds with gum, and percentage of infection were transformed using the arcsine of the square root of the percentage (7), subjected to analysis of variance and Duncan's multiple range test for separation of means. Data from callus formation assessments from all sites were analyzed using a 2 × 5 chi-square test to examine the proportion of callus types according to flush or collar-cut treatment. Data on visible necrosis and gumming from the two sites in Essex-Kent were combined and analyzed using simple *t* tests.

RESULTS AND DISCUSSION

In Niagara, collar cuts showed significantly less gumming and colonization by *Leucostoma* spp. than flush cuts (Table 1). Stub cuts had the highest incidence of *Leucostoma* infection in all 3 yr. Visible necrosis and gumming showed a significant pruning technique × year interaction caused by a low incidence of visible necrosis of stubs in 1985 and a relatively high incidence of gum at collar cuts in 1987. Incidences of visible necrosis, *Leucostoma* isolation, and gumming were highest in 1987; all parameters were similar in 1984 and 1985.

There were no differences in visible necrosis or gumming resulting from pruning technique in the Essex-Kent experiment. The spring and early summer of 1984 were extremely dry, and these conditions, combined with a relatively low incidence of disease at the beginning of the experiment, probably did not favor natural infection of pruning wounds at this site.

Chi-square analyses verified that pruning technique affected wound closure, as indicated by altered patterns of visible callus formation (Table 1). Visible callus was virtually absent from stub cuts. The proportion of wounds with a callus rating of 4 was always greater with flush cuts than with collar cuts, and collar cuts always had a greater proportion of wounds with a callus rating of 0. Evidently, the mean visible callus patten was not a good indicator of wound susceptibility to infection by *Leucostoma* spp.

Shigo (5) suggested that flush pruning cuts are more susceptible to colonization by pathogens than cuts in which the branch collar is preserved. The present study supports this suggestion and also demonstrates that the collar-cut technique, as described by Wilson et al (9), is applicable to reducing peach canker incidence under Ontario conditions. Peach canker in West Virginia is most commonly associated with *L. persoonii* (10). In Ontario, the disease is caused by two species of *Leucostoma*. Over the 3 yr of the present study, approximately 73% of infected pruning wounds yielded *L. cincta* and the remainder yielded *L.*

Table 1. Percentage of peach tree pruning cuts showing infection by *Leucostoma* spp., visible necrosis, and gumming and callus pattern index 1 yr after pruning[x]

Pruning technique	Visible necrosis (%)	*Leucostoma* isolation (%)	Gumming (%)	Callus index[y]
Stub	25.8 a	24.4 a	2.3 c	0.03 c
Flush	31.1 a	15.2 b	9.1 a	3.1 a
Collar	25.7 a	7.2 c	6.0 b	2.1 b

Source	df	Analysis of variance/sums of squares: Visible necrosis (%)	*Leucostoma* isolation (%)	Gumming (%)
Pruning technique	2	184	1,616*[z]	1,198**
Year	2	35,321**	27,578**	1,923*
Block	3	1,051*	820	691*
Pruning technique × year	4	1,202*	431	783*
Residual	72	8,883	18,221	5,113

[x] Data from three Niagara experiments (1984, 1985, and 1987) arranged in a randomized complete block with 20–30 pruning cuts per tree, three trees per pruning technique per block, and four blocks. Different letters in columns denote significant differences ($P \leq 0.05$).

[y] 0 = No callus, 1 = callus on one side, 2 = callus on two sides, 3 = callus on three sides, and 4 = callus around entire wound perimeter.

[z] Significant at * = $P \leq 0.05$ and ** = $P \leq 0.01$.

persoonii.

Wilson et al (9) suggested that resistance to infection in pruning wounds was due to formation of a protective barrier rich in phenolic compounds. A flush cut removes this barrier in the branch collar region and thus circumvents the plant's natural defenses.

Change in pruning technique alone will not eliminate peach canker from infected orchards or prevent its occurrence in new plantings. Improved pruning practices, however, will reduce the incidence of disease when integrated with a crop management strategy that includes proper planting practices, orchard sanitation, fungicide use, and pruning in relation to weather that favors wound closure over fungal infection.

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