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Woody Ornamental Tips

DIPLODIA TIP BLIGHT OR DIEBACK OF PINES

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Diplodia tip blight is a common disease that kills the new elongating shoots of Austrian, mugo, Scotch and red pines in spring. Shoots characteristically curl and brown, and needles die while still in their fascicle sheaths. The disease deforms and stunts landscape plants. Successive years of infection may kill the lower branches of the trees. Unfortunately, valuable landscape pines over 30 years old become most disfigured by the disease. *Diplodia* tip blight also may kill pine seedlings in the nursery.

Diplodia tip blight causes the greatest damage to exotic or introduced two- and three-needle hard pines. Most conifers are susceptible to the disease and, although

some pines are resistant, none are immune. In rare instances, Douglas fir (*Pseudotsuga menziesii*), Norway spruce (*Picea abies*), true and false cedars, firs, arborvitae and larch can be mildly infected. In the landscape, however, the disease is most severe on Austrian pine (*Pinus nigra*), followed in order of decreasing susceptibility by Mugo or Swiss mountain (*P. mugo*), Scotch (*P. sylvestris*), red (*P. resinosa*) and jack pine (*P. banksiana*).

Diplodia pinea (*Sphaeropsis sapinea*), the infectious agent of *Diplodia* tip blight, usually causes severe damage to trees older than 30 years. Therefore, the disease is more of a concern to landscapers and homeowners than to Christmas tree growers.

Diplodia seldom damages Scotch pines in Christmas tree plantations, though the reason for this is uncertain. Apparently, the more 2-year-old seed cones that are infected in a tree, the more likely that shoot blight will occur and Christmas trees are seldom mature enough to form cones. However, a particular selected seed source ('Nyebrach') of Scotch pine at one plantation in Michigan has shown more infection than nearby trees of different seed sources. Furthermore, the infected 'Nyebrach' trees have formed an unusually early crop of seed cones. Also, Christmas trees planted near windbreaks of infected pines often show a minor amount of infection. Severe injury to shoots and branches of Scotch pine has occurred



FIGURE 1. Common symptoms of trees infected by *Diplodia pinea* are curled, dead shoots that resemble a shepherd's crook.

in Michigan plantations when *Diplodia* is associated with pine spittlebug feeding.

It is often noted that pine trees weakened by environmental stresses are more commonly infected with tip blight than unstressed trees. Trees in the urban landscape are more readily damaged by *Diplodia* when weakened by environmental factors such as poor sites with compacted soils, sites subject to drought, flooding and lawnmower injury, or restricted or disturbed root zones.

Symptoms

The most pronounced symptom of *Diplodia* is the bent or curled infected shoot, which resembles a shepherd's crook (Fig. 1). The curling of the

shoot occurs when the new, developing shoot (candle) is infected early in spring. Symptoms become apparent in summer. Shoots not killed by infection are often permanently deformed, and branches that have been so affected for several successive years are bent and kinked. When a candle is killed, the host will often sprout buds from the healthy tissue at the base of the dead shoot.

Browning, dead lower branches in older pines are characteristic of infection by *Diplodia* because rain washes infectious spores from the infected seed cones down to the lower branches of the tree. Infection is, however, sometimes limited to one small area or one side of the tree. Also, an entire tree's branches may show brown tips if a spring is sufficiently

wet to favor epidemics. Small black specks (fruiting bodies of the fungus) will form on the umbos (scales) of cones, around the bases of browning needles under the sheath, and on shoots of the pine (Fig. 2 A, B, C). An infected stem will often have cankers at the youngest branch node.

Although *Diplodia* tip blight tends to disfigure rather than kill trees rapidly, consistent, repeated infections will kill trees through the combination of no new candle growth and the regular senescence of old needles. Twigs that have been killed will have dark brown bark and gray or blue-black sapwood. Recurring attacks may also result in reduced growth, lack of vigor and distortion of the tree. Also symptomatic of *Diplodia* infection is the way extraneous resin will surround twigs and needles and, in turn, result in clumps of resin-coated needles. Resinous cankers on stems and branches may occur on severely infected trees (Fig. 3). The cankers exuding resin are generally the result of *Diplodia* infections of tissues freshly wounded by pine spittlebugs.

Diplodia tip blight may occasionally be confused with symptoms of low temperature injury, drought and drying from winter conditions. Damage by these environmental factors can mimic the

characteristic brown, curled shoot tips of the shoot blight. The black fruiting bodies of *Diplodia* will be absent, however.

Tip death caused by the Nantucket pine shoot moth (*Rhyacionia frustrana*) and European pine shoot borer (see Extension bulletins E-530 and E-535) is frequently confused with *Diplodia* tip blight. The necrotic tissue will lack the black pycnidia (fruiting bodies) on infected twig bark, needles and cone tips. To differentiate *Diplodia* from the pine shoot moth and pine shoot borer as the causal agent of tip blight, break the brown candles. Brown candles are woody and resist breaking if infected by *Diplodia pinea*. If the candles are weak and brittle, breaking easily when bent, they were probably killed by the insects. Larvae burrow through candles and eat the pith, thus hollowing and weakening the shoots. The hollow shoot will usually contain insect frass (Fig. 4).

Another fungal blight caused by *Sirococcus* may cause symptoms similar to those of *Diplodia*, but this disease is currently limited to the forests and nurseries of Michigan's western Upper Peninsula.

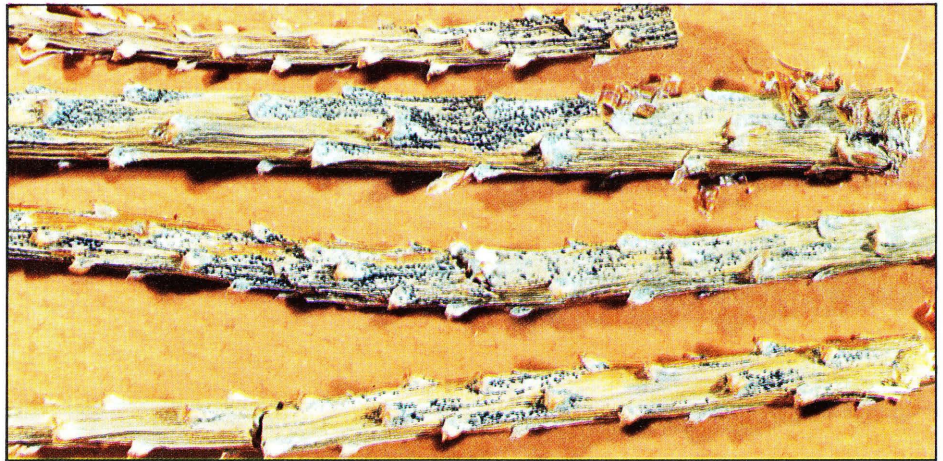
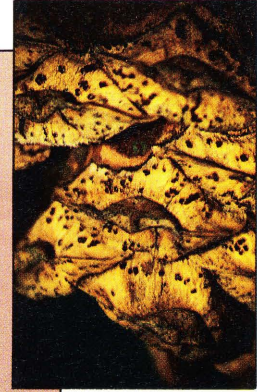
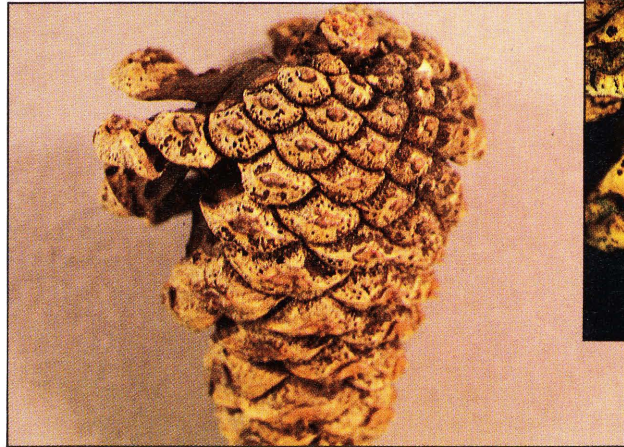


FIGURE 2. The principal clue in diagnosing *Diplodia* tip and shoot blight is the presence of small, black fruiting bodies of the fungus on dead tissues. The fruiting bodies are common on A) the umbos (scales) of cones, B) the shoots, and C) the bases of killed current year's needles beneath the sheath.



FIGURE 3. Resin-coated branches are the clue that cankers have formed on stems following infection of *Diplodia* through fresh wounds such as those made by the pine spittlebug.

Disease Cycle

Diplodia pinea overwinters as fruiting bodies in the bark, seed cones, needles, bud scales and litter of an infected host. The black fruiting bodies form at the bases of the needles beneath the fascicle sheaths. They develop in late fall or early summer and are especially noticeable during the following spring. When the fruiting bodies become wet, minute gelatinous masses of spores ooze out. The spores are disseminated by wind and rain in wet spring weather, or by insects such as the pine spittlebug (*Aphrophora parallela*).

The time from bud swell to

partial elongation of the shoots, prior to the needle's emergence from the fascicle sheath, is when current shoots are most susceptible to infection. Budbreak and shoot and needle elongation usually occur at the same time as the height of spore production. Germinating spores generally penetrate through stomates (air exchange openings) of the needles, though wounds such as those caused by hail also provide sites for infection. *Diplodia pinea* spreads from needle tissue to the stem and then to adjacent needles and pollen cones, resulting several weeks later in symptoms of dieback. Immune to infection are previous years' needles,

woody stems and first-year seed cones.

Generally, infection takes place in late April. The first sign of infection is droplets of resin that appear on shoots in early May. Near the resin are usually some very short, dead needles still in the fascicle sheaths. About three weeks after infection, the shoot yellows and dies, halting the expansion of the remaining needles.

Second-year seed cones are highly susceptible and are vulnerable to infection during the period when cones rapidly expand in late May. Many fruiting bodies of the fungus form on the umbos (scales) of infected second-year cones (Fig. 2A), making cones a reservoir of spores for potential infection of new shoots. The buildup of infected cones provides a heavy shower of spores cascading onto the lower branches of the tree during rainfall. This could account for the severe infection seen in older pines.

Recently, it has been determined that two types of *Diplodia* occur on pines. One type can infect non-wounded elongating shoots and needles, while the other type requires wounds such as those made by hail or spittlebug feeding to infect. It is common to find seed cones infected with *Diplodia* on

trees that otherwise have no disease symptoms. Perhaps the lack of shoot infection is due to seed cone infection by the less virulent type of *Diplodia*. Alternatively, cones may have greater susceptibility or a longer period of susceptibility than shoots and needles.

Infection of Seedlings in the Nursery

Pine seedlings in the nursery usually become infected with *Diplodia* only when beds are located near older, cone-bearing pines such as those in windbreaks. Unfortunately, many growers wish to maintain old trees as sources of cones and foliage for Christmas wreaths.

Two distinct symptoms are associated with infection of seedlings—shoot blight and collar rot. The symptoms of shoot blight vary, depending on the age of the seedling. Shoot blight of 1-year-old seedlings becomes evident in August in the form of dead terminal buds and upper needles. In contrast, shoot blight of 2-0 and 3-0 seedlings becomes evident in early June as curled, stunted and dead shoots. Usually the blighted shoots are resin-soaked and are not fully elongated. The seedlings may respond to the death of the terminal shoot by producing

adventitious buds below the blight, or seedlings may die. The black fruiting bodies of the fungus are abundant on the dead buds, shoots and needles.

Collar rot caused by *Diplodia* becomes evident in July, generally after the terminal buds have set. Symptoms include the death of 1- to 3-year-old seedlings with fully elongated shoots. Shoots first appear yellow, then dry and become shriveled, and needles die before they are fully elongated. When bark is removed from the seedling near the soil line, the wood appears resin-soaked and may be streaked with black staining. The fruiting bodies of the fungus are visible near the crown or collar of the seedling with the rot.

