Resistance of Honeylocust Cultivars to *Thyronectria austro-americana*

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ABSTRACT

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Three cultivars (Imperial, Skyline, and Sunburst) and one selection (thornless) of honeylocust (*Gleditsia triacanthos* var. *inermis*) were screened for resistance to the canker fungus *Thyronectria austro-americana*. Whether inoculated in fall or spring, the thornless selection produced significantly smaller cankers and formed callus and closed inoculation wounds twice as fast as any cultivar. Imperial and Skyline were similar in susceptibility, and Sunburst was the most susceptible. Partial mechanical girdling had little effect on canker expansion, but girdling Sunburst trees in the fall resulted in 40% mortality whether or not they were inoculated. Cankers induced by two isolates of *T. austro-americana* on Skyline and Imperial cultivars and on the thornless selection differed significantly in size.

Thyronectria canker of honeylocust (*Gleditsia triacanthos* L. var. *inermis* Willd.), induced by the fungus *Thyronectria austro-americana* (Spegazzini) Seeler, causes losses throughout most of the United States (2-4,6). Environmental stresses are thought to predispose trees to infection, but the specific conditions necessary for infection and canker development are unknown. Host resistance and proper tree maintenance may provide some degree of disease prevention (1). The objectives of this research were to: 1) assess the resistance of three commonly planted honeylocust cultivars and one thornless selection when inoculated during the fall or spring, 2) determine if partial girdling influenced host resistance, and 3) determine any differences in pathogenicity between two fungal isolates.

MATERIALS AND METHODS

Honeylocust trees. Three honeylocust cultivars (clones–Imperial, Skyline, Sunburst) and a seedling selection (variety–thornless, referred to as a cultivar in remainder of this report) were screened for resistance to *T. austro-americana*. One hundred trees of each cultivar were planted as 1.5-m whips at the Colorado State University Bay Farm research facility in Fort Collins in May 1981. Trees of each cultivar were planted in groups of 10, with each group randomly placed in each of 10 rows (reps); each row totaled 40 trees. Trees were 1.8 m apart and spacing between rows was 3.6 m. The trees were not irrigated, as moisture was readily available from a high water table. No fertilizer was applied. When inoculated in 1983, trees had an average height of 2.8 m and a diameter of 3.7 cm at 15 cm above ground.

Inoculation. Isolate 1 (83-28) was recovered in 1983 and isolate 2 (20a) in 1981 from cankered honeylocusts in Fort Collins and Denver, respectively. Both were grown on potato-dextrose agar (Difco) for 2 wk prior to inoculation. One wound on the east and one on the west side of each tree were made 23 cm above the ground by removing the bark to the sapwood with a 1.5-cm-diameter circular punch. An agar plug with fungus mycelium and spores was placed in the hole, and the hole was sealed with Parafilm; this covering was removed after 2 wk. Inoculations were performed on 15 October 1983 (fall) during leaf abscission and on 15 April 1984 (spring) before leaf expansion.

Treatments. One-half (five per group) of the trees were used for the fall inoculation experiments and the remainder for the spring experiments. Four trees were inoculated per cultivar per row (rep) at each date. Two of the inoculated trees were girdled mechanically around 80% of the circumference to a depth of 1 cm. The girdles were made 8 cm from the ground to simulate a ground-line wound. One partially girdled and one nongirdled tree were inoculated with isolate 1, and the other girdled and nongirdled trees were inoculated with isolate 2. One tree in each five-tree block was wounded and agar was placed in the wound as a control. Control trees in one-half of the rows were partially girdled. A total of 10 noninoculated trees and 40 inoculated trees per cultivar were used per experiment.

Measurements and analysis. Length and width of the cankers (orange-red discolored bark), including the original wound sites, were recorded monthly for 1 yr. Data were $\log_{10}$ transformed to equalize variances and for data normalization. Analysis was by an SPSS Manova program (5). The experimental design was a randomized block with rows as blocks and with the honeylocust cultivars randomly placed as a set within rows. Within each cultivar set, split-plot treatments (girdling and fungal isolates) were randomly applied to the trees. Each monthly reading was analyzed separately to determine whether the cultivar, the partial girdling, and/or the isolate of *Thyronectria* used influenced canker size.

