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SYSTEMIC CHEMICAL CONTROL OF SYCAMORE ANTHRACNOSE¹

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Abstract. The American sycamore, ultimately a very large tree, is extensively planted in urban areas throughout most of the United States. Anthracnose is an endemic fungus disease that frequently causes serious defoliation and disfigurement of the sycamore. The symptoms and cycle of this disease are discussed, and results are given for 4 years of field studies involving its control through the use of systemic fungicides.

Résumé. Le sycamore américain, en fait un arbre très gros, est planté largement en milieu urbain dans la majorité des états américains. L'antracnose est une maladie fongique endémique qui cause une défoliation et une déformation importantes du sycamore. Les symptômes et le cycle de la maladie sont discutés et les résultats sont donnés suite à quatre années d'étude sur le terrain, incluant son contrôle par l'utilisation de fongicides systémiques.

Sycamore anthracnose is a destructive fungus disease that occurs almost every year wherever the American sycamore (*Platanus occidentalis*) grows in the United States. In some years the disease symptoms are inconspicuous and little injury occurs. In 1 out of every 3 or 4 years, however, the disease is severe in the northern one-half of the United States, and trees may remain almost leafless throughout the spring and early summer. Disease symptoms in early spring can be confused with frost injury.

American sycamore has adapted to the disease and has developed a remarkable ability to recover by releafing in July and appearing normally foliated during the remainder of the growing season. With repeated defoliation and twig dieback for several years in succession, affected trees become weakened and develop distorted branching or "witches'-brooming."

The Nature of Sycamore Anthracnose

Four distinct stages of sycamore anthracnose can be observed, but all stages may not develop in a single year (1):

Twig Blight. Small 1-year-old twigs are killed before the leaves emerge in the spring. Repeated killing of twigs causes abnormal branching and gnarled growth. Cankers evident on the twig are located around one or more buds. On young sycamores in nursery plantings, trunk cankers can kill or seriously reduce the sale value of affected trees.

Bud Blight. Bud blight symptoms become evident when the buds expand in the spring. Buds are often girdled by cankers and killed before the bud caps break.

Shoot Blight. Shoot blight is more noticeable than bud blight and is represented by the sudden death of expanding shoots and immature leaves. This symptom is often confused with frost damage.

Leaf Blight. Early infection appears as small, almost inconspicuous spots on leaves that develop as elongated necrotic regions along the veins and midribs of the leaf blade. Over a period of several days, the necrotic areas enlarge and affected leaves may fall. Heavy defoliation can occur if leaf petioles become infected.

Disease Cycle

Little attempt has been made by commercial arborists or homeowners to control sycamore anthracnose primarily because of the high cost of

1. Presented by Dr. Neely at the Symposium on Systemic Chemical Treatments in Tree Culture at Michigan State University, East Lansing in October 1987.

spraying large sycamores and because of past failures attributed to ineffective fungicides and incorrect spraying schedules. In addition, the cycle of the disease is complicated and difficult to understand, and its severity fluctuates from year to year.

Sycamore anthracnose is caused by the fungus *Gnomonia platani* Kleb. The asexual stage, *Gloeosporium platani* Oud. (6), is found fruiting on infected twigs and leaves. The disease cycle begins with infection of the leaves in the spring from spores primarily produced in fungus-fruiting bodies on 1-year-old cankered twigs. Later, brown fruiting bodies of the fungus form along the veins and midribs in diseased leaf tissue. Fungus spores released from these fruiting bodies can infect leaves formed later during the spring and early summer. During the summer, the fungus grows through the veins, midrib, and petiole and into the twig to which the leaf is attached. The fungus overwinters in diseased twig tissue adjacent to the current season's buds.

When temperatures are suitable during late fall, winter, and early spring, the fungus grows rapidly in year-old twigs. A canker may form in the twig bark around the base of a bud and kill the bud before the leaves emerge (bud-blight stage). The twig-blight stage occurs on twigs that are girdled by fungus cankers before bud expansion in the spring. These twigs have no foliage beyond the point of the girdling canker. During some seasons, cankers develop more slowly at the base of buds and young shoots and unfolded leaves are killed a few days after emergence (1).

