United States
Department of
Agriculture

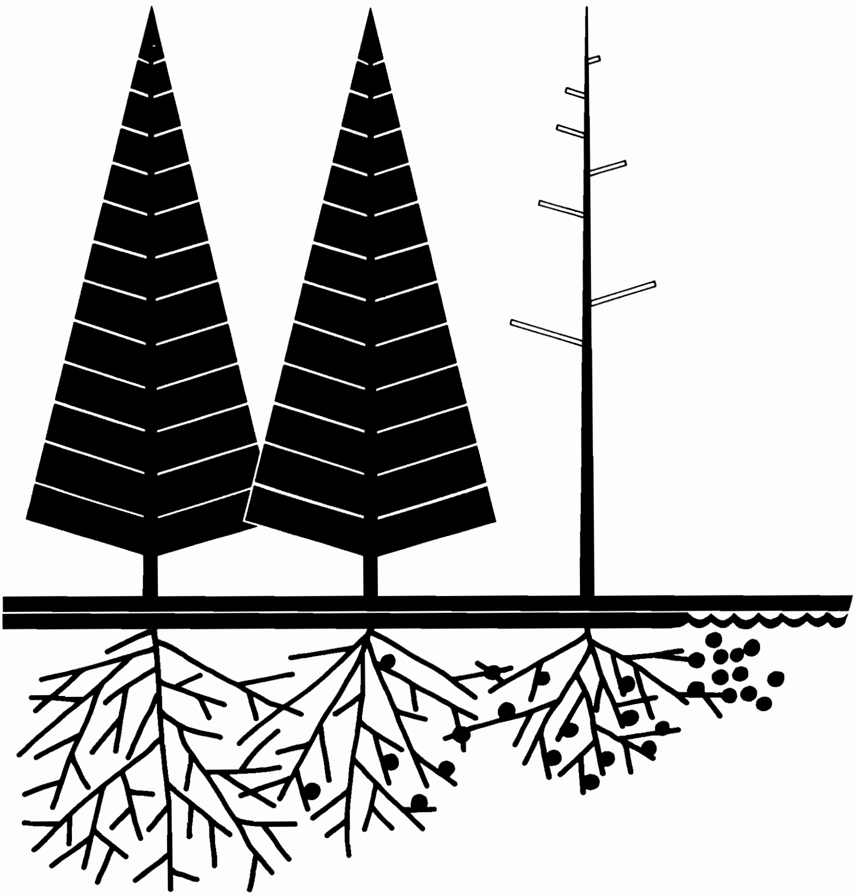
Forest Service

**Pacific
Northwest
Region**

R6 FPM PR 010 91

June 1987

Port-Orford-Cedar Root Disease



Port-Orford-Cedar Root Disease

By

Lewis F. Roth
Professor Emeritus
Oregon State University
Corvallis, Oregon
Consultant in Forest Pathology

Robert D. Harvey, Jr.
Plant Pathologist
USDA-Forest Service
Pacific Northwest Region
Portland, Oregon

John T. Kliejunas
Plant Pathologist
USDA-Forest Service
Pacific Southwest Region
San Francisco, California

Preface

This USDA-Forest Service publication was prepared to help forest land managers plan and implement the most effective and timely actions for managing Port-Orford-cedar both in areas free of the disease and in areas at risk of infection.

Additional copies of this publication can be obtained from Forest Pest Management, USDA-Forest Service, Pacific Northwest Region, P.O. Box 3623, Portland, OR 97208.

Introduction

The most serious disease of Port-Orford-cedar (*Chamaecyparis lawsoniana* (A. Murr.) Parl.) is a root disease caused by the fungus *Phytophthora lateralis*. Nursery stock, ornamentals, and timber trees are subject to attack. Other species of *Chamaecyparis* are less susceptible than Port-Orford-cedar, and trees of other genera are not affected.

History and Distribution

Origin of the root disease is unknown, but the complete susceptibility of Port-Orford-cedar suggests that the fungus evolved outside the native cedar range, perhaps in Asia. Asiatic species of *Chamaecyparis* are somewhat resistant, suggesting a long association between those hosts and the pathogen; however, *P. lateralis* has not been found in Asia.

The disease was first reported on ornamentals near Seattle, Washington, in 1923. It was not until 1942, in the Willamette Valley of Oregon, however, that the fungal cause was discovered and named. Losses became so severe among ornamentals in northwest Oregon and western Washington that, within a decade, production of the valuable horticultural varieties was mostly abandoned (fig. 1).

