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OBSERVATIONS ON THE DECLINE AND DEATH OF SOUTHERN MAGNOLIA

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Abstract. A decline and death of southern magnolia in urban areas of the South was observed from 1976 to 1985. Defoliation, dieback, discoloration of stem wood, and root necrosis occurred 1-2 years before death. The xylem temperature was higher and xylem moisture content lower in declining trees than in healthy trees. The nature of the causal agent(s) was not established. A variety of treatments was applied to affected trees in an attempt to arrest symptom development. Some diseased trees injected with Oxytetracycline HCL have survived while trees receiving other chemical or cultural treatments did not survive.

The decline and death of southern magnolias (*Magnolia grandiflora*) has been observed primarily in west central Mississippi and to some extent in adjacent southern states from 1976 to 1985. The nature of the causal agent has not been determined. Due to the high value of southern magnolia as a shade and ornamental tree, this disease can be of considerable economic importance where it occurs. A preliminary report of this disease was made (McCracken 1981); however, the author is unaware of any other reports of similar magnolia disorders. This report summarizes 9 years of observations on this disease of magnolia which will be of value to those interested in determining its cause(s) and control.

Materials and Methods

An indication of decline distribution was based on inquiries, reports and personal observations during 1976 to 1985. On-site observations of above and below ground symptoms were made in all cases except one, from which tissue samples were examined. Leaf, twig, stem, root and soil samples were returned to the laboratory on ice. Four declining and 4 healthy trees in Washington County, Mississippi were observed for differences in wood moisture, temperature, tyloses, water injection rate, N, P, K, Ca, Mg, Fe, Mn, and Zn. Nitrogen was determined by standard Kjeldahl procedure; P by colorimetry with molycleum blue color development and the other elements were determined by atomic absorption spectrophotometry after samples had been dry-ashed and taken up in dilute HCL. Stem temperatures were determined between 10 a.m. and 2 p.m. for 4 days in July with an electric thermometer with the probe inserted 2.25 in. into stems 4.5 ft. above ground. Wood moisture content was determined by comparing fresh and dry weights. The time to inject 0.34 oz. of water into stems with a syringe was performed as described by Lee et al. (1984).

Five severely affected trees in Bolivar and Washington Counties, Mississippi were destructively sampled. Cross sections about 3 in. thick were taken from large roots and the stems were sectioned at 3-ft. intervals. Wood chips about 0.1 cu. in. in size were removed asceptically from the stained and unstained wood and placed on malt and anaerobic agar in petri dishes. The plates were incubated for 9 days (aerobic) and 21 days (anaerobic) at 78 ± 3°F in darkness. Microscopic observations were made to identify the microorganisms and tyloses or other symptoms in tangen-

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tial stem sections.

Cultures of 6 fungi recovered from declining trees, grown on potato dextrose agar were used to inoculate bark flap wounds on 28 3-year-old magnolia seedlings in the greenhouse. Sterile agar was applied as check inoculations and all wounds were covered with parafilm. Magnolias 12 to 18 in. dbh were inoculated with cultures which produced necrosis in greenhouse tests. Inoculum was grown on wood discs on PDA. Discs were placed in wounds made with a 1-in. diameter spade drill bit. Sterile discs were used in check inoculations and all wounds were covered with parafilm. Soil samples from declining and nearby healthy trees at 3 locations in Mississippi and one each in Louisiana and Alabama were tested for N, P, K, pH, and nematodes. Nematodes were separated from soil samples using a combined decanting, sieving and funnel technique (Christie and Perry 1951). Soil pH was metered with a glass electrode pH meter at a 1:1 soil to water ratio.

Chemical treatments were applied to declining trees in an attempt to arrest the disease and to provide an indication of possible causes. Treatments were injection of Lignasan, 16 oz. in 18 oz. of water per inch of dbh; injection of Oxytetracycline HCL, 100 mg in 8 oz. of water per inch of dbh, according to the Elm Research Institute (1978); tree fertilization (13-13-13, 1.5 lbs. per 1000 sq. ft. under tree crown); a fungicide soil drench (Benlate, 1.5 lb. per 1000 sq. ft. under tree crown); and a systemic insecticide (Furadan, 2.0 lb. per 1000 sq. ft. under tree crown). Individual and combined treatments were applied. However, the number of trees found at any one time in a similar state of disease development was insufficient to conduct satisfactory comparative experiments. Trees showing moderate to advanced symptoms often could not be injected due to an apparently restricted vascular system.

