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Cold-Induced Cankers and Associated Fungi in a Sycamore Seed Orchard

F.I. McCracken and R. Rousseau

SUMMARY

Of the trees in a 6-year-old sycamore seed orchard in Carlisle County, KY, 66 percent developed obscure vertical cankers in the spring of 1990. A variety of wound-invading saprophytes, including *Hyalodendron* sp., *Stachylidium* sp., *Botrytis* sp., *Phialophora* sp., *Trichoderma* sp., and *Fusarium* sp., were isolated from canker wood. Weather records indicated that trees were subjected to abnormally low temperatures from December 15–25, 1989. Five clones demonstrated an apparent tolerance to the cold damage, but there was no correlation between clone response and geographic origin of the clones. The consistent southern orientation of cankers, record low temperatures in 1989, and apparent absence of virulent pathogens strongly suggest that the cankers resulted from freeze damage.
Keywords: *Platanus occidentalis*, wound-invading fungi.

INTRODUCTION

Sycamore, *Platanus occidentalis* L., is a fast-growing, easily propagated hardwood species that can be grown on plantations to help meet fiber and fuel needs (Briscoe 1969). However, the plantation ecosystem composed of genetically similar trees enhances the probability of damage by pest agents. Tolerance to pests and seed quality may vary greatly between seed sources (Coggeshall and others 1981). Seed orchards derived from desirable selections can supply uniform high-quality seed for annual production needs, but can be affected by canker fungi, cold temperatures, or other agents (Filer and others 1977). The purpose of this study was to determine the cause(s) of extensive canker-like bark necrosis in a 6-year-old sycamore orchard near Wickliffe, KY, established from progeny-tested selections of 25 individuals from North Carolina, Illinois, Kentucky, Alabama, Tennessee, and Mississippi.

MATERIALS AND METHODS

A 3-acre sycamore seed orchard with 324 trees was established in Carlisle County, KY, in 1985 from progeny test selections grafted onto 1-year-old local root stock. The orchard was cultivated through the first two growing seasons and mowed periodically. Most trees produced seed by the third year. Several trees died (23 percent) due to graft failure. Trees were rated annually in the spring for anthracnose, canker disease, and seed viability after the third growing season.

In the spring of 1990, many of the trees developed flat, obscure vertical necrotic streaks on the stems that appeared as 1- to 2-year-old *Ceratocystis fimbriata* Ell. and Halst. F. *platani* Walker infections. All trees in the seed orchard were examined for extent and location of injury symptoms during July 1990. Sections were removed from stems at 2-, 3-, and 5-meter intervals through the canker. The wood samples were split, and chips approximately 1 mm^3 were removed aseptically without surface treatments from the transmission zone between necrotic tissue and live stem wood. Fungal isolates were recovered from samples on potato dextrose agar after incubation without light at 68 °F. Fungi were identified after 1 to 2 weeks of incubation.

Weather records of recent past winters from a nearby location (Mayfield, KY) were obtained from the Midwest

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Agricultural Weather Service Center, National Oceanic and Atmospheric Administration, Purdue University, and evaluated for periods of possible temperature damage.

RESULTS AND CONCLUSIONS

Fungi were recovered from 32 percent of more than 200 tissue samples examined; 30 percent yielded no microorganisms, and 38 percent yielded bacteria only. The necrotic tissues had been invaded by the wood saprophytes *Hyalodendron* sp. (8 percent), unidentified spp. (8 percent), *Stachylidium* sp. (7 percent), *Botrytis* sp. (5 percent), *Trichoderma* sp., (2 percent), and *Fusarium* sp. (2 percent). No isolates of the fungi *C. fimbriata platani, Phomopsis* sp., *Botryodiplodia theobromae* Pat., or other pathogens capable of producing elongate cankers were recovered.

The damage data from the 25 clones showed that 145 of the 220 total ramets (66 percent) exhibited typical symptoms of vertical necrotic streaks. The majority of the clones (16) had both affected and unaffected ramets. Very few clones showed complete resistance or susceptibility. Four clones showed no damage, while five clones were completely affected. There was no apparent correlation between damage and geographic origin of the clones. Weather records from Mayfield, KY, show a record cold period from December 15 to December 25, 1989 (fig. 1). Such low temperatures were not recorded during the previous three winters, and there was no evi-

