THE OHIO STATE UNIVERSITY EXTENSION

FACT SHEET

Agriculture and Natural Resources

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Sudden Oak Death (aka Ramorum blight)

Nathan M. Kleczewski, Dennis Lewandowski, and **Pierluigi (Enrico) Bonello**
Department of Plant Pathology
The Ohio State University

Background

Sudden Oak Death (aka Ramorum blight) is a disease caused by the oomycete pathogen *Phytophthora ramorum* that was discovered in central-coastal California in 1995. This pathogen had been known to cause disease in nurseries and gardens since 1993, but was largely ignored until the organism was discovered in the United States.

The disease causes extensive mortality on tanoak (*Lithocarpus densiflorus*), coastal live oak (*Quercus agrifolia*), California black oak (*Quercus kelloggii*), and Shreve oak (*Quercus parvula var. shrevei*). On these and other oak species, *P. ramorum* produces cankers that exude reddish liquid and are sometimes referred to as bleeding cankers. *P. ramorum* also causes non-fatal infections including stem cankers, twig dieback, and leaf blighting on numerous other hosts, including many popular ornamentals (**Table 1**). These other hosts can serve as major sources of disease spread and long distance transfer of the pathogen.

Contaminated nursery stock from a west coast nursery was distributed throughout the United States in 2004. Since that time, government funded surveys of nurseries that received contaminated stock and nearby forest sites have been carried out in hopes of preventing or detecting outbreaks of this disease into Midwestern forests, which include numerous susceptible oak species and other hosts. In addition, nurseries in California, Oregon, and Washington that ship ornamental stock interstate are required to be inspected and found to be free of *P. ramorum*. Infected individuals are immediately destroyed to eradicate the pathogen and the nursery is placed under quarantine.

Although *P. ramorum* may have the potential to cause widespread oak death in all forests, it is important to note that the pathogen may be limited by other factors such as the environment, and therefore may never be able to become established or persist long enough to cause the disease in Midwestern forests. To date, *P. ramorum* has not been detected in Midwestern or eastern forests, but measures to prevent its spread continue.

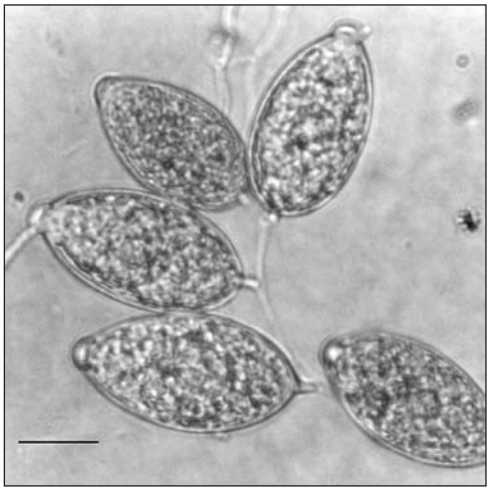

Figure 1. Sporangia of *P. ramorum*. *Photo by UC Berkeley.*

Pathogen and Symptoms

Unlike many *Phytophthora* species, which infect hosts through soil and water, *P. ramorum* also infects hosts aerially. Reproduction occurs asexually through the production of sporangia, zoospores, and chlamydospores. Sporangia are oval, papillate, 40–90 µm in length and serve as the source of primary inoculum (**Figure 1**). