

43. Elm Yellows

Wayne A. Sinclair and David S. Wysong

Elms native to the United States are subject to a systemic, lethal disease called elm yellows, formerly phloem necrosis. The disease is caused by a mycoplasma-like organism (MLO) which is transmitted by leafhoppers and other homopteran insects. Because the pathogen has not yet been cultivated apart from plant or insect hosts, it has not been fully described or named. Epidemics of elm yellows from the late 1800's to the present have killed tens of thousands of elm shade trees as well as wild elms.

Hosts and Distribution

Natural infections are known only in winged elm, American elm, cedar elm, red or slippery elm, September elm, and *Ulmus rubra* x *U. pumila* hybrids. The hybrids show various symptoms but remain alive, while trees of the above species die when affected by yellows. Siberian elm seems immune.

The disease now occurs in 22 States from Kansas, Nebraska, and Oklahoma eastward, and from Minnesota to Mississippi. It is spreading slowly, and by 1983 had reached approximately 99° west.

Symptoms and Signs

Foliar symptoms (figs. 43-1, 43-2) usually develop between mid-June and mid-September. In American elm these include drooping, yellowing, and premature casting. The sequence takes only a few weeks. All branches usually show symptoms at once, but occasionally leaves yellow first on just one branch. Bright yellow leaves are sometimes interspersed with green ones, but more often all leaves discolor. Twigs and bran-

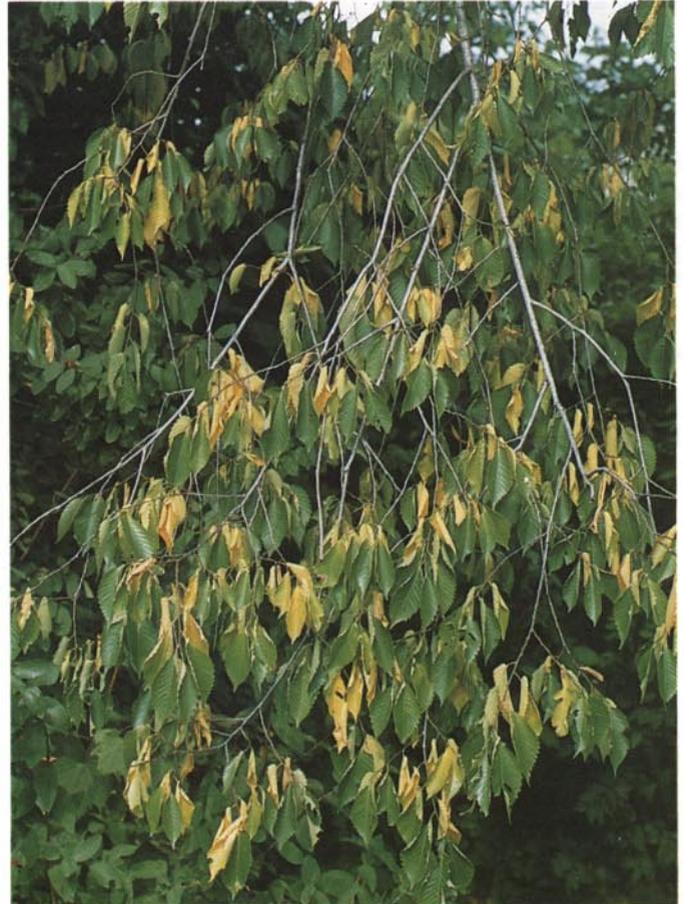


Figure 43-2. Drooping yellow and green leaves.



Figure 43-1. Affected and normal American elms in August.

ches dry out after the leaves fall. Trees sometimes wilt and die rapidly, most often in late spring to mid-summer. Shrivelled brown leaves remain on trees for several weeks.

By the time leaves turn yellow, roots and the inner bark at the base of the tree may be dying or dead. Fine roots die first. As large roots and the trunk become involved, the innermost bark and the cambial zone change color from normal light cream to light yellow, then tan sometimes flecked with dark brown (figs. 43-3, 43-4), and finally dark brown. The remainder of the bark then dies. The phloem on upper branches usually does not discolor. On exposure to air, the inner phloem and cambial region of infected elms turn brown much more rapidly than do comparable tissues of healthy elms.

Infected phloem produces methyl salicylate (oil of wintergreen), which can often be smelled at the surface of freshly exposed, moist inner bark. If indistinct, the odor can be concentrated by enclosing a phloem sam-



Figure 43-3. Discolored inner phloem and cambial region seen in slant cut into small stem.



Figure 43-4. Bark peeled from main stems of saplings shows yellowish inner phloem flecked with brown (upper), compared to normal, healthy trees (lower).

Figure 43-5. Branch of defoliated red elm bears small brooms.



ple in a small container for a few minutes. Wintergreen odor cannot be detected after the leaves turn brown or the bark dies.

Symptoms in red elm fit the same general pattern except that, in the majority of infected trees, witches' brooms form during the final season before death, and no wintergreen odor is produced. The brooms are ordinarily only a few cm long (fig. 43-5), but occasionally become much larger. Infected red elms show discolored phloem inconsistently, and this sometimes includes elliptical pockets of dark brown, degenerated tissue a few mm long. Leaves and bark of red elms killed by yellows produce a characteristic odor that reminds some of caramel, others of maple syrup. This odor does not occur in red elms dying from other causes.

Disease Cycle

The elm yellows agent is probably spread by several different insects, including leafhoppers and spittlebugs. The yellows agent also spreads among closely spaced trees of the same species via root grafts.

The causal mycoplasma-like organisms are found in phloem sieve tubes throughout the plant. They can be observed with electron microscopy but generally not with a light microscope.

Few if any elms show yellows in the year of inoculation; symptom development requires at least 3 months in very small trees, and 9 months or more in large ones. The yellows agent thus overwinters in its plant hosts. Most transmissions are thought to occur during the last half of the growing season, and a typical disease cycle lasts 1 to 2 years.

Elms can show yellows symptoms for several years before death, but this is rare. Most American elms die within 1-year and red elms within 2 years after foliar symptoms appear. Recovery is unknown.

Damage

Outbreaks of elm yellows are usually localized, but

sometimes spread at rates of 3 to 5 miles per year. Spot outbreaks presumably develop after long-distance transport of vectors by wind. The disease can be endemic for many years between outbreaks in a given locale. When an outbreak begins, however, it characteristically continues until few elms remain in the locality. Trees of all sizes die.

Control

No practical controls are available for elm yellows in susceptible trees. Resistant trees are the only available approach. Natural infections of European and Asiatic elm species are unknown. Therefore, pending more detailed information, exotic elms adapted to the Great Plains may be planted without fear of loss to elm yellows.

Selected References

- Sinclair, Wayne A. Elm yellows. In: Stipes, R. Jay; Campana, Richard J., eds. Compendium of elm diseases. St. Paul, MN: American Phytopathological Society; 1981: 25-31.
- Swingle, Roger U. Phloem necrosis, a virus disease of the American elm. Circular 640. Washington, DC: U.S. Department of Agriculture; 1942. 8 p.