32. Cylindrocladium Diseases

Edward L. Barnard and Jennifer Juzwik

Hosts

Nearly 50 species of the closely related fungal genera *Cylindrocladium* and *Cylindrocladiella* induce diseases of various kinds on more than 130 genera of plants and trees worldwide. *Cylindrocladium* species including *C. scoparium*, *C. floridanum,* and *C. parasiticum* cause diseases on a wide variety of forest tree seedlings. Notable hosts in the North Central and Northeastern United States and Eastern Canada are red and eastern white pine and black, red, and white spruce. Highly susceptible hosts in the South include black walnut, yellow-poplar, sweetgum, eucalyptus, and eastern white pine. Other species that have been affected by *Cylindrocladium* species include cherrybark oak, northern red oak, flowering dogwood, and redbud seedlings.

Distribution

Cylindrocladium diseases of forest tree seedlings occur primarily in the North Central, Northeastern, and Southern United States. These diseases also occur in Ontario and Quebec, Canada. In addition, a species of *Cylindrocladium* has been isolated from soil samples in Washington State.

Damage

Cylindrocladium diseases, especially root infections, can cause significant seedling mortality (up to 80 percent) in forest nursery seedbeds and transplant beds (figs. 32.1 and 32.2). Sublethal infections may induce foliar chlorosis, stunting, or top dieback, resulting in costly culling of infected seedlings. Outplanting of nursery stock with undetected *Cylindrocladium* infections may also result in significant mortality within several years of plantation establishment.

Diagnosis

Depending on specific host, pathogen, and environmental combinations, *Cylindrocladium* species can cause pre- and post-emergence damping-off, foliage blight, stem lesions, and root rots. In northern conifers, lesions often accompanied with exuded resin masses may be visible on infected roots before any foliar symptoms are apparent. When the epidermis is removed from affected roots, reddish-brown cortical tissue can be seen. Advanced stage root rot on conifers results in lateral and primary root necrosis, often accompanied by blackening and slipping of the root cortical tissues (fig. 32.3). Root rot on hardwoods typically exhibits pronounced blackening, often with distinct longitudinal fissuring (fig. 32.4). Stem lesions on infected eucalyptus seedlings are frequently centered on leaf petioles, suggesting that infections beginning as leaf spots often progress to stems through the petioles. Foliage blights on black spruce and other conifers are characterized by foliar chlorosis, reddening and browning, necrosis, defoliation, and eventual seedling mortality in severe cases. Abundant asexual spores (conidia) may be produced on infected plant parts when conditions are suitable. Such fungal blooms often appear as a white, powdery, or granular covering or sheet.

Cylindrocladium species can be isolated directly from diseased tissue, indirectly from plant baits (for example, alfalfa seedlings and azalea leaves)

Figure 32.1—*Cylindrocladium root rot affected black spruce in a northern bareroot nursery field.* Photo by Jennifer Juzwik, USDA Forest Service.

Figure 32.2—*Bed of black walnut infected by* Cylindrocladium *species.* Photo by Charles E. Cordell, USDA Forest Service.

Figure 32.3—*Root infection of black spruce seedling by* Cylindrocladium floridanum. Photo by Jennifer Juzwik, USDA Forest Service.

growing in or exposed to infested soil, or indirectly from soil when microsclerotia (groups of dark-colored, thick-walled cells) are captured on fine-mesh sieves. Once a *Cylindrocladium* has been isolated, the identity of the species present can be determined by microscopic observation of features of the asexual state. Distinguishing features are the shape of the terminal vesicle (swelling) of the conidiophores (spore-producing structures) and the size of the conidia (asexual spores). *C. parasiticum* and *C. floridanum* are characterized by spherical-shaped vesicles compared with the ellipsoidal to pear-shaped vesicles of *C. scoparium*. The straight conidia of *C. parasiticum* are larger (62 by 6 microns) than those of the straight conidia of *C. floridanum* (40.0 by 3.5 microns) and the straight to slightly curved conidia of *C. scoparium* (37 by 6 microns).