In 1952, the disease was found in southwestern Oregon where young cedar abounds on wild and cutover lands and where many cedars were planted as ornamentals. By 1954, mortality was conspicuous in the area's towns and along major roads. Aerial photographs taken in 1956 showed a

Figure 1 – Dead and dying ornamental Port-Orford-cedars in residential setting.

network of dying trees along watercourses, around lakes and sloughs, and along rural roads, livestock trails, and farmsteads. Spread of the disease into the mountains has been slower but progressive.

In mild, moist regions, other *Phytophthora* species, especially *P. cinnamomi,* cause symptoms in Port-Orford-cedar similar to those of *P. lateralis.* Potentially, the diseases could overlap in moist areas in the southern portion of the cedar range.

Disease Spread

Rootlets infected with *P. lateralis* first appear to be watersoaked; then they darken. Fine roots quickly disintegrate. As the fungus advances, the inner bark and cambium of larger roots discolor to a deep cinnamon brown, contrasting strongly with the rich cream color of healthy inner bark (fig. 2). Spread of the disease up the trunk is limited to a distance of about twice the stem diameter as the crown dies and tissues dry.

Foliage of infected trees appears slightly lighter in color than that of healthy trees and, on warm spring days, wilts slightly. Later, the foliage withers, turns bronze, and finally, light brown. Discoloration occurs

Figure 2 – Inner bark infected and discolored by *P. lateralis*.

simultaneously throughout the crown (fig. 3). The final browning is concurrent with drying and darkening of the inner bark. Infected trees are often attacked by bark beetles, which speed death and may modify foliage discoloration by altering the rate of drying. Recently killed trees are predisposed to windthrow.

Figure 3 – Young stand of Port-Orford-cedar showing progressive symptoms of wilting, slight discoloration, and browning.

The fungus grows more slowly in the laboratory than most *Phytophthora* species and forms a tangle of mycelium. Minute, lemon-shaped sporangia develop at the mycelial tips, and thick-walled, spherical, resting spores (chlamydospores) develop along the sides of the mycelium. The swimming spores (zoospores) burst forth from the sporangia in saturated soil and move with the surface water. New infections of root tips occur as spore-bearing water percolates into the soil. Resting spores spread the fungus as they are moved about with soil (fig. 4).

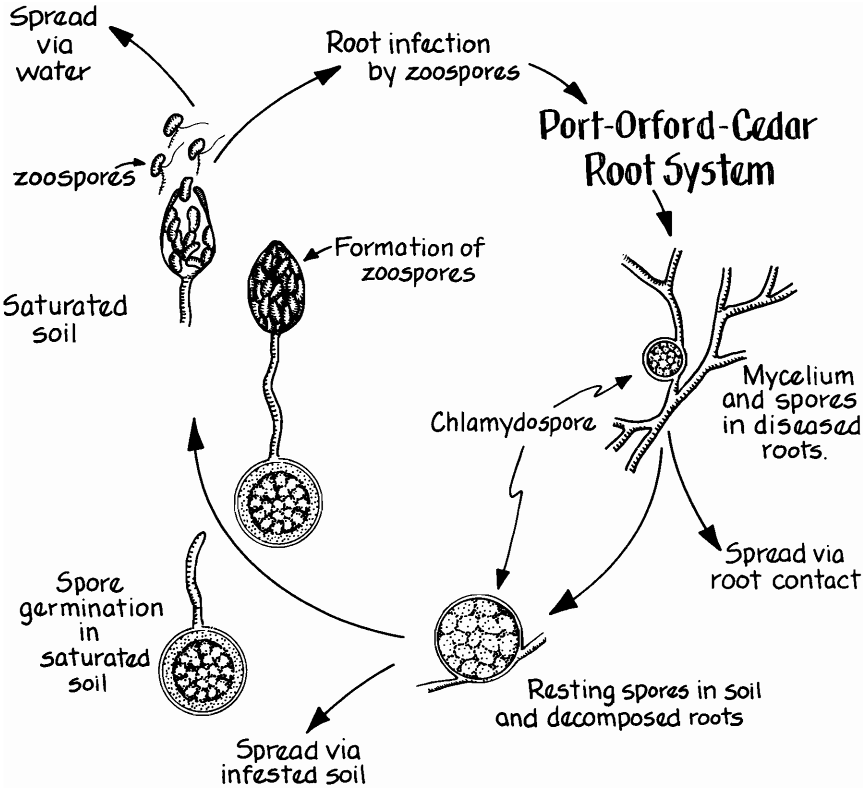


Figure 4 – Simplified *P. lateralis* life cycle.

