3. Diplodia Shoot Blight, Canker, and Collar Rot

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Hosts

Diplodia pinea and *D. scrobiculata* (previously known as the single species *Sphaeropsis sapinea*) cause serious diseases of many conifers. Although many conifers, including species of spruce, fir, and larch, can be hosts, severe damage is most common on hard (two- and three-needled) pines, including Austrian, jack, Monterey, mugo, ponderosa, red, and Scots pines.

Distribution

These pathogens are widely distributed in the continental United States, although *D. pinea* appears to be more common and more frequently associated with severe damage.

Damage

Seedlings of all ages may be rendered unmerchantable due to shoot blight, canker, and collar rot leading to deformity or death. In addition, these pathogens may persist on or in asymptomatic seedlings, be transported with seedlings to field sites, and proliferate to cause seedling mortality after planting. Seed rot and damping-off of young seedlings have also been attributed to *Diplodia* pathogens.

Diagnosis

Infection during the first growing season can result in rapid seedling mortality with retention of dead needles (fig. 3.1). On older seedlings, diseased needles often turn yellow, then from red to brown or gray, with stem curling or crooking resulting from shoot death before full needle elongation (fig. 3.2). Cankers on seedling stems begin as discrete, purplish, resinous lesions that result from direct infection or pathogen growth into stems from diseased needles. Collar rot symptoms include relatively rapid needle desiccation and seedling death, with blackening of the lower stem and root collar inner bark, and dark staining of the underlying wood (fig. 3.3).

Asexual fruiting bodies of these *Diplodia* pathogens are black flask-shaped pycnidia that can be seen with the naked eye or a hand lens. They are produced in dead needles and stems and also are abundant on open female cones (fig. 3.4).

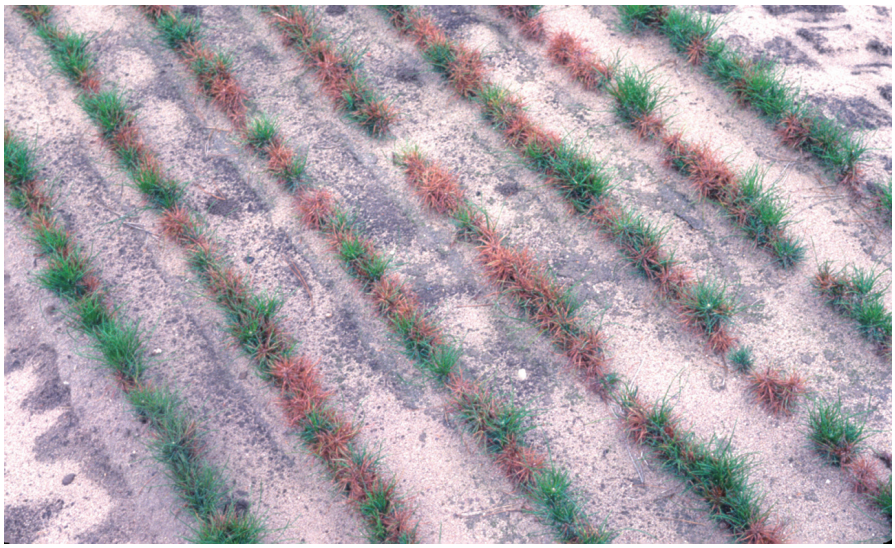

Figure 3.1—*Dead red pine seedlings killed by* Diplodia pinea *in the first season of growth.* Photo by Glen R. Stanosz, University of Wisconsin-Madison.

Figure 3.2—*Distorted red pine shoot killed by* Diplodia pinea *during elongation.* Photo by Glen R. Stanosz, University of Wisconsin-Madison.

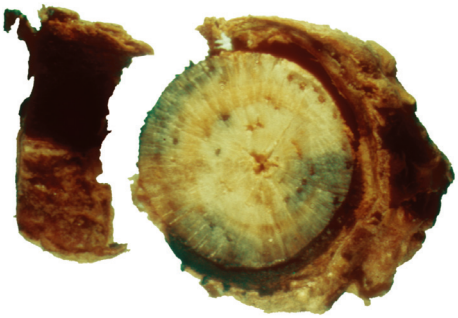

Figure 3.3—*Darkly discolored inner bark tissues and stained wood of seedling killed by Diplodia collar rot.* Photo by Glen R. Stanosz, University of Wisconsin-Madison.

