MAPLE DISEASE EPIDEMIC IN SOUTHEASTERN MICHIGAN

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During the summer of 1984, large numbers of Norway maples (*Acer platanoides*) in Dearborn, Michigan developed a necrotic condition, apparently due to an infectious disease. Dead branches usually retained reddish-brown necrotic leaves. Slightly sunken cankers were occasionally present on affected branches. Occasionally, cankers were observed oozing reddish-brown fluid. Wood under the infected area was discolored. In early spring, orange spore tendrils were observed arising from pycnidia on the surface of the cankered area. Symptoms reportedly progressed from twig dieback to death of the entire tree, or major portions of the tree, in one season. The disease was apparently spreading rapidly and had the potential of killing large numbers of trees.

In 1983 a complete inventory of Dearborn identified 30,735 street trees. Of these 78% were maples and 53% (16,185 trees) were Norway maples. With this high proportion of Norway maples in the population, city officials became concerned about the potential aesthetic and financial loss due to a disease epidemic.

The objectives of this study were to identify the causal agent and to determine the extent of the problem.

Materials and Methods

Wood and bark samples from the area between severely affected and healthy tissue were collected from 18 trees. Slivers of discolored wood and bark were removed and cultured on potato-dextrose agar and water agar (Tuite, 1969). The resulting fungal growth was identified by microscopic examination. Twigs and stem pieces were sectioned with a sliding microtome and examined for infection and pycnidial morphology.

The isolated fungus was inoculated in the spring of 1985 into recently transplanted 'Miller's Superform' Norway maple whips which had received predisposing treatments. The treatments were: dry ice damaged stem with and without a 1 cm vertical slit in the bark (Helton, 1962A), non-ice damaged stems with and without a 1 cm vertical slit and control trees with ice damage, a vertical slit, and no inoculum.

Degree of infection was determined in three ways. Pycnidia on bark were observed, bark samples were cultured on PDA and fungal growth observed, and discoloration of the wood above and below inoculation site was measured.

The city of Dearborn has been divided into 21 public works districts, and has three naturally divided residential sections. A partial disease inventory was conducted by stratifying the sampling area by the three sections and randomly choosing one work district in each. Observers drove all public streets and examined all street-side Norway maples in each of the three chosen work districts.

Results

Cytospora annulata (*Valsa ambiens* subsp. *leucostomoides*) was isolated from the discolored xylem and cambial tissue in 12 of 18 samples collected in Dearborn. Pycnidia of *C. annulata* were observed in the bark of numerous samples. Erumpent pycnidial discs were grayish white and less than 1 mm diameter. Fungal hyphae were observed in both large and small wood vessels in and around the discolored xylem.

In the inoculation trials, infection took place mainly on inoculated whips which were damaged by freezing (Table 1). *Cytospora annulata* was reisolated from one inoculated tree which was mechanically injured but not freeze damaged. Vascular discoloration was at least two times greater in inoculated, wounded, ice damaged trees than in ice damaged, wounded controls.

The disease inventory included 25% of Dearborn's Norway maple population. It identified 27.6% of Norway maples as having some symptoms of the disease. Symptoms were most often

identified on trees 30-45 cm (12-18 in.) DBH. Trees of this size were generally 25-35 years old and exhibited reduced growth ring thickness during the past three years.

Discussion

Canker diseases are those which affect the inner bark or phloem tissue of a tree. They are usually localized and often exhibit a sunken necrotic area. Hudler (1984) lists seven canker diseases of maples in eastern North America. One of these is Cytospora canker, caused by *Valsa ambiens* subsp. *leucostomoides* (anamorph *Cytospora annulata*). Typically, this disease is characterized by elongate shallow cankers which do not kill the host tree. *Cytospora* has also been associated with wood discoloration and decay in sugar maple when allowed to enter through tap holes drilled for the production of maple syrup (Sproston and Scott, 1954).

Cytospora requires three conditions for successful infection of the host. First, sufficient numbers of spores must be present at the potential infection court. Spores are spread during rainy periods in water droplets which splash off sporulating fruiting bodies (Bertrand and English, 1976). *Cytospora* spores are often found on the bark of healthy trees and are viable during all seasons (Luepschen and Rohrback, 1969).

Second, a wound in the outer bark which exposes phloem or xylem tissue is required. *Cytospora* does not penetrate healthy, intact bark, and is not known to enter through leaves or roots. Spores require external nutrition from the wounded tissue, and high relative humidity to germinate (Rohrback and Luepschen, 1968).

Third, since *Cytospora* is a weak, or nonaggressive, pathogen, the tree must be stressed, or predisposed, prior to infection. There are many factors which predispose urban trees (Schoeneweiss, 1975). Three factors were identified as possibly being related to the Dearborn epidemic. During the two summers prior to the epidemic, and the early summer of 1984, the southern part of Michigan experienced a drought. In August of 1982 and 1983 Dearborn received 0.67 and 1.41 inches of rain, respectively, compared to the normal 3.34 inches. In 1984 there were five consecutive weeks in July and August without significant rainfall. Schoeneweiss (1983) has shown that water stress is the primary predisposing factor associated with Cytospora canker of blue spruce (*Picea pungens*); the less water available to the tree, the larger the canker.

Herbicides are known to be predisposing factors. However, they have not received much attention as related to woody ornamentals (Schoeneweiss, 1975). The city of Dearborn is characterized by well kept, generally weed-free lawns. Numerous trees with moderate to severe *Cytospora* infections were found to have herbicide symptoms on the lower foliage. The correlation between the amount of injury, and type, amount and frequency of lawn herbicide application was not examined, but may be related to the epidemic as a secondary predisposing factor.

Winter injury and freezing stress are often associated with *Cytospora* infection (Helton, 1962A, Schoeneweiss, 1981). Schoeneweiss (1981) indicated that red maple is predisposed to *Cytospora* by freezing stress. The threshold of predisposition for non-hardy seedlings was between −20 and −25°C (−4 to −13°F), with irreversible predisposition at temperatures less than −30°C (−22°F). Helton (1962A) found that 25% of artificially freeze-damaged prune (*Prunus domestica*) stems were invaded by *Cytospora*. When frost cracks were simulated, natural infection rates increased to 100%. He

Table 1. Preliminary *Cytospora* inoculations on 2 cm diameter 'Miller's Superform' Norway maples.

Treatment	Measure of infection*		
	Pycnidia	Reiso-lation	Discolora-tion in cm
Ice + inoculum	2/3**	3/3	6.5
Ice + wound + inoculum	4/6	6/6	12.4
Ice control	0/2	0/2	3.6
Ice + wound control	0/4	0/4	4.7
Wound control	0/1	0/1	1.1
Wound + inoculum	0/6	1/6	2.6
Inoculum only	0/3	0/3	0

*Degree of infection was measured three ways. First, formation of pycnidia on bark was observed; second, bark was placed on PDA and growth of *Cytospora* was observed; third, discoloration of wood above and below inoculation site was measured.

**2/3 indicates that 2 out of the 3 inoculations were positive for pycnidia or isolation.

concluded that it was not just cell death due to winter injury, but the combination of cell death and wounds, which predisposed the trees to infection and made possible the epidemic spread of the disease. In Dearborn, the winter of 1983-1984 was warmer than normal in November and February and colder than normal in December, January, and March. The lowest temperature recorded was −27°C (−17°F) on January 21. This was preceded by temperatures seldom falling below −19°C (−2°F). The importance of freezing injury as a predisposing or inciting factor in the disease is indicated not only by the observed occurrence of the disease but is also supported by the inoculation experiment.

The widespread occurrence of Cytospora canker on Norway maples observed in 1984 was probably due to the combination of predisposing, inciting, and contributing factors as described by Manion (1981).

In this situation the predisposing factors included the stresses commonly associated with urban trees and the extreme lack of moisture. The inciting factor was the winter injury. *Cytospora annulata* then infected wounds on the weakened tree and caused the widespread necrotic condition observed during the summer of 1984 in Dearborn.

The long-term management of this or other diseases is accomplished by careful selection of species to be planted. No city should allow a single species to make up over half of the street tree population (Kielbaso and Kennedy, 1983). The maximum for any species should be less than ten percent of the population. Aesthetic and financial losses would, therefore, never be devastating with a host-specific insect or disease outbreak.

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