Major spread of disease is through earth movement in construction, road maintenance and use, and logging operations (fig. 5). Surface water is also important in moving the fungus. Movement of the fungus in soil clinging to the feet of cattle has had a significant impact in the coastal

Figure 5 – Muddy tractor wheel and track assembly that may transport *P. lateralis* from an infested site.

ranching region. The fungus may also be moved on the feet of game animals, particularly elk. Spread by movement of infected transplants was especially important in the original dispersal of the fungus and is still significant. The fungus can slowly spread uphill within and between overlapping root systems.

The disease will continue to spread at rates determined by human and animal activity and site and weather conditions. Spread will be slower in warmer, drier forests. Cedar regenerates profusely from surviving trees. This continuing supply of susceptible new seedlings on high-risk sites is likely to sustain a chronic disease source, threatening trees on more favorable sites.

Damage

The nursery industry of valuable horticultural Port-Orford-cedar varieties has nearly disappeared because of losses to the fungus. Residential owners have had to replace costly trees and suffer esthetic losses while property values have depreciated.

Commercial forestry's greatest loss has resulted from death of young-growth trees at the lower size limits of merchantability. Old-growth trees die within 2 to 4 years after infection, seedlings within a few weeks. Since the value of large cedar logs is very high, loss of a single tree can be economically significant. Most large, dead trees are salvable, but not without reduction of grade and value.

Much old-growth Port-Orford-cedar has been logged in staggered settings with the prominent Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco.). Soil movement in logging and roadbuilding, however, has introduced the fungus into mountainous forest stands (fig. 6). Some reserve blocks of timber had to be harvested earlier than planned to avoid loss of the cedar component to root disease. Special planning and practices are needed to perpetuate Port-Orford-cedar as a commercial resource.

Disease Management

Port-Orford-cedar is not an endangered species despite the widespread root disease. Production of the valuable cedar is encouraged for low risk sites, where it can be grown in mixture with other species without a lower than average return from the land.

Genetically resistant stock is not available. Although occasional trees are found that, by their survival or delayed death, suggest some genetic resistance, these features have not provided effective control in either the field or experiments in the laboratory. Asiatic *Chamaecyparis* and Alaska-cedar (*C. nootkatensis* (D.Don) Spach) are more resistant than Port-Orford-cedar. Neither upgrading of resistance in the slow-dying Port-Orford-cedars nor hybridization with the resistant species has been undertaken.

Figure 6 – Dying Port-Orford-cedars along a mountainous forest road used for logging and public access.

Phytophthora diseases of many agricultural crops can be suppressed by fungicides that are specific against Phytophthora without actually eliminating the fungus. By masking the presence of the fungus on nursery stock, however, these fungicides may increase the risk of introducing the disease into planting sites.

Economic and environmental constraints limit use of fungicides in the forest. Therefore, for the foreseeable future, control of Port-Orford-cedar root disease must depend on prevention of infection. Because spores of the fungus normally are not airborne, infection can be avoided: first, by growing the cedar on elevated, disease-free ground; second, by minimizing and isolating sources of infection; and third, by preventing the movement of soil from infested to uninfested areas. Cedar trees growing on road edges and moist sites are vulnerable or infected, and killing them may be the best way to prevent cedar regrowth and perpetuation of the fungus on these sites.

Phytophthora lateralis depends on free water for spread and infection (fig. 7), and on humans for long-distance spread. These facts must be the foundation of a Port-Orford-cedar root disease management program.

Figure 7 – Young, infected Port-Orford-cedar on the edge of a stream.

Restricting movement and activities of vectors, principally humans, is a control method that can be either active or passive. Active restrictions include closing roads to travel, requiring dry-season harvesting, and cleaning of all vehicles before they leave infested areas or enter clean areas. Passive restrictions include locating Port-Orford-cedar production areas in sites where people and their vehicles are not likely to be present. People are not restricted from these areas, nor are there attractions to draw them there.

The only way to eliminate the disease from an infested area is to remove the host for several years. The length of time is not known but is suspected to be a minimum of 3 years, but more likely 5 years.

