

SUPPRESSION OF ELM PHLOEM NECROSIS SYMPTOMS
WITH TETRACYCLINE ANTIBIOTICS

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This publication reports research involving pesticides. It does not contain recommendations for their use nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State or Federal agencies before they can be recommended.

ABSTRACT

Symptoms of phloem necrosis were suppressed on American and cedar elms in Mississippi, by injecting tetracycline antibiotics.

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Starting in 1947, a long list of workers reported that antibiotics may have controlled certain yellowing diseases (5, 8, 9, 10, 11) for which mycoplasma bodies have been identified as the probable cause (2). Doi, et al. (4) first reported pleomorphic mycoplasma in the phloem of plants, and several other workers have related mycoplasma to phloem infection (3, 6, 7). The possibility that elm phloem necrosis, which has symptoms similar to those of yellow diseases, might be controlled with antibiotics was investigated in the study reported here..

Tetracycline antibiotics were injected into elms with phloem necrosis symptoms, and the trees were observed. Results were highly encouraging. The disease is a serious threat in at least 13 Midwestern, Southern, and Eastern States (1), and many of the ornamentals that are threatened have such high value that some form of intensive care could be justified.

MATERIAL AND METHODS

In June 1970, four 50-year-old trees 30 to 40 inches in diameter 4 1/2 ft above ground were selected in a residential area in Mississippi where phloem necrosis had caused mortality the previous year. All trees were growing within a 40,000 ft² area on good soil and received adequate moisture. Two trees had symptoms of phloem necrosis and two exhibited no symptoms. The American elm (*Ulmus americana*) selected to receive the tetracycline antibiotic had a thin crown and butterscotch-colored phloem which smelled of wintergreen. Another tree with these symptoms and two symptomless trees were used as checks and received no antibiotics. The tetracycline was administered to the trees through the trunk. A 1-inch diam hole 1 to 2 inches in depth was drilled into the trunk 4 feet above ground. A reservoir 3/8 x 6 inches was made with an increment borer by drilling downward in the center of the 1-inch diam hole.

Table 1. Elms treated with chlortetracycline and tetracycline antibiotics in 1971 to suppress elm phloem necrosis.

Species	Diameter (inches)	Treatment intervals	Rate per application (mg)	Total for year (mg)	Antibiotic
American elm	32.9	1 application	2,000	2,000	Chlortetracycline
Cedar elm	18.6	Biweekly	2,000	6,000	Chlortetracycline
American elm	8.7	Biweekly	2,000	6,000	Chlortetracycline
Cedar elm	7.1	Biweekly	1,000	7,000	Chlortetracycline
American elm	14.8	Biweekly	1,000	7,000	Chlortetracycline
American elm ^a	33.1	Biweekly	2,000	16,000	Tetracycline

^aTreated tree from 1970 test.

Table 2. Amounts of oxytetracycline^a applied to cedar elms in 1972.

Tree diameter (inches)	Date			
	6-28-72	7-7-72	8-4-72	8-11-72
18.7	1,400	2,000	2,000	2,000
20.5	2,000	2,000	2,000	2,000
9.6	1,000	1,000	1,000	1,000

^aAmount in milligrams.

A rubber stopper with one hole was inserted in the larger hole to receive liquid and prevent spillage. Identical excavations were made at 1.5-ft intervals around the tree's circumference. Plastic tubes ran from the stoppers to 2-liter bottles that contained the antibiotic (Fig. 1). The time required for uptake of 1 liter of antibiotic solution varied from 0.15 to 48 hr, probably depending upon the suction force generated by the tree's transpiration. The tree was treated with 1000 mg tetracycline 10 times at intervals of 7 to 10 days during June, July, and August.

In 1971, the elm treated in 1970 was retreated by the same procedure except that 2000 mg of tetracycline were provided eight times on a biweekly schedule starting in June.

In addition, 10 new elms were included. Three American elms and two cedar elms (*U. crassifolia*) were treated with chlortetracycline at different intervals and rates (Table 1).

All five of these trees showed disease symptoms prior to treatment. Three cedar and two American elms were untreated checks.

In 1972, six new trees were added. Three were treated with oxytetracycline and three were checks (Table 2). Treatments from earlier years were continued on the assigned trees as previously described.



FIGURE 1. Tetracycline antibiotic solution applied to elm tree trunk with gravity flow injector.