They may be solitary or in groups and are often mostly submerged in the host tissue with only short necks erupting through the epidermis and cuticle. Pycnidia are sometimes numerous on dead needle bases (fig. 3.5) below the fascicle sheath. Because numerous fungi produce similar fruiting bodies, spore examination will aid in diagnosis. Conidia produced in the pycnidia are thick-walled, oval, may have one, two, or occasionally more cells, and vary from approximately 30 to 45 by 10 to 15 microns in size (fig. 3.6). These spores are colorless or slightly yellow to light brown when young, becoming very dark brown and opaque with age.

Cultures of *D. pinea* and *D. scrobiculata* can be obtained by placing surface-disinfested, symptomatic needle or stem pieces on malt extract agar or potato dextrose agar amended with lactic acid or streptomycin sulfate to inhibit bacterial growth. A semiselective medium incorporating 0.5 percent w/v (weight:volume) tannic acid in 2 percent water agar facilitates detection of *D. pinea* from asymptomatic seedlings. These fungi will colonize and then produce pycnidia on sterile pine needles placed on the medium surface. Daylight or artificial light will stimulate pycnidia production during incubation at 20 ºC to 24 ºC (68 ºF to 75 ºF). Because host ranges and geographic distribution overlap and colony morphology is variable, molecular methods have been developed to differentiate *D. pinea* from *D. scrobiculata*. These methods can be used to identify pathogen isolates or detect their presence on or in host samples without the need to obtain cultures.

Figure 3.4—*Pycnidia of* Diplodia pinea *on scales of an Austrian pine cone.* Photo by Glen R. Stanosz, University of Wisconsin-Madison.

Figure 3.5—*Pycnidia of* Diplodia pinea *emerging from the base of a red pine needle.* Photo by Glen R. Stanosz, University of Wisconsin-Madison.

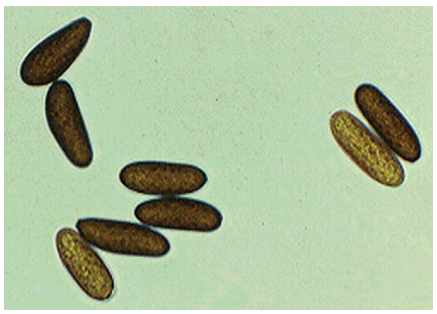

Figure 3.6—*Conidia of* Diplodia pinea. Photo by Glen R. Stanosz, University of Wisconsin-Madison.

Biology

D. pinea and *D. scrobiculata* survive in and sporulate on dead needles, stems, cones on diseased trees, and debris on the ground. Viable spores can be disseminated by rain splash year round, but are most abundant during spring and early summer when young shoots are most susceptible. Germination occurs rapidly during moist weather, with infection through stomata, directly through the surface of young stems, or through fresh wounds. Pycnidia with conidia can develop within a few weeks after infection, so multiple disease cycles within a single growing season are possible.

Control

Biological

Inherent host resistance is maintained by avoiding both water stress and excessive nitrogen fertilization, which increase susceptibility to disease. Grow nonhost species or less susceptible conifers such as five-needled pines in areas of nurseries where inoculum is present.

Cultural

Eliminate inoculum sources, including host trees in windbreaks and adjacent forests, in the nursery vicinity to minimize disease. Host materials, such as bark, needles, and cones, should not be used as soil amendments or mulches. Practices such as early morning irrigation and decreasing bed densities may promote shoot drying, which reduces infection frequency. Do not move infested seed, diseased seedlings, and seedlings on which the pathogens persist asymptomatically into or out of the nursery.

Chemical

Protectant fungicides can reduce the disease incidence in nursery beds. Repeated applications are required during shoot elongation, however. Note that if inoculum sources are present, fungicide application has not been shown to reduce or eliminate asymptomatic persistence of these pathogens on nursery seedlings that appear to be healthy.

Selected References

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