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CONTROL OF DIPLODIA AND DOTHISTROMA BLIGHTS OF PINES IN THE URBAN ENVIRONMENT

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Diplodia tip blight and Dothistroma needle blight are two of the most common diseases afflicting pines in urban areas in the central United States. Research conducted at the Rocky Mountain Forest and Range Experiment Station's Forestry Sciences Laboratory, at the University of Nebraska, Lincoln has led to the development of effective and economical methods for control of these two diseases.

Diplodia Tip Blight of Pines

The causal fungus, *Diplodia pinea* (Desm.) Kickx, infects new shoots early in the growing season; these shoots are usually killed back to the node. Older stem tissues also become infected with the result that branches are killed back to the main stem. Thus the fungus can destroy the esthetic value of pines in urban areas and also can reduce their screening, noise abatement and other protective values.

Diplodia pinea has been found in 32 states, 30 of them in the central and eastern United States (9). This fungus is most commonly found in plantings of exotic pine species, but it also occurs in plantings of native pines. Damage has been most severe on Austrian pine (*Pinus nigra*); which has been widely used in landscape plantings in the central and eastern United States, (*P. sylvestris*) and mugo pine (*P. mugo*). Ponderosa pine (*P. ponderosa*) and red pine (*P. resinosa*) are native species that have been severely damaged in plantings in the central United States.

Stunted new growth and brown needles are the most conspicuous symptoms of this disease. Needles on infected new shoots often become discolored (brown) while still encased in fascicle sheaths. Entire new shoots are killed rapidly by the fungus. Although damage is frequently first evident in the lower crown, infection can occur throughout the crown. Sometimes nearly all of the new shoots will be infected. Trees that have been infected repeatedly usually have some branches killed back to the main stem, with the result that growth is reduced, trees become deformed and unsightly and may ultimately die. New shoots do not have to be wounded to become infected; however, branches wounded by hail and other agents are vulnerable to infection.

Insects infesting tips of shoots (European pine shoot moth, pine tip moths) cause damage which might be confused with Diplodia blight; however, the tips infested with these insects are soft and crumbly due to tunneling, whereas Diplodia-infected tips are firm.

Diagnosis of this disease can be aided by looking for the small, black, fruiting bodies, in which spores of *D. pinea* develop. These fruiting bodies form on needles and on scales of second-year seed cones. They erupt through the epidermis and are usually numerous beneath the sheath at the base of needles. The fruiting bodies can easily be seen with a 10X hand lens. Short needles which have turned ashen gray and which are easy to detach are good specimens for fruiting body observation. Needles from shoots infected the previous year are likely to contain fruiting bodies. Fruiting bodies may be present on current-year needles late in the summer, but they will be more numerous on these needles the next spring.

Spores produced in the fruiting bodies are dispersed from March to October in eastern Nebraska; large numbers are dispersed during rainy periods (1). Typically, spores in the genus *Diplodia* are dark and one-septate (two-celled).

Confusion in identifying *D. pinea* frequently arises because most *D. pinea* spores are non-septate (one-celled).

Current-year shoots can become infected just as soon as buds begin to open. These shoots continue to be susceptible until about mid-June (1). Research during three growing seasons, however, revealed that new shoots are most susceptible during a period of about 2 weeks starting when buds begin to open (8).

New shoots on pines of all ages are susceptible to infection by *D. pinea.* Damage is more severe, however, in older plantings. We found few pines infected by *D. pinea* in eastern Nebraska windbreaks that were 20 years old, but incidence of the blight and damage increased as trees approached 30 years of age (5). The increased damage to older trees is probably related to the buildup of the fungus on seed cones. Seed cones of Austrian, Scots, and ponderosa pines are resistant to infection the first year; but they are highly susceptible during the second-year of their development (8). Fruiting bodies are numerous on infected seed cones, and these provide spores for infection of shoots. We commonly observe infected seed cones on otherwise healthy pines. Thus, it seems that inoculum on older pines builds up on seed cones before there is extensive infection of new shoots on these pines.

