Elm yellows (EY) is a debilitating or lethal disease caused by an unnamed phytoplasma. Phytoplasmas are prokaryotic obligate parasites of plant phloem, of insects that act as vectors, and probably of additional insects that feed by sucking phloem sap. Phytoplasmas can be detected by electron or fluorescence microscopy or by PCR amplification of particular DNA sequences. The phytoplasmas associated with EY are distinguished from others by analysis of ribosomal DNA. EY is widespread in the eastern half of the USA, where sporadic epidemics have killed native elms but not those of Eurasian origin. In 1998, epidemics were in progress in Illinois, New York State, and an area centered in the Potomac valley northwest of Washington, DC. One EY vector, the leafhopper Scaphoideus luteolus, is known, and others probably exist. Research in progress or needed includes assessment of EY phytoplasma resistance or tolerance in elm cultivars developed for resistance to the Dutch elm disease pathogen, identification of EY vectors in different geographic regions, elucidation of vector biology, determination of reasons why elms of Eurasian origin seem to escape damage from EY in North America, and elucidation of mechanisms of phytoplasmal pathogenicity.

Introduction

Elm yellows (EY) is lethal in Ulmus spp. indigenous to North America. The disease is known for spectacular epidemics that have been scattered both spatially and temporally. It has never been controlled on a practical scale, and information that could provide a basis for its prevention or management by ecologically acceptable techniques in highly susceptible species does not exist. EY is not familiar to many people who are knowledgeable about elms and Dutch elm disease. The ability of EY to disrupt elm management and elm improvement programs has been underestimated. This disease has defeated several elm conservation programs that were based on control of Dutch elm disease. It threatens susceptible elm populations that have survived to the present.

History, Distribution, and Hosts

EY was initially described in the midwestern United States in the 1930s (Swingle, 1938), but it was probably present there at least 50 years earlier, based on descriptions of undiagnosed mortality of Ulmus americana (American or white elm) (Garman, 1893, 1899; Forbes 1912). It seemed confined to the Mississippi, Missouri, and Ohio.
River basins below 41°N for many years, occurring in parts of 13 states (Carter, 1950) in dramatic outbreaks that each killed hundreds to tens of thousands of American elms. Then came outbreaks farther north and east: Rockford, Illinois in 1946 (Carter and Carter, 1974); Alabama and Georgia in the 1950s (Curl et al., 1959; Miller et al., 1954); New Jersey, New York, and Pennsylvania in the 1970s (Sinclair, 1972; Merrill and Nichols, 1972; Weber et al., 1974); and Delaware in the 1990s (RP Mulrooney, personal communication). A major epidemic in the Potomac valley beginning in the mid-1990s involved parts of Virginia, West Virginia, Maryland, and Pennsylvania. In the Chicago suburb of Arlington Heights, Illinois, in the late 1990s, tree managers learned anew the ability of EY to kill elms that had been protected against DED.

Up to 1998, EY had been reliably reported from parts of 25 states (Fig. 7.1) and southeastern Ontario. Occasional records of EY in single trees far from the main range of the disease are presumed to reflect long-distance transport by wind of infected vectors to localities where indigenous vectors were absent or insufficient to initiate local spread of the disease. These localities include, for example, Fargo, North Dakota (Stack and Freeman, 1988), Detroit, Michigan (Hart, 1978), and Lincoln, Massachusetts (Holmes and Chater, 1977). EY was unknown in Canada until 1984, when an outbreak was found in progress in the Niagara peninsula of Ontario. The disease had apparently spread there from adjacent New York (Matteoni and Sinclair, 1989). It subsequently disappeared from the peninsula.

Figure 7.1. The known geographic distribution of elm yellows in North America. Sustained epidemics have occurred in the shaded region. Transient occurrences, including some based on unpublished reports believed to be reliable, are marked by spots. Distribution data are from Gibson (1977), Hart (1978), Holmes and Chater (1977), Stack and Freeman (1988), unpublished reports, and the author's observations.