Fruiting bodies of the asexual stage of the fungus develop and produce spores in the cankered areas of twigs. The spores produced in the fruiting bodies are washed off by rain and infect newly formed leaves in the spring, thus completing the disease cycle.

The severity of the disease, especially the shoot-blight stage, is determined by the mean temperature during the 2-week period immediately following bud break and first leaf development in the spring. The disease is most severe in those years when the average mean daily temperature for this period is 50 to 55°F, the optimum for fungus growth and disease development. Shoot-

blight severity decreases from moderate to slight as the temperature increases from 55 to 60°F (5). The amount of spring rainfall has no effect on the severity of twig, bud, or shoot blight, although spring rains and relatively cool temperatures are usually associated with high incidence of the leaf-blight stage (5).

Control Studies

Sycamore anthracnose was one of the first urban tree diseases studied by staff of the Illinois Natural History Survey more than 50 years ago. The present authors initially started extensive field and laboratory research on the life cycle of the fungus, its physiology, and the testing of fungicide sprays in 1957.

Spray Control Studies, 1957 to 1976. We determined earlier that the most effective control of sycamore anthracnose was an application of mercury spray when the buds begin to swell in the spring (1). When a ban was placed on the use of mercury sprays, other fungicides were tested. Some control of shoot blight was obtained using benomyl (Benlate) at the rate of 2.4 pounds per 100 gallons of water, a concentration higher than is stipulated on the label. Leaf infection was prevented by spraying either Difolatan 4F at the rate of 2 pints per 100 gallons of water or Cyprex 65W at the rate of 1.0 pound per 100 gallons of water when the leaves were one-half to three-fourths developed (2, 3).

Systemic Control Studies. Trunk-injected systemic chemicals offer great potential for controlling several kinds of tree diseases, particularly vascular and leaf diseases. Studies by Wysong, Sing, and Willmeng in 1977-1979 indicate that Arbotect 20-S gave some control of sycamore anthracnose when trunk-injected in the fall (7). Studies by Himelick and Duncan using Arbotect 20-S in 1979-1981 gave excellent results in controlling the disease (4).

Early Field Studies, 1979 to 1982. American sycamores, 32 feet tall (10.0 m) and 10 to 12 inches (25-30 cm) in diameter at breast height, growing in the Illinois Natural History Survey arboretum near Urbana were gravity-injected in the fall of 1979 and 1980. Six trees were injected once (October 4, 1979) with 400 ml of Arbotect

20-S² in 8 L (1:20 dilution) of distilled water per tree; six trees were injected twice (October 4, 1979 and October 8, 1980) with 200 ml of Arbotech 20-S in 8 L (1:40 dilution) of distilled water per tree. Injections were made into four 3/16-inch holes equally spaced around the trunk, 6 inches (15 cm) above the ground. Complete uptake of the solutions required 5 to 8 hours. Twelve untreated trees served as controls.

Results of Early Field Studies. In the spring of 1980, a very low incidence of all stages of sycamore anthracnose was observed, and no data were recorded. The spring of 1981, however, was one of the most severe seasons for the disease in the past 30 years of our field records. The spring of 1982 was a moderately severe season. Efficacy data on the control of twig-, shoot-, and leaf-blight stages were taken on June 6, 1981 and June 15, 1982.

Arbotech 20-S injected at the 1:40 dilution rate for 2 consecutive years dramatically reduced both twig and shoot blight (Table 1). In addition, the percent of leaf infection was low compared to that of nontreated trees.

The 1:20 dilution rate, injected only once, gave effective control, but this rate caused bark injury around and above injection sites. Both concentrations of Arbotech 20-S gave significant control of the disease through the spring of 1982, three spring seasons after the initial injections.