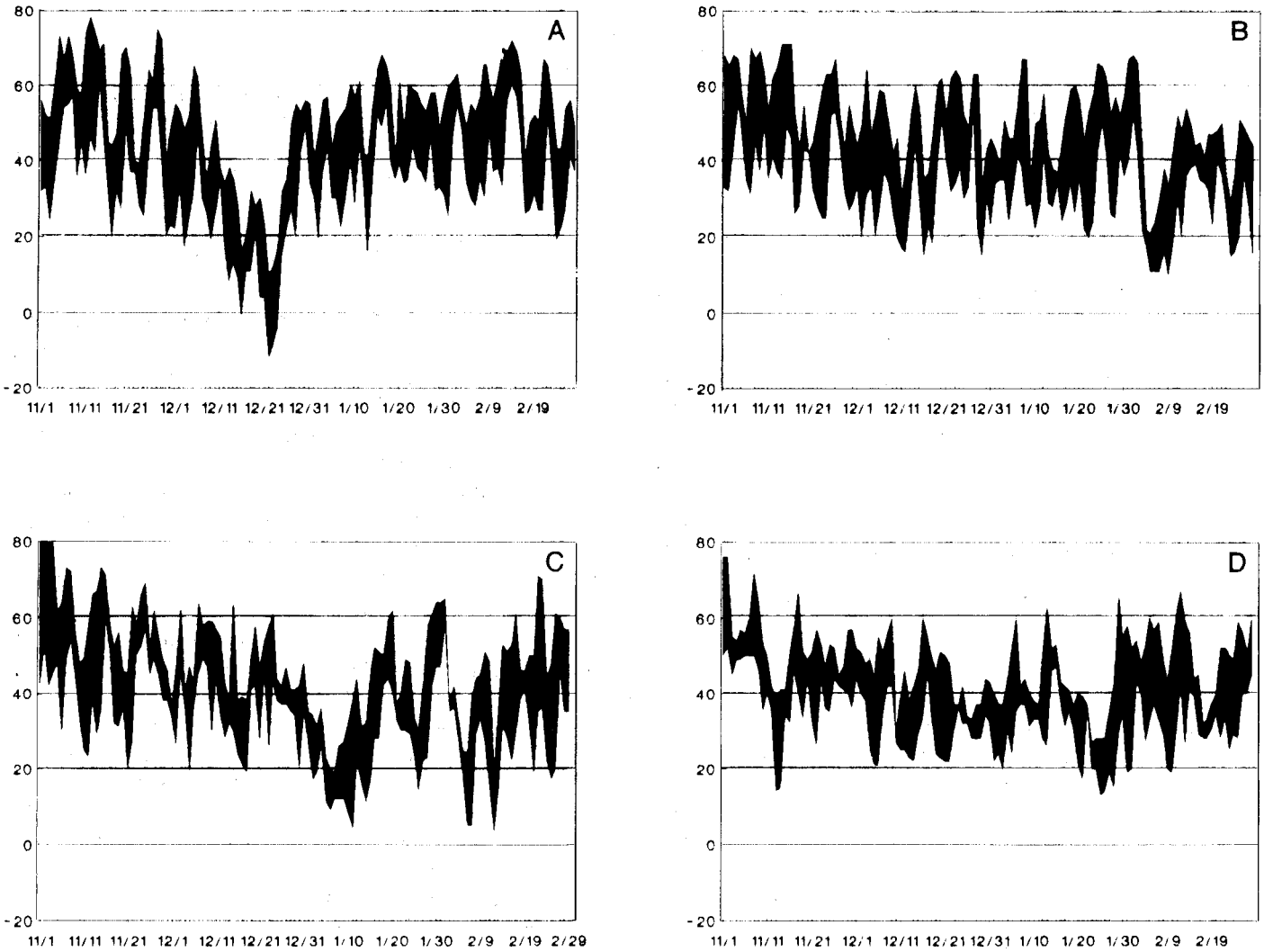

Figure 1.—*Daily maximum and minimum temperatures (°F) at Mayfield, KY, (A) during the unusually cold winter of 1989–1990, compared with previous winters of (B) 1988–1989, (C) 1987-1988, and (D) 1986–1987.*

Francis I. McCracken is principal plant pathologist, U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Stoneville, MS 38776. R. Rousseau is forest research geneticist at Westvaco, Wickliffe, KY 42087.

dence of damage during those years. Similar low temperatures were recorded during December of 1983.

The presence of only known saprophytic fungi in necrotic zones, consistent southeast to southwest orientation of necrosis, and the record low temperatures during December 1989 strongly suggest that the vertical necrotic streaks resulted from freeze damage.

Failure to isolate the known canker-producing fungus, *C. fimbriata platani,* alone cannot be considered conclusive evidence that the damage was due to other causes. However, by August 1990, the vertical necrotic zones were developing callouses which is not typical of sycamore canker stain. The few trees that demonstrated thin crowns and wilt symptoms typical of canker stain were found to exhibit graft incompatibility that resulted in restricted root stock growth at the graft line. This abnormality in the vascular system could account for the wilt symptoms exhibited during periods of summer water stress.

The arctic air mass responsible for the abnormally low temperatures in December 1989 also damaged several cold-susceptible or woody species across the South. During the years recorded, previous low winter temperature extremes occurred only in 1983. The wounds on affected trees in the seed orchard do not represent a significant threat by infection of the principle canker-producing fungi because old exposed wounds do not readily support establishment of C. fimbriata *platani* (McCracken 1987). Wounds are first inhabited by saprophytic fungi such as those isolated and may be invaded by wood decay fungi, which would further weaken the stems (McCracken 1988). However, the scar widths were small enough to close in 1 to 3 years and arrest decay development. Early season cold extremes cause considerable injury because of water content in tissue. Stem surface temperatures may change greatly (>100 °F) in a few hours on the south side during abnormally cold, clear weather. Such extreme temperature variations also cause extensive tissue damage even during the dormant season (Boyce 1948). Wound dressings are not advised for small cold-weather wounds because they are not highly susceptible to pathogens as are wounds during the growing season.

Foresters should avoid establishing plantations on sites with topographic characteristics subject to frost development. Cultural treatments that promote tree growth and facilitate wound closure are recommended.

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