37. Phytophthora Root Rot

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Hosts

Phytophthora root rot occurs on a broad range of conifers and hardwoods. Tree species most often affected by *Phytophthora* in forest nurseries include black walnut, Fraser fir, Douglas-fir, and red pine. Other *Phytophthora* hosts in forest nurseries include species of true fir, hemlock, larch, pine, spruce, white-cedar, yew, oaks, birch, and American chestnut. Species identified as highly tolerant of *Phytophthora* include western redcedar, western larch, lodgepole pine, ponderosa pine, and Chinese chestnut.

Distribution

Phytophthora root rot is predominately a problem in bareroot forest nurseries throughout the United States. The disease develops in nurseries where susceptible seedlings are grown in saturated soils. Damage by *Phytophthora* in bareroot forest nurseries occurs most often in low wet areas or poorly drained areas (fig. 37.1). Damage in container nurseries occurs when container soil becomes contaminated either by storing containers and potting soil on infested ground or by irrigation from infested water sources. Some common *Phytophthora* species that cause root rot and stem damage include *P. cinnamomi*, *P. citricola*, *P. cactorum,* and *P. drechsleri.* In the Pacific Northwest conifer seedlings are also affected by *P. sansomeana*, *P. megasperma*, *P. pseudotsugae*, *P. cryptogea*, and *P. gonapodyides*.

Damage

Phytophthora root rot can extend to the root collars and stems of susceptible conifer and hardwood seedlings, affecting seedling quality and mortality. Seedlings lifted with an incipient *Phytophthora* infection on the root systems can result in seedling losses in storage, transport, and outplanting. Whole nursery fields of highly susceptible hosts have been destroyed due to infestation by *Phytophthora*.

Figure 37.1—*Phytophthora root rot develops on seedlings in low wet and poorly drained areas.* Photo by Everett M. Hansen, Oregon State University.

Diagnosis

General aboveground symptoms of Phytophthora root rot on seedlings include chlorosis, stunting, wilting, and eventual mortality (fig. 37.2). The disease usually occurs in patches as infection spreads from seedling to seedling. The cambium tissue of infected conifers turns a reddish-brown or butterscotch color at the root collar and in the primary and lateral roots (fig. 37.3). Fine feeder roots infected by *Phytophthora* are often black, decayed, or missing.

Black walnut is the hardwood species most susceptible to Phytophthora root rot. Black walnut infected tissue becomes black, soft, and water-soaked at the root collar, extending into the stem and primary root (fig. 37.4). Oak and chestnut seedlings have similar damage patterns, but the infected tissue is brown or tan.

Positive identification of *Phytophthora* infection requires using the services of a pathologist or commercially available test kits. Diagnostic kits for *Phytophthora* provide a quick identification in the field.

Figure 37.2—*Symptoms of Phytophthora root rot in a black walnut bed.* Photo by Michelle M. Cram, USDA Forest Service.

Figure 37.3—*Red-brown or butterscotch colored cambium tissue of a Douglas-fir seedling infected by* Phytophthora. Photo by Everett M. Hansen, Oregon State University.

Figure 37.4—*Blackened and water-soaked tissue of black walnut infected by* Phytophthora. Photo by Michelle M. Cram, USDA Forest Service.

Accuracy of these tests is high, but false negatives and positives for *Phytophthora* can occur. To increase test accuracy, take multiple samples and use the diseased tissue along the leading infection edge to avoid secondary organisms that invade dead tissue. Pathologists can provide a very accurate *Phytophthora* species identification with the use of selective culture media; however, laboratory isolation techniques require more time.

Biology

Phytophthora species produce motile spores (zoospores) in sporangia (fig. 37.5) that can swim up to several hours in saturated soil or flowing water before infecting roots or root collars. These motile spores can be produced under wet conditions within 24 hours. Seedlings growing in flooded or saturated soil are further predisposed to infection from damage created by oxygen deficiency. *Phytophthora* species can survive dry conditions and temperature extremes by forming resting structures (chlamydospores and oospores) in damaged plants or soil. These resting structures will remain dormant until activated by high soil moisture.

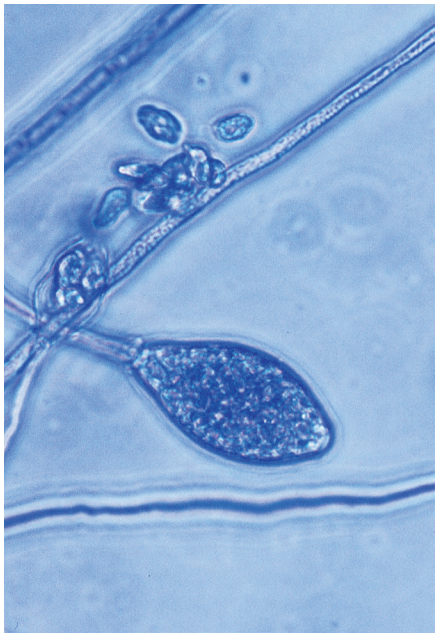

Figure 37.5—*Sporangium and zoospores of* Phytophthora. Photo by Michelle M. Cram, USDA Forest Service.

Control

Prevention

Select nursery fields with well-drained soils. Maintain good drainage by avoiding compaction and promptly fixing leaking irrigation pipes and sprinkler heads. Avoid transplanting seedlings from infested to disease-free nurseries or fields. Do not use diseased trees as mulch and avoid moving equipment from infested to uninfested areas. Use *Phytophthora*-free water sources, such as well water, if possible. Irrigation water from sources that include surface runoff may have *Phytophthora* contamination and require chlorination before use.

Cultural

Reduce potential for saturated soil by improving soil surface and subsurface drainage. Drainage can be improved by building raised nursery beds or installing underground drain tile systems and drainage ditches. Correct compacted soils by deep ripping or chiseling. After seedbeds are sown, wrenching can help reduce compaction. Prevent overwatering by monitoring soil moisture and irrigation output.

Patches or small areas of seedlings with Phytophthora root rot should be lifted separately from the noninfested areas and destroyed. Any equipment used in infested areas must be cleaned of soil

and plant debris before being used again. When possible, avoid moving equipment through areas affected by *Phytophthora,* or work in infested areas last and clean the equipment before moving to another field. Losses to Phytophthora root rot during storage and outplanting can be reduced by not lifting seedlings in infested zones and culling seedlings that appear diseased.

In container operations, avoid *Phytophthora* contamination by irrigating with uninfested water and keeping containers and soil off the ground. Use a potting mix that is highly porous and avoid soil compaction in the containers.

Chemical

Fumigation significantly reduces *Phytophthora* populations in the soil, although it is less effective in poorly drained soils where *Phytophthora* is most likely to be a problem. Systemic fungicide use may also be required to control Phytophthora root rot development, especially with susceptible seedlings in nurseries affected by this pathogen in the past. Fungicides are more effective if applied prior to infection and can be used to reduce disease progression in an infested field. They seldom eradicate an established infection, and may make diagnosis more difficult by temporarily limiting symptom expression on already infected seedlings. Rotate between different chemical families to avoid development of resistant strains of *Phytophthora* to systemic fungicides.

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