Forest land managers wanting to grow Port-Orford-cedar must have a long-term commitment. Important considerations for this commitment can be grouped into two overlapping categories; management based on exclusion and management based on eradication. Depending on the land manager's individual situation, the following should be considered:

Management based on exclusion

- Maintain awareness of the threat of root disease and the continuous need for sanitary operations to minimize unintentional introductions of the disease.
- Identify and map production sites that can be protected and are suitable for new generations of cedar. Such a site is one unlikely to receive surface drainage from roads, from a diseased site, or from a site with a reasonable possibility of becoming diseased in the future. These sites should be away from trails used by cattle and elk and should be protected from nonessential human activity.
- Assess risks to Port-Orford-cedar from proposed management activities and determine mitigating measures to be used, before starting activity.
- Establish lateral and upper boundaries of protection units so that surface water does not flow onto the unit from outside. These may be located either just over a ridge crest or just above a lateral drainage. Lower boundaries, and those along lateral drainages, should be located above flood stage of the waterway (fig. 8).

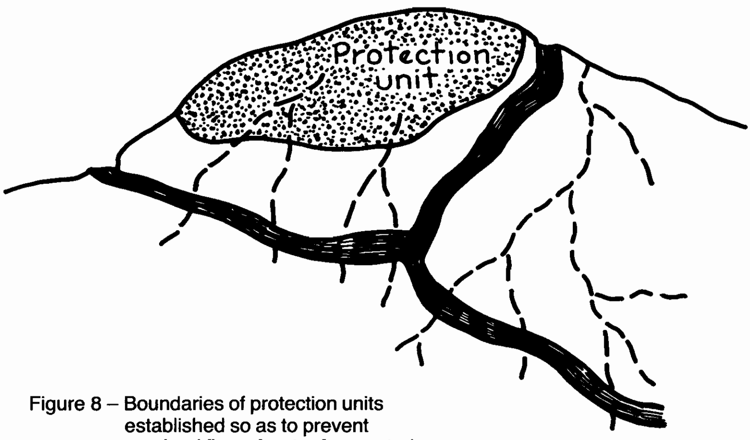


Figure 8 – Boundaries of protection units established so as to prevent overland flow of water from entering.

- Engineer roads and landings serving protection units so that they drain away from the unit. Build the landing and adjacent road with clean equipment.
- Work during dry weather.
- Dump debris from ditch cleaning and road maintenance away from protected sites.
- Separate operations in disease-free locations in both space and time from salvage or other work in diseased stands. Separation applies to construction, logging, and maintenance.

- Carry out operations on protection units with thoroughly cleaned equipment. Always complete work in disease-free locations before starting work in diseased areas, if the latter is necessary. Never move contaminated equipment into a clean area.
- Strive for ideal spacing of the best trees during precommercial thinning of young stands. Eliminate all Port-Orford-cedars in potholes, along streams, or adjacent to infected areas while thinning.
- Retain a mix of cedar along with other appropriate species. Mixed species will do better than a single species on some sites.
- Use clean equipment and, if possible, cable systems or helicopters during intermediate timber harvesting; however, delay cutting as long as economics allow.
- Minimize use of ground-based logging equipment on sites designated for cedar production. Where possible, use helicopters to remove cedar adjacent to waterways. Use cable logging systems elsewhere.
- Plant production sites with stock known to be free of *Phytophthora lateralis*. Seedlings grown in containers are less likely to be contaminated than those grown in bare root beds.
- Leave Port-Orford-cedar seed sources in and around sites that can be protected to provide for natural regeneration. Planting of Port-Orford-cedar may be needed only on sites where all seed sources have been removed because it is such a prolific and reliable seed producer.
- Do not plant Port-Orford-cedar in low spots and swales, within 50 feet of streams, or in locations subject to overland waterflow.
- Maintain a mix of species with up to 25 percent Port-Orford-cedar.
- Block or limit use of all nonessential roads where work has been completed.

Management based on eradication

- Locate, map, and monitor all known sources of infection, including contaminated streams and water-accumulating sites.
- Salvage or prelog valuable concentrations of diseased or recognizably threatened Port-Orford-cedars at the earliest opportunity. Ensure that remaining cedar is widely scattered to limit spread of disease.
- *Phytophthora lateralis* cannot survive indefinitely outside living host material; research suggests 3 to 5 years.

Although some forest land management considerations also apply, residential land managers should consider the following:

- Ownership patterns, property lines, and rights-of-way sometimes make protection impossible.
- Soil near or uphill from established Port-Orford-cedars should not be disturbed, especially by transplanting.

Suggested Reading

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