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CONTROL OF LIVE OAK DECLINE IN TEXAS WITH LIGNASAN AND ARBOTECT

Robert Lewis, Jr.
USDA Forest Service
Southern Forest Experiment Station
Stoneville, Mississippi

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ABSTRACT

Two systemic fungicides, Arbotect 20-S (2-(4-thiazolyl) benzimidazole) and Lignasan (methyl-2-benzimidazole carbamate phosphate), were tested as possible controls for live oak decline in Texas. Both fungicides killed Ceratocystis fagacearum in vitro at 1 µg/ml.

Live oaks with incipient and advanced wilt were pressure injected with the fungicides. Trees with incipient wilt and those treated during summer responded better than trees with advanced wilt or those treated during spring and fall.

Introduction

Live oak decline has affected live oaks (Quercus virginiana) and other oak species in Texas since 1933 (12). It was first observed in Austin, but now occurs throughout the natural range of live oaks in Texas (4,5) and is suspected to occur in other southern states. In central Texas alone, the disease kills thousands of live oaks annually.

Attempts to control live oak decline were made as early as the 1940's (2) and have accelerated over the past decade (1,6,13,14,15). Still, no acceptable method of control exists; the procedures used for control of oak wilt in natural stands

(10,11) are not desirable for shade trees since they involve killing standing trees. The objective of this study was to develop an effective treatment for live oak decline in Texas.

Live oak decline is a vascular wilt caused by a fungus that colonizes the vascular system and impairs normal water flow by chemical and physical actions. Wilting is the primary disease symptom. Cephalosporium diospyri was once believed to be the only fungus responsible for wilt of live oaks in Texas (4,5,13,14). But recent studies indicate that C. diospyri is not lethal to healthy live oaks (8,9). Ceratocystis fagacearum (oak wilt) has now been associated with live oak decline in Texas (9). It is highly pathogenic to live oak and probably the primary cause of the disease.

Materials and Methods

Two fungicides,[1/] Lignasan (methyl-2-benzimidazole carbamate phosphate) and Arbotect 20S (2-thiazolyl) benzimidazole hypophosphite), were selected as potential controls for oak decline in Texas. Both fungicides are registered for the control of Dutch elm disease.

Lignasan and Arbotect were tested in vitro against C. fagacearum and Cephalosporium spp. Each fungicide was mixed in potato dextrose agar (PDA) at 1.0, 5.0, 10.0, and 25 µg/ml a.i. Three dishes of PDA for each of the fungicide concentrations plus three dishes of PDA without fungicide were seeded with 4-mm-diameter discs of agar containing the target fungi. The fungi used were an isolate of Ceratocystis fagacearum from Texas live oak, the ATCC #24789 isolate of C. fagacearum, Cephalosporium sp. from Texas live oak, and Cephalosporium sp. isolated from American elm in Mississippi. The seeded dishes were incubated in the dark at 26° C for 2 wks. Growth (colony diameter) was compared between the controls and the different fungicide concentrations.

1/ Mention of trade names is solely to identify material used and does not imply endorsement by the U. S. Dep. Agric.

Live oaks with incipient and advanced wilt were treated with Lignasan at different seasons in 1977. In May, eleven trees with incipient wilt were injected with 30 ml of Lignasan per cm of tree d.b.h.$_2$(2.6 oz/in d.b.h.) in an equal volume of water at 4.6 kg/cm^2 (65 psi). Eleven untreated controls with incipient wilt were selected in May and compared with the treated trees in July 1978.

Six live oaks that developed wilt in spring 1977 were injected with Lignasan in July and four that developed incipient wilt in fall 1977 were injected with Lignasan in November. The Lignasan was applied at the same rate used in May, but it was not diluted with water. Six untreated control trees were chosen to compare with trees injected in July and four were chosen to compare with trees injected in November. Comparisons were made in July 1978.

Twelve live oaks that developed wilt in fall 1977 were treated in April 1978. The trees were completely defoliated in November 1977 and in April had only about one quarter the amount of foliage as surrounding trees. Four trees were injected with undiluted Lignasan at 65 ml/cm d.b.h. (5.6 oz/in d.b.h.); four were injected with 6.5 ml of Arbotect, in 4 parts water, per cm d.b.h. (0.56 oz/in d.b.h.); and 4 controls received no fungicide. The response of the trees to treatments was evaluated in July 1978.

