# 38. Pythium Root Rot

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## Hosts

Pythium root rot, caused by various *Pythium* species, affects a wide range of hosts, including most conifer and hardwood seedlings. The most common species identified as causing damage are *P. aphanidermatum*, *P. irregulare*, *P. mamillatum*, *P. splendens*, *P. sylvaticum*, and *P. ultimum*.

## Distribution

*Pythium* species are present in agricultural and nursery soils throughout the United States and Canada.

## Damage

Aboveground symptoms include leaf or needle chlorosis, stunting, and seedling death. In some cases, new growth may wilt and form a shepherd's crook before ultimately dying (fig. 38.1). Belowground, roots are stunted with few lateral and feeder roots (fig. 38.2). Damage is often limited to fine roots, although in severe cases necrosis may extend into older root tissues.

## Diagnosis

Look for patches of dead or dying seedlings in nursery beds, particularly in low-lying areas where water accumulates (fig. 38.3). Seedlings may pull easily from the ground as the root system deteriorates. The remaining roots are brown or black and often lack healthy, white root tips. Frequently, the cortical tissue is easily slipped off the root, which leaves a white cylinder of xylem (fig. 38.4).

Diagnosis is confirmed through isolation of the pathogen into culture. Alternatively, ELISA (Enzyme-linked immunosorbent assay) test kits, which use specific antibodies to detect *Pythium* species, are available and provide quick results in the field. *Pythium* species, grow readily from freshly killed root tips. Cultures are white and fast-growing with relatively large, coenocytic hyphae. Identification is based on microscopic features or DNA (Deoxyribonucleic acid) analysis. However, fast-growing *Pythium* cultures can mask the presence of slower-growing pathogens such as *Fusarium* or *Phytophthora* species, which also cause root rot. Therefore, the appropriate selection of isolation media is often required for proper diagnosis.

**Figure 38.1—***Shepherd's crook on seedling killed by* Pythium *species.* Photo by Jerry E. Weiland, USDA Agricultural Research Service.

**Figure 38.2—***Five-week-old seedlings: Three healthy seedlings on left with a long, central root and lateral roots beginning to form. Three seedlings on right infected with* Pythium ultimum *and showing stunted root and shoot formation.* Photo by Jerry E. Weiland, USDA Agricultural Research Service.

Samples should be collected as soon as possible after symptoms are noticed. Entire plants, including the root system, should be dug, gently shaken to remove excess soil, and then kept cool and moist until the diagnosis can be performed. A collection of seedlings with a range of symptoms is ideal for analysis. Avoid collecting seedlings, however, which have been dead for an extensive period of time because secondary, saprophytic fungi quickly colonize freshly killed plant tissue and can make pathogen isolation difficult.

## Biology

*Pythium* species survive in the soil and crop debris primarily as thick-walled oospores. Root and seed exudates stimulate the oospores to germinate. Hyphae then grow through the soil and directly infect host roots. Fine roots, or roots damaged during planting or weeding, are particularly susceptible. Sporangia are formed where excess moisture is present. Sporangia produce motile spores (zoospores) that swim to the host plant, then attach, encyst, germinate, and infect the root or seed. Excess moisture also allows exudates to travel further in the soil and may stimulate spore production. *Pythium* species are spread through the movement of infested soil or infected plant material and by water splash, runoff, and contaminated irrigation water.

## Control

### Cultural

Avoid poorly drained soils and low-lying areas that collect water. Do not overwater and install drainage as necessary. Water from recycling ponds should be filtered or treated before reapplication. Avoid excessive fertilization and overcrowding. These conditions promote succulent growth that is susceptible to infection.

Rotation to bare fallow during the summer months can significantly reduce *Pythium* populations. Start with clean stock and avoid replanting newly fumigated fields with heavily infested stock material. In container production systems, start with pathogen-free media or pasteurized soil and use clean, disinfested pots.

**Figure 38.3—***Pythium root rot in low-lying area next to leaky irrigation line.* Photo by Jerry E. Weiland, USDA Agricultural Research Service.

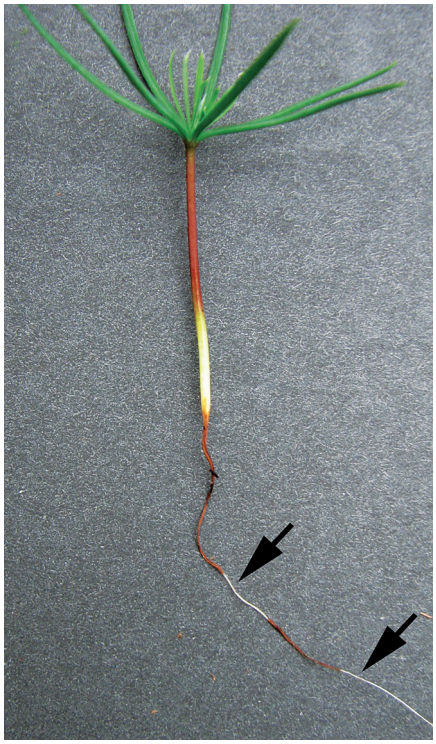

**Figure 38.4—***Root cortex of a diseased seedling easily slips and reveals a white cylinder of xylem underneath (arrows).* Photo by Jerry E. Weiland, USDA Agricultural Research Service.

## Chemical

Management with fungicides requires an accurate diagnosis. *Pythium* species are oomycetes and many fungicides are ineffective against these particular pathogens; therefore, make sure to select fungicides that target oomycetes. Rotate fungicide use according to mode of action to prevent resistant *Pythium* strains from developing. Application is achieved through soil drenches or by incorporating granular or wettable powder formulations directly into the soil. Fungicides are best used as a preventative. After seedlings have become infected, fungicides rarely function effectively as a curative treatment.

Fumigation continues to be the most viable method for large-scale disinfestation of field soils. When applied properly, low permeability plastic films (totally impermeable film, TIF) cause fumigants to be retained in the soil for longer periods of time. This may enable nursery managers to reduce fumigant rates while maintaining the same level of disease control observed under conventional rates of application.

## Selected References

Hansen, E.M.; Myrold, D.D.; Hamm, P.B. 1990. Effects of soil fumigation and cover crops on potential pathogens, microbial activity, nitrogen availability, and seedling quality in conifer nurseries. Phytopathology. 80: 698–704.

Jones, R.K.; Benson, D.M. 2003. Diseases of woody ornamentals and trees in nurseries. St. Paul, MN: APS Press. 482 p.

Martin, F.N. 2003. Development of alternative strategies for management of soilborne pathogens currently controlled by methyl bromide. Annual Review of Phytopathology. 41: 325–350.

Martin, F.N.; Loper, J.E. 1999. Soilborne plant diseases caused by *Pythium* spp.: ecology, epidemiology, and prospects for biological control. Critical Reviews in Plant Science. 18: 111–181.

Sinclair, W.A.; Lyon, H.H. 2005. Diseases of trees and shrubs. 2nd ed. Ithaca, NY: Cornell University Press. 660 p.