RESULTS

In both fall- and spring-inoculated and both girdled and nongirdled trees, canker size varied significantly ($P = 0.05$) among the four honeylocust cultivars (Fig. 1). Girdled trees were pooled with nongirdled trees for analysis, since girdling had little effect on canker expansion. In the fall inoculation experiment, thornless honeylocust had significantly ($P = 0.05$) smaller cankers than the other three cultivars. In the spring experiment, the thornless cultivar had significantly smaller cankers than the Skyline and Sunburst cultivars. Thornless trees also formed callus and covered the inoculation wound twice as fast as the other cultivars in both fall and spring tests. Imperial and Skyline were similar in susceptibility, especially in the fall, and Sunburst produced the largest cankers in both experiments. The differences in canker sizes were distinctly (significantly) evident by December in the fall experiment and by July in the spring experiment.

Fall-inoculated trees had much larger cankers than spring-inoculated trees (Fig. 1). Cankers on fall-inoculated trees had two periods of rapid expansion, from October to January and from April to June. Cankers on spring-inoculated trees expanded rapidly only from April to July; after July, canker expansion stopped and callus formation caused a reduction in canker size for both inoculation experiments. Canker expansion slowed during the winter in both experiments.

Girdling had no effect on canker expansion and did not affect wound closure in the fall test. However, significantly ($P = 0.05$) larger cankers occurred above a partial girdle than above no girdle in the spring experiment after callus formation had begun (Fig. 2). Additionally, 40% of Sunburst trees

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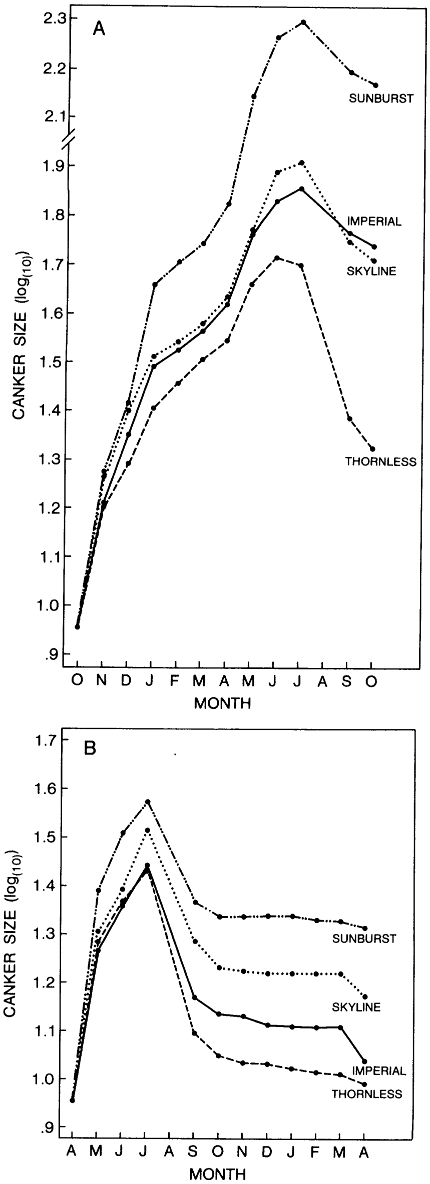

Fig. 1. Canker size on **(A)** four honeylocust cultivars inoculated in the fall and **(B)** four honeylocust cultivars inoculated in the spring with *Thyronectria austro-americana.* Canker size (cm) is the arithmetic mean of the sum of $\log_{10}$ values of the combined horizontal and vertical diameters of the two wounds on each of four trees, including girdled and nongirdled trees. $n = 40$ per date and cultivar.

partially girdled in the fall and 5% of Sunburst trees partially girdled in the spring died during the winter whether they were inoculated or not. Mortality was not observed in the other cultivars.

The two isolates caused different canker sizes in both fall and spring experiments. In fall inoculations, isolate 1 caused significantly larger cankers than isolate 2 on all cultivars except Sunburst (Fig. 3A); when Sunburst was added to the analysis, there were no significant differences in canker sizes between isolates. In the spring test, isolate effect was less evident and opposite that seen in the fall, as isolate 2 caused significantly larger cankers than isolate 1 on thornless, Imperial, and Skyline trees. The larger

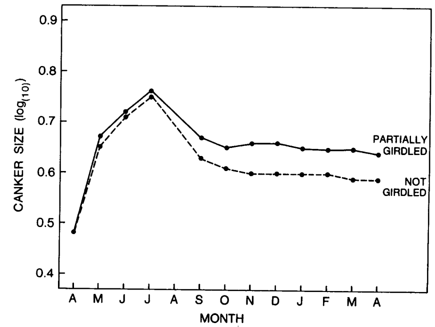

Fig. 2. Canker size on four partially girdled and nongirdled honeylocust cultivars inoculated in the spring with *Thyronectria austro-americana.* Canker size (cm) is the arithmetic mean of the sum of the two $\log_{10}$ values of the combined horizontal and vertical diameters of wounds on the side of each tree with or without girdling, controls excluded. $n = 80$ per date per isolate.

cankers occurred on the wound above the partial girdle and at the end of the summer when wound closure had begun (Fig. 3B).

DISCUSSION

A range of resistance to *T. austro-americana* was observed among honeylocusts in these tests. These cultivars also ranked similarly in tests by Bedker and Blanchette (1), who tested cultivar resistance to *Nectria cinnabarina* (Tode:Fr.) Fr. Thus, cultivar selection should play an important part in managing these two canker diseases.

Canker expansion apparently is related to dormancy, since canker expansion was the greatest in the fall (September–November) when the opportunity for host responses is most limited. Canker expansion also appears to be linked to wound closure, since the thornless selection had the smallest cankers and closed wounds the fastest.

Partial mechanical girdling had a minimal effect on canker expansion. Wound closure, however, may be affected by girdling, since only after wound closure was initiated were cankers significantly larger on girdled vs. nongirdled trees inoculated in the spring. Young honeylocusts apparently have the ability to redistribute water and nutrients above a partial girdle so neither the inoculated areas nor the whole tree is under detectable stress. Thus, partial girdling of small trees, such as that caused by lawn mowers, did not significantly increase canker expansion by *T. austro-americana.* However, the Sunburst cultivar is not as tolerant of girdling as the other cultivars and should be considered a poor choice in landscape settings where mechanical injury is common.

The isolates induced different canker sizes, and their pathogenicity was related to cultivar, girdling, and season of inoculation. Since these two randomly selected isolates were different in viru-

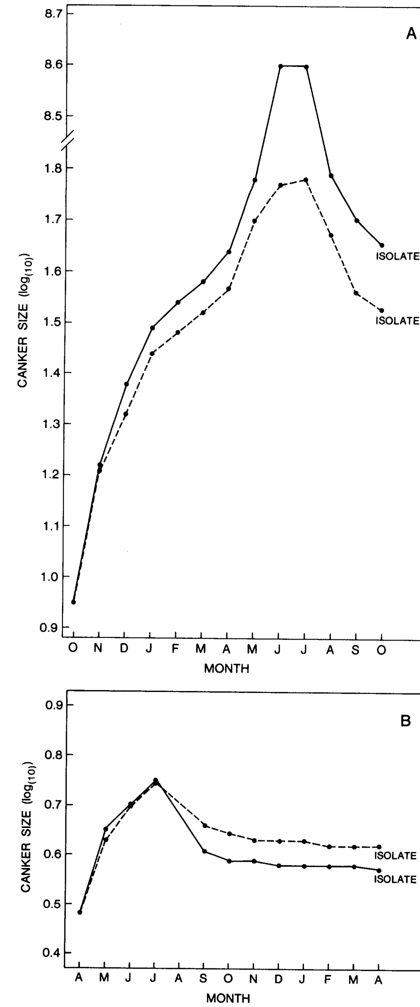

Fig. 3. (A) Canker sizes on Skyline, Imperial, and thornless honeylocust cultivars inoculated in the fall with two isolates of *Thyronectria austro-americana.* Canker size (cm) is the arithmetic mean of the sum of the two $\log_{10}$ values of the combined horizontal and vertical diameters of the two wounds on each tree. $n = 60$ per date per isolate. **(B)** Canker sizes of wounds above the partially girdled area on Skyline, Imperial, and thornless honeylocust cultivars inoculated in the spring with two *T. austro-americana* isolates. Canker size (cm) is the arithmetic mean of the sum of the two $\log_{10}$ values of the combined horizontal and vertical diameters of one wound on each tree. $n = 60$ per date per isolate.

lence, pathogen variability should be considered in any further selection or testing for resistance. Because there are potentially more virulent races of the pathogen, disease management should not rely totally on the use of resistant cultivars.

The effect of Thyronectria canker can be minimized by utilizing the information gained by this study. Specifically, the more resistant cultivars Skyline, Imperial, and thornless should be selected instead of Sunburst. Pruning or other wounding activities should be avoided in late summer, fall, and winter, since spring pruning allows defenses by the tree to occur sooner after wounding.

Unfortunately, information on optimal growth conditions for honeylocusts is limited. To meet this need, future research should focus on short- and long-term environmental effects on honeylocusts and their interactions with canker diseases.

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