RESULTS

The 50-year-old infected American elm treated with tetracycline until late August 1970 showed symptoms of twig dieback on 1% of its crown in the fall.

In late spring 1971, these symptoms occurred on 25% of the twigs prior to the first tetracycline treatment of that year. The crown continued to thin, and dead leaflets were evident throughout the crown 4 weeks after treatment. The tree recovered fully by 12 weeks after treatment began and produced an excellent seed crop. In August 1972, the tree appeared healthy and no symptoms were visible. The three untreated elms selected as checks died, one in 1970 and two in 1971. No untreated elms in the immediate area survived the disease by 1972.

No mortality occurred in any trees treated with chlortetracycline, oxytetracycline, or tetracycline in 1970, 1971, and 1972. All trees appeared healthy at the end of the 1972 growing season. Several untreated trees in the vicinity of the test area died, and many of those surviving showed phloem necrosis symptoms. Cedar, American, September (*U. serotina*), and winged (*U. alata*) elms appeared to be equally susceptible.

The minimum amount of tetracycline needed to control the disease has not been established. The results indicate that 100 mg or less per year for each inch of tree diameter may be sufficient.

A sample of diseased American elm sent to the ARS Shade Tree Laboratory for examination showed the presence of mycoplasma (private communication with Charles Wilson). Wilson has also reported mycoplasma in other elm samples with phloem necrosis (12). This tree, which was 33 inches in diameter, showed no disease symptoms in the spring of 1972 after being treated with 2000 mg of chlortetracycline in August 1971.

Observations show that symptoms may recur during the growing season after treatment if no additional tetracycline is administered. This infection may be from new inoculum or from original inoculum that was not killed by the antibiotic.

Literature Cited

1. BRETZ, T. W., and R. U. SWINGLE. 1946. Known distribution of phloem necrosis of the American elm. *Plant Dis. Repr.* 30: 156-159.
2. DAVIS, R. E., and R. F. WHITCOMB. 1970. Evidence on possible mycoplasma etiology of aster yellows disease. I. Suppression of symptom development in plants with antibiotics. *Infect. Immun.* 2: 201-208.
3. DAVIS, R. E., R. F. WHITCOMB, and R. L. STEERE. 1968. Remission of aster yellows disease by antibiotics. *Science* 161: 793-795.
4. DOI, Y., M. TERANAKA, K. YORA, and H. ASUYAMA. 1967. Mycoplasma or PLT group-like micro-organisms found in the phloem elements of plants infected with mulberry dwarf, potato witches' broom, aster yellows, or Paulownia witches' broom. *Ann. Phytopathol. Soc. Jap.* 33: 259-266.
5. FREITAG, J. H., and S. H. SMITH. 1969. Effects of tetracyclines on symptom expression and leafhopper transmission of aster yellows. *Phytopathology* 59: 1820-1823.
6. GRANADOS, R. R., K. MARAMOROSCH, and E. SHIKATA. 1968. Mycoplasma: suspected etiologic agent of corn stunt. *Proc. Nat. Acad. Sci. U.S.A.* 60: 841-844.
7. HARRISON, B. D., and I. M. ROBERTS. 1969. Association of mycoplasma-like bodies with potato witches' broom disease from Scotland. *Ann. Appl. Biol.* 63: 347-349.
8. ISHIE, T., Y. DOI, K. YORA, and H. ASUYAMA. 1967. Suppression effects of antibiotics of tetracycline group on symptoms development in mulberry dwarf disease. *Ann. Phytopathol. Soc. Jap.* 33: 267-275.
9. KenKNIGHT, G. 1955. Chemotherapy of the peach rosette virus with antibiotics. (Abst.) *Phytopathology* 45: 348-349.
10. STODDARD, E. M. 1947. The X disease of peach and its chemotherapy. *Connecticut Agr. Exp. Sta. Bull.* 506. 19 pp.
11. STORY, G. E., and R. S. HALLIWELL. 1969. Association of a mycoplasma-like organism with bunchy top disease of papaya. *Phytopathology* 59: 1336-1337.
12. WILSON, C. L., C. E. SELISKAR, and C. R. KRAUSE. 1972. Mycoplasma-like bodies associated with elm phloem necrosis. *Phytopathology* 62: 140-143.