Seedlings in nursery beds are susceptible to infection. Damage to seedlings was observed only in nurseries where pine seedbeds were located near old, cone-bearing pines. Similarly infected new shoots have been observed on young pines (10- to 15-year-old) in plantings adjacent to older pines whose seed cones contained numerous fruiting bodies and spores of *D. pinea.*

The infection of new shoots can be significantly reduced by applying fungicide to trees during a 2-week period when shoots are highly susceptible to infection (Figure 1). This period is approximately from April 24 to May 8 in eastern Nebraska (Figure 2). The period begins with the opening of buds. Two applications of Bordeaux mixture (8-8-100) during this short period were more effective than one application (8, 9). Fungicide applied after mid-May was ineffective. Benomyl is also effective in reducing infection by *D. pinea* (14). Shoots can be examined in mid-June to determine effectiveness of fungicides. By then, symptoms are well developed and shoots killed during the current year can be distinguished from those killed in previous years.

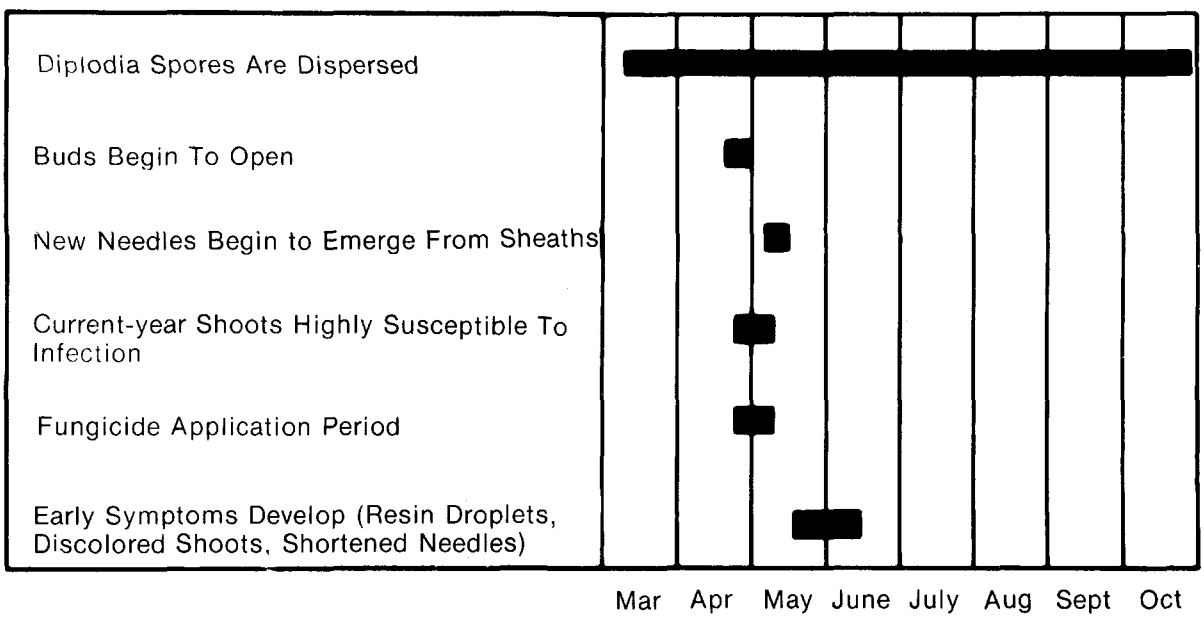

Figure 1. Facts for use in developing and evaluating a control program for Diplodia tip bight of pines.