Results

During 1976 to 1985 affected trees were observed in Bolivar, Hinds, Sharkey, Warren, and Washington Counties, Mississippi; Ashley County, Arkansas; Montgomery County, Alabama; Shelby County, Tennessee; and Orleans Parish, Louisiana. The disease occurred in somewhat restricted areas and it appeared to spread to adjacent trees in the same general location. A total of 101 affected trees were examined, 89 of which were in Mississippi. Early symptoms included a slight yellowing of leaves and an abnormal amount of defoliation. Defoliation continued for several months and twig dieback became apparent (Fig. 1). Often, a large branch or one side of the tree was affected first. A dark necrosis of the cambium and wood usually occurred near the soil line on the affected side of the tree (Fig. 2). An obscure, elongate narrow canker may extend 3 ft. or more up the bole and into large branches. Roots have necrotic areas and the number of feeder roots is reduced. Wood in the affected areas was stained blue-black and had an unpleasant odor. Ingrown pockets of stain associated with older growth rings indicated that some trees had been similarly but less affected during the previous 10-12 years. In the advanced stages, a few flowers, and small chlorotic and necrotic leaves usually persisted ((Fig. 3). Affected trees typically appeared wilted and most died within 2 years after the first symptoms appeared.

Figure 1. Declining southern magnolia showing excessive defoliation and dieback.

The xylem temperature within the stems of declining trees was 6-7°F higher than that of unaffected trees in the same area. The wood moisture content of declining trees averaged about 6% less than that of healthy trees. Tyloses occurred frequently in the outer wood vessels of declining trees. There were no obvious differences between healthy and diseased trees in the concentration of zinc in the bark of wood, nor in the time required to inject 0.34 oz. of water into stems. Similarly, there were no consistent differences in the concentrations of nitrogen, potassium, phosphorus, calcium, magnesium, iron, or manganese detected in tissues from healthy and diseased trees.

Fusarium spp. and a *Cephalosporium*-like fungus were the most frequently isolated fungi of the eight genera of fungi typically recovered from diseased tissues. The other fungi were *Aureobasidium* sp., *Botryodiplodia* sp., *Verticillium* sp., *Macrophoma* sp., *Phomopsis* sp., and *Phialophora* sp. The *Cephalosporium*-like fungus was the only isolate that produced necrosis of stem tissues on seedling trees. Inoculations with the same isolate into naturally occurring trees produced small cankers, 2-4 inches long during the growing season. However, the cankers did not continue to develop the following spring, but became grown over.

The environment in which the affected trees were growing appears to have little, if any, effect on the disease. Young and older trees were found to be affected on acidic and on neutral soils, sandy and heavy clay soils, and on wet and on dry sites. There were no significant differences in soil nitrogen, phosphorus, potassium, or nematode populations taken from around healthy and diseased trees.

Four of the 19 trees receiving treatments since 1979 have survived. All 4 surviving trees had been treated with Oxytetracycline HCL. Some had also received fertilization and the fungicide soil drench. The most complete recovery was associated with all three treatments applied at the same time (Fig. 4).

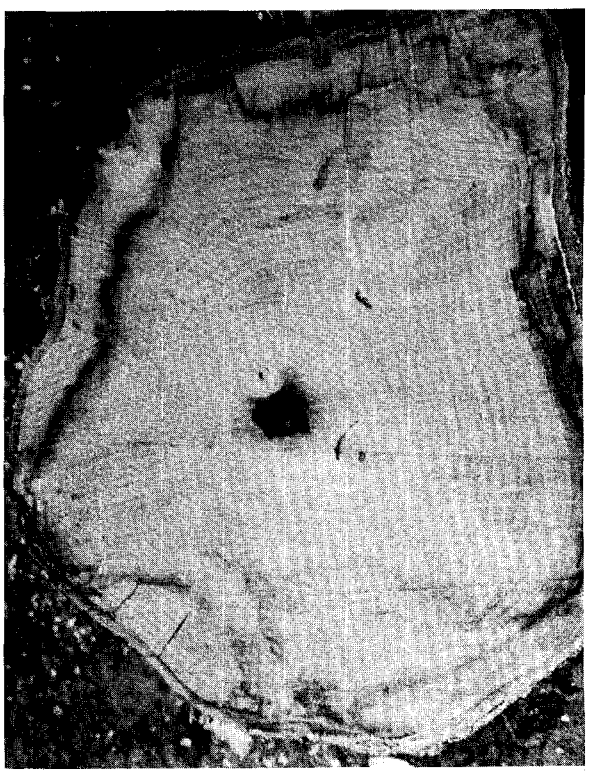

Figure 2. Stem cross section of affected tree showing internal stain.

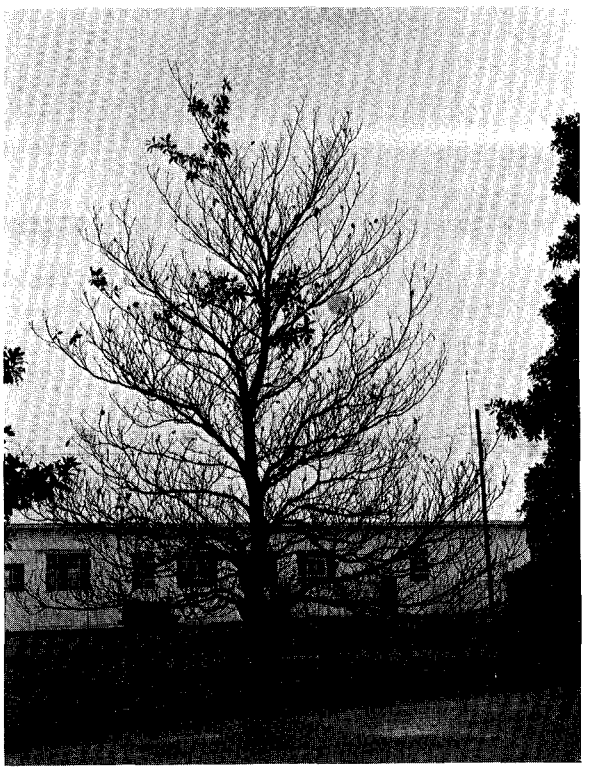

Figure 3. Declining southern magnolia showing advanced symptoms of dieback. Some live leaves remaining.

Discussion

Symptoms of magnolia decline and mortality have some similarities with other tree declines of uncertain cause(s) (Manion 1981). The two diagnostic features of citrus decline of unknown etiology (Lee, et al. 1984), were not found in affected magnolias. Observations of symptoms suggest that the disease first involves the root and vascular system and may not result from a complex set of interacting factors. Some of the fungi associated with the disease appear to contribute to mortality but were of a secondary nature. Affected trees had been planted near residences, roads, in parks, or public use areas. Trees in native stands have not been affected. Thus, site may contribute to the development of this disease. Treatments that promoted recovery of diseased trees are not recommended because the form and appearance of the recovered trees were unsatisfactory for ornamentals. Symptom suppression of affected trees following injection of Oxytetracycline HCL indicates that an infectious mycoplasma or bacterium could be the cause of the disease. A more in-depth investigation into the cause(s) and cure of magnolia decline and mortality may be warranted if the problem persists or increases.

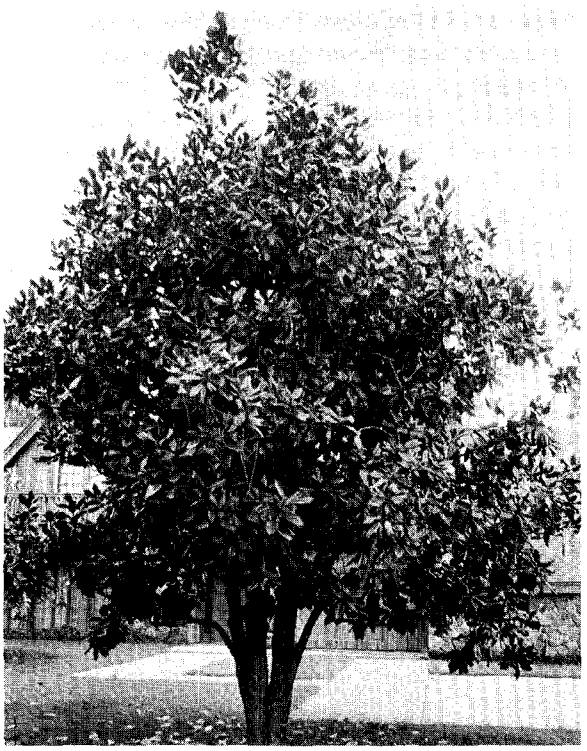

Figure 4. Partial recovery of declining tree which received Oxytetracycline HCL injections and soil treatments.

Literature Cited

1. Christie, J.R. and V.G. Perry. 1951. *Removing nematodes from soil.* Proc. Helminthol. Soc. Wash. 18: 106-108.
2. Lee, R.F. et al. 1984. *Syringe injection of water into the trunk: A rapid diagnostic test for citrus blight.* Plant Dis. 68: 511-513.
3. Manion, P.D. 1981. Tree Disease Concepts. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 399 pp.
4. McCracken, F.I. 1981. Southern magnolia decline in Mississippi. (Abstr.) J. Miss. Acad. Sci. Suppl. XXVI. P. 1.
5. The Conscientious Injector's Handbook. 1978. Elm Res. Inst. Leafl., 6 pp. Harrisville, NH 03450.

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