Recent Field Studies, 1986 to 1987. To confirm our earlier results (4) and to support the data

with a greater number of replications, a second test was initiated (September 17, 1986) in a new sycamore block-planting in the Survey arboretum. The American sycamores were 25 feet (7.6 m) tall and 6 to 7 inches (15 to 18 cm) in diameter at breast height. In this study, Phyton 27³ and Arbotech 20-S were used at the rates recommended by the manufacturers. Phyton 27 was gravity-injected into 14 trees on September 23, 1986, at the rate of 7.5 ml of 21.4 percent active ingredient in 1,500 ml of distilled water per tree; Arbotech 20-S was gravity-injected into 14 trees on September 25, 1986, at the rate of 100 ml of concentrate (26.6 percent active ingredient) in 4 L of distilled water per tree. Gravity-injections were made into four 3/16-inch holes equally spaced around the trunk, 6 inches (15 cm) above the ground. Two liter enema bags were used, and complete uptake of the solutions required 6 to 10 hours. A randomized tree selection was made, and 14 randomly selected trees were used as untreated controls.

Results of Recent Field Studies. Disease ratings for percent twig blight were made independently by two observers on May 7, 1987; an additional rating for percent leaf infection was made on July 6, 1987. The twig-, bud-, and leaf-blight stages of sycamore anthracnose were moderately severe in the spring of 1987.

Arbotech 20-S injected at the 1:40 dilution rate during September gave good control the following spring, with 2.4 percent of the top twigs blighted

Table 1. Effectiveness of trunk-injecting Arbotech 20-S on October 4, 1979, and October 8, 1980. Data were recorded on June 6, 1981, and on June 15, 1982.

Number of trees	Dilution rate	Years injected	% Twigs blighted		% Shoots blighted		% Leaves infected	
			1981	1982	1981	1982	1981	1982
6	1:40	1979, 1980	0.8a ¹	3.4 a	1.6 a	0.8 a	6.2 a	2.0 a
6	1:20	1979	1.5 a	6.2 a	2.3 a	9.7 b	11.8 a	1.8 a
12	Controls	----	47.0 b	40.8 c	42.4 b	49.6 c	---- ²	40.0 b

¹Numbers in a column followed by the same letter are not significantly different, DMRT (P=0.01).

²No leaves were present on control trees when data were taken in 1981.

2 Arbotech 20-S (26.6 percent active ingredient) 2-(4 thiazoly)benzimidazole hypophosphite.

3 Phyton 27 (21.36 percent active ingredient) copper sulphate pentahydrate.

compared to 46.6 percent in the control trees (Table 2). On the lower portion of the crowns of treated trees, reasonably good control was obtained; 16 percent of the twigs were killed compared to 74 percent on the control trees. Outstanding control of leaf infection was obtained compared to 44.3 percent on the control trees (Table 3). The untreated control trees continued to have increased infected leaf tissue with some defoliation. The few infected leaves on treated trees remained attached and showed little or no increase in infected tissue. Only minor bark injury was observed above a few of the Arbotect 20-S injection sites. No other phytotoxic symptoms were observed on trees treated with Arbotect 20-S.

Powdery mildew infection was relatively high in 1987 on both American sycamore and London plane trees, *Platanus X acerifolia*. A reduction in the amount of powdery mildew was also obtained using Arbotect 20-S. Trees treated with Arbotect 20-S had 15 percent of the leaves infected with powdery mildew compared to 35 percent on control trees.

Twig blight and leaf blight on American sycamores treated with Phyton 27 were slightly less than on control trees (Tables 2 and 3). No significant reduction in powdery mildew infection was noted. Considerable injury occurred around and above two-thirds of the injection sites. Later in the summer, a callused ridge developed 1 to 3 feet (30 to 90 cm) above the injection sites where a streak ¼- to ½-inch (5 to 15 mm) wide of cambium cells were killed by the chemical dilution tested. We concluded that we had used a slightly higher concentration of chemical solution than should be used to avoid plant injury. The amount of disease control obtained did not appear to justify the expense of the chemical and the labor involved in using Phyton 27.