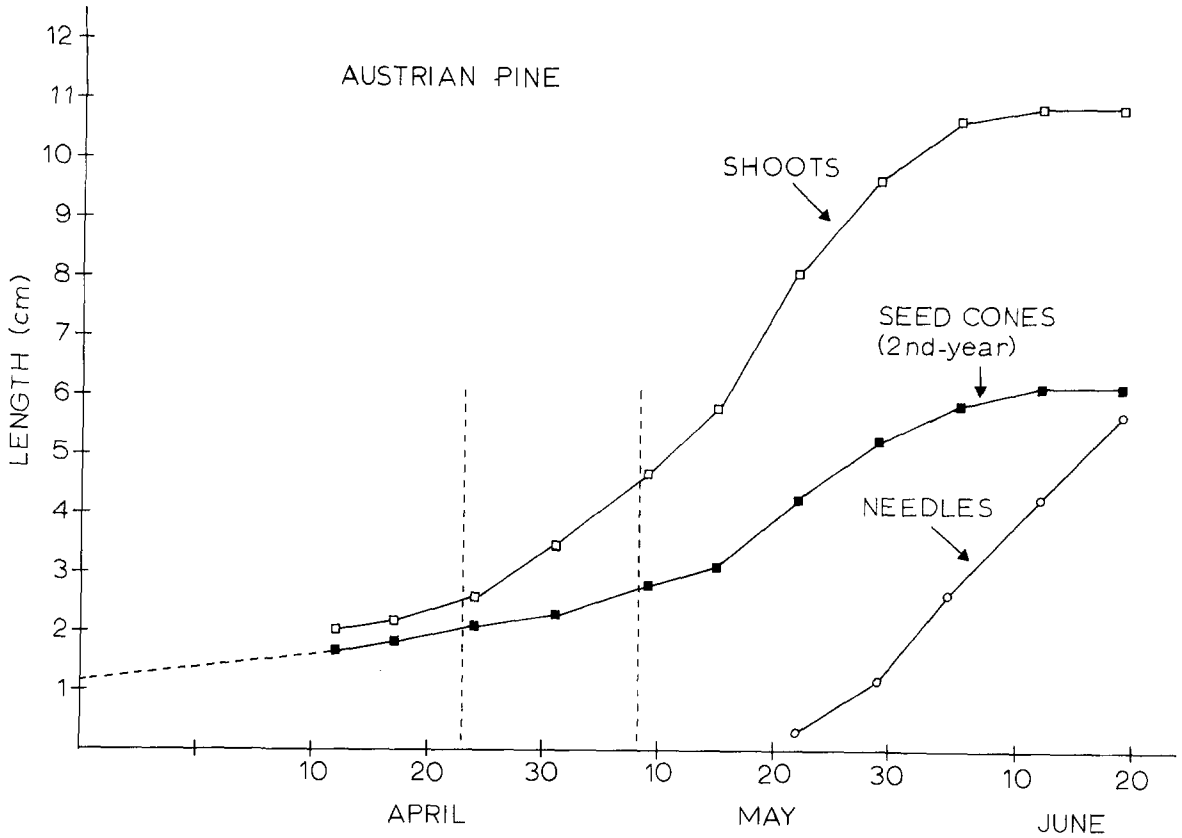

Figure 2. Chronology of development of shoots, needles, and seed cones of Austrian pine in relation to the period of high susceptibility (broken vertical lines) of new shoots to *Diplodia pinea* in eastern Nebraska. Needle measurements were made from the top of fascicle sheaths.

Fungicide applied during late April and early May to protect new shoots does not prevent infection of seed cones (8). Thus, it would not be practical to try to reduce inoculum on seed cones with protective fungicides, since at least one additional fungicide application would be required and perhaps more. Removal of second-year and older seed cones would reduce inoculum (spores) and probably reduce amount of infection, but again this would not be practical. Removal of infected branches can be justified on the basis of improving appearance, but this procedure will not likely reduce amount of infection significantly (5).

Dothistroma Blight of Pines

A needle blight caused by the fungus *Dothistroma pini* Hulbary is widespread and causes serious damage to Austrian and ponderosa pines in landscape, shelterbelt, Christmas tree, and other plantings in the central United States. The fungus has been found in 21 states on 20 pine species and hybrids (3, 10).

Symptoms develop in the fall of the year of infection in the central United States. Usually, infection is more intense in the lower crown of trees, but the entire crown can be infected even in 40-year-old trees. Early symptoms on needles consist of yellow and tan spots and deep green bands. The bands and spots may turn brown to reddish brown. The reddish bands are more distinctive and numerous on infected needles of pine in the western United States; thus in that area, this

disease is often referred to as the red band disease. Commonly, the tips of infected needles turn light green, then yellow, and necrotic, and the base of the needles remaining green. There may be extensive necrosis of needle tips 2 to 3 weeks after the first appearance of symptoms (6).

Infected needles are cast prematurely. Infected second-year needles are cast before infected first-year (current-year) needles. In some seasons, casting is not extensive until late the following spring or early summer. Infected first-year needles often are not shed until late summer following the year they were infected.

The fungus has both an asexual stage (*Dothistroma pini*) and a sexual stage (*Scirrhia pini* Funk & Parker). In the United States, both the asexual and sexual stages have been found in the West (California, Oregon) (11) but only the asexual stage has been found in the central United States. The asexual stage produces conidia (spores) in fruiting bodies which develop below the epidermis of needles. The fruiting bodies develop in the fall in the central United States, but most do not mature until the spring following the year of infection. Fruiting body development in the fall may be sufficient to cause splits in the needle epidermis, but spores have seldom been observed in these fruiting bodies in the fall in the central United States (13). The spores are dispersed by rainsplash throughout the growing season. Infection occurs from May to October, but symptoms do not develop until September or later in the central United States. Accordingly, observations to determine extent of infection are best made late in the year (November or December) or in the spring (April, May).