Methods of Control

The best measure for preventing *Diplodia* tip blight is to avoid planting introduced or exotic conifers that are extremely susceptible to *Diplodia* in windbreaks and the landscape. Use native pines in plantings, such as eastern white pine, or less susceptible pines, such as red pine and Norway pine. Keep landscape pines well maintained by watering, especially during the short droughts of midsummer. Pines that are

stressed are generally more prone to infection. A common stress in urban soils is soil compaction. Therefore, improving soil structure and aeration may benefit plant vigor. Controlling insect pests may also help promote tree vigor and ward off the infectious *Diplodia pinea*.

Pruning and burning diseased tips and limbs is no longer recommended because research has shown this practice cannot significantly reduce the incidence and/or severity of the disease. Prune infected pines in dry weather—open wounds are very vulnerable to infection by *Diplodia* when weather is wet enough to stimulate spore release, germination and penetration. If infection is present, disinfect pruning tools between cuts by dipping the blade in 70 percent denatured or rubbing alcohol or in a fresh household bleach solution (one part bleach and nine parts water).

Chemical control is an effective means of controlling *Diplodia*. Chemical applications must be precisely timed for just before budbreak (budswell), and shoots should be chemically covered until the current-year growth is finished. Usually an application in mid-April and another in early May will provide effective control. Mid-May is too late to begin applications.

When spraying, take care to cover lower branches well because infections often attack this part of the host. See Table 1 for timing of fungicide treatments. Fungicides registered for use in controlling tip blight (*Diplodia* or *Sphaeropsis*) are listed under "pine" in Extension bulletin E-2023. The chemical used will determine rate and frequency of application.

The timing of fungicide applications for controlling *Diplodia* crown rot, top die-back and shoot blight in seedlings in nursery beds differs from the information in Table 1. To protect 1-0 seedlings, apply one to four applications of fungicides (registered fungicides are listed in Extension bulletin E-2023) beginning in early July and continuing into August. To protect 2-0 and 3-0 seedlings, apply fungicides from late April to late May. Do not ship or receive infected seedlings. Old cone-bearing pines located near the nursery bed should be removed.

Pesticide Storage and Disposal

Reduce the need for and the hazards of pesticide storage and disposal by buying only what you will use during a growing season and mixing only what you need for each application. In addition, try to apply leftovers, rinsate, etc., to the appropriate crop rather than storing or disposing of them. Long-term storage may degrade the effectiveness and/or increase the toxicity of pesticides.

If storage is necessary, choose a suitable environment that is dry, cool and out of direct sunlight. Avoid extreme heat

or cold. Place in a location that is not accessible to children, pets and wildlife and that is not near food, feed or water. Keep pesticides under lock and key when not in use. Store pesticides in their original containers. Store herbicides separately from insecticides and fungicides to prevent possible interactions. Check labels for specific storage recommendations.

Always triple rinse pesticide containers immediately after emptying. Then crush or puncture rinsed containers to prevent misuse. Dispose of rinsed containers in a licensed sanitary landfill or recycle through a scrap metal dealer. Consult the phone directory for scrap metal dealers and contact your county Cooperative Extension Service office for the locations of the landfills nearest you.

TABLE 1. TIMING OF FUNGICIDE TREATMENTS

<i>DIPLODIA</i> SPORES PRESENT	March to October							
BUDS BEGIN TO OPEN	April							
NEEDLES EMERGE FROM SHOOTS	April		May					
TIME TO APPLY FUNGICIDES	April		May					
EARLIEST DISEASE SYMPTOMS			May					
	March	April	May	June	July	Aug	Sept	Oct

*Table is adapted from G. W. Peterson, Am. Nurseryman 147(1):13 66, 70, 72.



A



B

FIGURE 4. A) A browning pine shoot with short needles can be the symptom of *Diplodia* tip blight or of wounding by the pine shoot borer. B) Breaking the tip reveals the pest. The shoot borer causes the tip to be brittle, hollow and filled with frass. *Diplodia* leaves the tip solid.



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