Results

Both Lignasan and Arbotect killed *Ceratocystis fagacearum* in vitro at 1 µg/ml (Table 1). Both isolates of *Cephalosporium* were killed by Lignasan at 1 µg/ml but were not completely inhibited by Arbotect at the same concentration (Table 1). Arbotect was lethal to the two fungi at 5 µg/ml. A low concentration of the fungicides in live oaks should inhibit growth of *C. fagacearum* and the *Cephalosporium* spp. and prevent wilt development.

Most of the live oaks injected with Lignasan in 1977 had responded to treatment when evaluated in July 1978. No injected trees had died and little dieback occurred after treatment. Much dieback and some deaths occurred among control trees (Table 2) The trees treated in July had larger, greener leaves and thicker crowns than trees treated in other months.

Trees injected in April 1978 had been affected by wilt 6 or more months earlier and exhibited fresh symptoms at the time of treatment. Four injection sites per tree were used, but it was difficult to inject fungicides into the trees. A brown sticky substance was found in the sapwood of all of the injected trees and was apparently partly responsible for occluding vessels and making it difficult to inject the fungicides. There had been no improvement in the appearance of any of the trees treated with either fungicide when they were evaluated in July 1978 and on some, 50% or more of the crown had dieback (Table 2). No treated trees died, but 25% of the controls died. (Table 2).

Two uninjected trees within 3 m (10 ft) of two trees injected with Arbotect developed no wilt after the April treatment. All of the other trees within 3-30m of the two injected trees developed wilt, and the wilt was lethal to some. Arbotect may have moved from the injected to the adjacent non-injected trees through root grafts. Chemical movement through root grafts between injected and non-injected oak trees has been demonstrated (11).

Conclusions

The physical condition of trees and the climate at the time of fungicide application appear to be key factors for controlling live oak decline. If trees have advanced wilt, it is difficult to inject fungicides into them and the treatment appears to be ineffective. Trees respond best to the fungicide treatment in summer when the temperature is high. When trees with incipient wilt were treated, favorable responses were observed during other seasons. Ceratocystis fagacearum does best in moderate temperatures and cannot tolerate prolonged exposure to 32° C or higher. In Texas, the fungus can be readily isolated from wilting live oaks during spring and fall, but isolating it during summer is extremely difficult (9). Ceratocystis fagacearum probably is attenuated by high summer temperatures in central Texas and is easier to kill with fungicides during summer than during spring or fall.

Both fungicides appear to be suitable for therapeutic treatment of live oak decline but can probably be used more effectively as preventative treatments. Benomyl has been demonstrated to be effective in preventing oak wilt in trees inoculated with C. fagacearum after treatment (3,7). Additional research is being conducted to determine the best time and method of treatment and the minimum amount of fungicide required to control live oak decline most effectively in Texas.

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Table 1. Growth of *Ceratocystis fagacearum* and *Cephalosporium* spp. on potato dextrose agar with and without fungicide at 26 C

Fungus	Colony diameter after 2 wks.		
	Control	Arbotect (1 µg/ml)	Lignasan (1 µg/ml)
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Ceratocystis fagacearum Texas live oaks	[a]62	0	0
Ceratocystis fagacearum ATCC # 27890	81	0	0
Cephalosporium sp. Texas live oak	59	[b]59	0
Cephalosporium Mississippi American elm	41	[b]23	0

[a] Colony diameter is an average of the diameters of 3 dishes of the fungus.

[b] No growth occurred at 5 µg/ml.

Table 2. Responses of diseased live oaks in Kerrville, Texas, to various fungicide treatments during different seasons

Treatment	Date treated	No. trees treated	Mortality	50% or more crown dieback[a]	Improved appearance since treatment
			-Pct		
Lignasan 30 ml/cm (d.b.h.)	May 1977	11	0	9	64
Control		11	27	63	9
Lignasan 30 ml/cm (d.b.h.)	July 1977	6	0	0	83
Control		6	33	83	17
Lignasan 30 ml/cm (d.b.h.)	Nov. 1977	4	0	0	50
Control		4	0	50	50
Lignasan 65 ml/cm (d.b.h.)	April 1978	4	0	25	0
Arbotect 6.5 ml/cm (d.b.h.)		4	0	50	0
Control		4	25	75	0

[a] The figure includes those that are listed under percent mortality.