Figure 32.4—*Symptomatic roots of yellow-poplar seedlings infected with* Cylindrocladium *species.* Photo by Charles E. Cordell, USDA Forest Service.

Biology

Cylindrocladium species survive and overwinter as microsclerotia in infected plant tissues and infested soils. The microsclerotia may persist in northern nursery soils for more than 15 years. Microsclerotia germinate and initiate new infections when stimulated by host root contact or exudates under suitable soil conditions. During periods of excessive moisture (humidity, rainfall, or overhead irrigation) and suitable temperatures, foliage and stem infections may develop from airborne asexual or sexual spores (conidia or ascospores, respectively). Perithecia (up to 1 mm) are reddish, enclosed structures of the sexual state that are not particularly abundant. They have been observed with *C. parasiticum* infections and on containerized longleaf pines infected with *C. floridanum* (sexual state *Calonectria kyotensis*) in Florida (fig. 32.5). *Cylindrocladium* species are apparently tolerant of a wide pH range, a reality that reduces the effectiveness of certain cultural control measures.

Figure 32.5—*Perithecia of* Calonectria kyotensis, *the sexual state of* Cylindrocladium floridanum, *on containerized longleaf pines.* Photo by Edward L. Barnard, Florida Division of Forestry.

Control

Cultural

Delineate and avoid infested nursery sites as much as possible. Restrict infected stock movement (for example, transplanting of susceptible stock within the nursery). Avoid spread of infectious propagules through movement of contaminated soil, equipment, or seedlings. Reduce disease spread by pressure washing tires and tillage implements between uses in Cylindrocladium disease-prone and other nursery fields. Favor nonhost cover crops such as corn and grasses (for example, sorghum-sudangrass) as opposed to known hosts such as soybeans, clover, and alfalfa in areas where *Cylindrocladium* has been problematic. Reduce the amount of organic substrate for *Cylindrocladium* population buildup by reducing sowing density and limiting cover crop development prior to soil incorporation. Maintain proper seedling spacing to promote aeration and growth while discouraging foliage and root infection. Rogue and cull badly damaged seedlings.

Chemical

Deep soil fumigation may be required for highly susceptible deep-rooted hardwoods including black walnut, yellow-poplar, and sweetgum. In northern nurseries, "preplant" soil fumigation is effective in dramatically reducing soil fungus populations and preventing the disease in subsequent crops. Judicious fungicide use may be helpful to prevent infections on certain conifer, hardwood, and eucalyptus species. Dipping transplant seedling roots in a fungicide solution is an effective control, but concerns regarding worker exposure to the chemical are significant.

Selected References

Barnard, E.L. 1984. Occurrence, impact, and fungicidal control of girdling stem cankers caused by *Cylindrocladium scoparium* on eucalyptus seedlings in a south Florida nursery. Plant Disease. 68: 471–473.

Cordell, C.E.; Barnard, E.L.; Filer, Jr., T.H. 1989. Cylindrocladium diseases. In: Cordell, C.E.; Anderson, R.A.; Hoffard, W.H.; Landis, T.D.; Smith, Jr., R.S.; Toko, H.V., tech. coords. Forest nursery pests. Agriculture Handbook 680. Washington, DC: USDA Forest Service: 114–117.

Crous, P.W. 2002. Taxonomy and pathology of *Cylindrocladium* (*Calonectria*) and allied genera. St. Paul, MN: The American Phytopathological Society (APS Press). 294 p.

Juzwik, J.; Honhart, C.; Chong, N. 1988. Cylindrocladium root rot in Ontario bareroot nurseries: estimate of losses in spruce seedlings. Canadian Journal of Forest Research. 18: 1493–1496.

Saunders, J.E.; Juzwik, J.; Hutchison, R. 1992. Outplanting survival of Cylindrocladium root rot affected black spruce seedlings. Canadian Journal of Forest Research. 22: 1204–1207.

Sinclair, W.A.; Lyon, H.H. 2005. Root rots and blights caused by *Cylindrocladium* and *Cylindrocladiella*. In: Diseases of trees and shrubs, 2nd ed. Ithaca, NY: Cornell University Press: 220–221.