Copper fungicides effectively prevent infection by *D. pini*. (2, 4, 7). Bordeaux mixture (8-8-100) applied twice in the growing season provides essentially complete control in urban plantings (Figure 3). The first application (mid-May) protects previous seasons' needles, while the second protects current-year needles. When controlling this disease in Austrian and ponderosa pines, the second application can be made after new growth occurs, since current-year needles of these species initially are resistant to infection and do not become susceptible until mid-summer (July) (4-6).

Effective control has also been obtained in plantings in the central United States with a single application after considerable growth has oc-

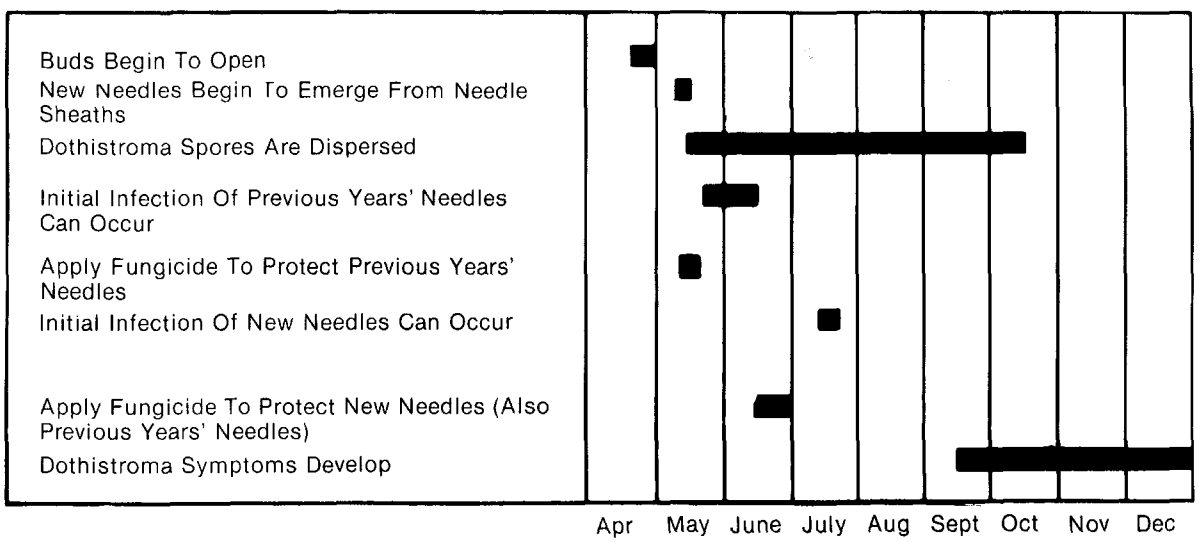

Figure 3. Facts for use in developing and evaluating a control program for Dothistroma needle blight of pines.

curred (early June). There is some risk in this procedure, since infection could occur prior to the early June application; however, in our tests, significant infection before early June occurred only once in five years.

Only one application of fungicide needs to be made under most circumstances (parks, landscape, residence). Also, since nearly complete control can be obtained, trees in urban plantings need not be sprayed every year. Assuming that fungicide applied one year is effective, there is a chance that infection will not occur the next year. If infection occurs, then copper fungicide applied the following year will again bring the disease under control.

The use of genetic resistance looks promising for preventing or reducing damage caused by this fungus. A geographic source of Austrian pine that has high resistance has been identified (12). Currently, we are evaluating 50 geographic sources of ponderosa pine for resistance. On some trees, needles of all ages are highly resistant. On other trees, current-year needles are resistant, but older needles are susceptible.

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ABSTRACT

Chapman, D.J. 1980. **Increased diversity needed in landscape tree selection.** Weeds Trees & Turf 19(1): 26, 27, 30.

A large number of trees are used because of familiarity, with little consideration of their maintenance requirements. In making planting decisions, one should understand the cultural requirements; diseases, insects, and air pollution resistance or susceptibility; and site requirements. With these concerns playing a co-equal role with aesthetics, there would be an increase in diversity of trees utilized in cities and home landscapes. Every tree has conditions which make it the outstanding selection. It should be paramount when making landscape plant choices to increase the diversity of trees grown. Each tree fills an important niche in our total overall landscape.