



Sudden Oak Death

Phytophthora ramorum Werres, de Cock & Man in't Veld (Peronosporales: Pythiaceae)

Introduction:

Sudden Oak Death (SOD) is caused by a fungal-like organism identified in 2001 as *Phytophthora ramorum*. Reported in Europe on nursery stock in 1993, it was first detected in the U.S. in 1995 on tanoak in Marin County, California. The fungus killed over 100,000 oak trees there over the next decade, earning it the misleading name of SOD. However, diseases caused by *P. ramorum* have since been observed in dozens of forest and ornamental plant species. In North America, *P. ramorum* was initially damaging to trees in forested regions, but it is increasingly being found infecting nursery plants. APHIS currently regulates over 100 species of plants in an effort to restrict the spread of SOD into non-infested areas.

U.S. Distribution/Spread:

P. ramorum has been confirmed in nurseries, landscape plantings and/or forests in CA, OR, WA and British Columbia, Canada. In 2004, infected nursery stock was shipped across the nation and SOD was subsequently detected and destroyed in another 21 U.S. states coast to coast, including Maryland. In spite of interstate shipping regulations on nursery stock to prevent the movement of this pathogen, SOD continues to be detected on new hosts and in nurseries outside of quarantined areas.

SOD is dispersed from infected plant tissue, and from spores spread naturally by wind and contaminated water or soil. SOD spreads even further from human activities, primarily the sale and transportation of infected nursery plants, and in spore-infested soil on boot soles, vehicle wheels, gardening equipment, etc.

Host Plants:

As of 2007, the USDA APHIS lists 40 plant species as proven hosts, and another 64 species as associated plants. SOD is found on ornamental plants such as rhododendrons, viburnums, pieris, and camellias; on tree species such as oaks, beech and chestnuts; on understory plants such as bay laurel; and on conifers such as coastal redwood, Douglas-fir, and grand fir. Tanoak is the most susceptible of the known hosts, and all sizes and ages can be infected and killed by SOD. Over half the forests in the Eastern U.S. contain potential SOD hosts.

Biology and Damage:

P. ramorum is a fungal-like organism that thrives in cool, humid climates and produces abundant spores under moist conditions. This pathogen has a complex life cycle, two general categories of host plants (trunk and foliar), and different symptoms for the two types of hosts. Most *Phytophthora* pathogens are root-infesting organisms, but SOD infests hosts above the soil line (leaves, shoots, woody stems and bark), and is primarily spread aerially,



Symptoms on trunk host: dark colored sap bleeding from cracks in bark.

although it can be spread through contaminated soil and water.

P. ramorum develops oval-shaped sacs called sporangia which produce and store infectious zoospores, especially during rainy periods. When a sporangium lands on a host it releases zoospores, which are blown or splashed onto the leaves and twigs of nearby susceptible plants. Within 48 hours, the zoospores produce new sporangia and hard, round, resting forms called chlamydospores. The dark brown chlamydospores accumulate in soil beneath host plants, where they can survive for years, reinfesting susceptible plants when conditions are right.

Trunk hosts, primarily trees, are considered terminal hosts and often die. Infected foliar hosts, primarily ornamental and forest understory plants, rarely die, but provide a reservoir for the infectious zoospores, which may then be dispersed to trunk hosts. Typically, foliar hosts must be present for trunk hosts to become infected. Infections on trunk hosts develop into bleeding cankers, which lead to decline. Secondary organisms and opportunistic pathogens (e.g., bark and ambrosia beetles, wood decay fungi and canker rots) may hasten tree death. In highly susceptible species such as tanoaks, death can occur in as little as two years.

Identification:

SOD can not be identified by visual inspection of host symptoms. Many other organisms and injuries produce similar symptoms. Confirmation can only be done by laboratory analysis.

What to Look For:

Foliar hosts typically show symptoms on the leaves and twigs. Trunk hosts show symptoms on the trunk. Tanoak is unique in that it is both a trunk and a foliar host.

Symptoms are grouped into three disease categories: leaf blight (spots) and twig dieback on foliar hosts, and cankers on trunk hosts. Hosts can exhibit one or more symptoms at the same time, and symptoms may vary slightly between species.

General Symptoms on Trunk Hosts:

- Bleeding cankers on the trunk, typically above the soil line within the first 10' (3 m), which may be > 7 feet (2 m) in length.
- Cankers ooze deep-red/black sap from intact bark with no obvious wounds; the sap does not have a foul odor.
- In later stages the bark may split.
- Beneath the bleeding, cankers are sunken with discolored bark (dark red-brown to black), outlined by thin black lines.
- Sudden oak death syndrome: Relatively rapid progression (2 to 4 weeks) from healthy-green to dead-brown, with full complement of dead leaves still on the tree.



Beneath the bleeding, cankers are sunken or flattened, and discolored.

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General Symptoms of Foliar Hosts:

- Leaf spots, shoot tip wilt, and twig dieback.
- Spots can occur anywhere on the leaf or petiole and may be accompanied by small branch cankers on some foliar hosts.
- Leaf spots are usually dark gray to brown with indistinct edges, appear water-soaked, and may be surrounded by a yellow halo or a diffuse margin of black.
- Spots may be triangular or irregular in shape; and 2/5" (0.5 cm) to nearly half the leaf surface.
- Leaf drop and defoliation of the lower part of the plant.



Leaf blight (spots) on rhododendron.

- In tanoak, wilted twig shoots are usually the first symptom, followed by twig dieback and Shepherd's crook. Leaf flagging is a particularly good indicator of the disease in tanoak.



Twig blight (Shepherd's crook) on tanoak.

How to Report a Possible Sighting/Infestation

In Maryland:

University of Maryland Cooperative Extension Exotic Pest Threats Website:
<http://hgic.umd.edu/faq/sendAQuestion.cfm>

Maryland Department of Agriculture: call 410-841-5920 to report suspect pests; visit http://www.mda.state.md.us/plants-pests/invasive_species.php for information.

Nationally:

USDA-Animal and Plant Health Inspection Service (APHIS):
http://www.aphis.usda.gov/services/report_pest_disease/report_pest_disease.shtml

National Plant Diagnostic Network: <http://www.npdn.org/DesktopDefault.aspx>

Where to Get More Information:

UMD Cooperative Extension Exotic Pest Threats Website: <http://www.PestThreats.umd.edu/index.cfm>

For excellent diagnostic images see: <http://www.padil.gov.au/viewPestDiagnosticImages.aspx?id=525>

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