Discussion

Our results indicate that suitable control of sycamore anthracnose can be obtained with one injection of Arbotect 20-S in the fall before leaf abscission occurs. Based on the 1979-1982 test (2), a fall injection of Arbotect 20-S will give reasonably good control for up to three growing seasons. Since our data for the second field study in 1986 were for only one growing season, we

cannot support the results of the first study until we have collected at least two more years of field data.

The American sycamore should not be planted in residential areas; it is best grown in an undisturbed woods or forest environment. In an urban environment, homeowners become quite disturbed with this "dirty" tree following a few years of raking leaves, twigs, and bark from the lawn. The sycamore tree does, however, grow rapidly, even in unsuitable soil. It is easily transplanted, produces firewood and wood chips, and is an easy tree for animals and professional arborists to climb. As a result, the American sycamore will probably always be found growing as an ornamental shade tree in urban areas of the United States. The loss of its leaves in years when sycamore anthracnose is prevalent is, therefore, of concern to city dwellers.

The selection of disease-resistant species may be an answer to the problem, although such genetic selections may be an economic "gamble" for the nursery industry. Until resistant varieties are developed, the use of systemic chemicals appears to be the best method of control.

Table 2. Sycamore anthracnose. Percentage twig blight, 1987.

Treatment	May 7
Arbotect 20-S	2.4a ¹
Phyton 27	32.9 b
Untreated	46.6 c

¹Numbers in data column differ significantly, DMRT (P=0.05).

Table 3. Sycamore anthracnose. Percentage leaf blight, 1987.

Treatment	July 6
Arbotect 20-S	2.1 a ¹
Phyton 27	40.1 b
Untreated	44.3 b

¹Numbers in data column followed by the same letter do not differ significantly, DMRT (P=0.05).

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STATE GOVERNMENT INVOLVEMENT IN COMMUNITY FORESTRY: A SURVEY

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Abstract. State government involvement in community forestry varies from state to state. A survey sent to each state's Chief Forester provides information on community forestry assistance programs. Many programs are limited in scope, yet nearly all provide insect and disease control assistance, Arbor Day information and promotion, technical tree care assistance, and public information and education. Most programs are technical rather than financial in nature; however, sixteen states administer Federal Cooperative Forestry Assistance grants to communities, and five states provide financial assistance from state monies. Most programs are financed through combined state and federal funding, although eleven states rely on federal funding exclusively. Thirty-two state programs are administered by Urban Foresters or similar specialists. Budget and staffing limitations are cited by twenty states as major program obstacles. Despite limitations, expansion of services is predicted by twenty-seven states.

Résumé. L'implication des gouvernements des états américains en foresterie urbaine varie d'un état à l'autre. Une enquête réalisée auprès de tous les forestiers en chef de

chaque état présente des informations sur les programmes d'assistance en foresterie urbaine. Plusieurs programmes sont peu développés, pourtant presque tous les états donnent de l'assistance sur le contrôle des insectes et maladies, font de la promotion pour la journée de l'arbre, offrent de l'assistance technique en arboriculture, et dispensent de l'information et des programmes éducationnels auprès du public. La plupart des programmes consistent en de l'assistance technique plutôt que financière. Cependant, 16 états administrent un programme de subventions du service forestier fédéral à l'intention des municipalités et 5 états offrent une assistance financière basée sur des fonds de l'états. La plupart des programmes sont financés conjointement par le fédéral et l'état, bien que 11 états comptent seulement sur les argents de source fédérale. Trente-deux programmes des états américains sont administrés par des forestiers urbains ou d'autres spécialistes dans ce domaine. Des contraintes budgétaires et en personnel qualifié sont citées comme le principal obstacle. En dépit de ces contraintes, une augmentation des services offerts est prévue dans 27 états.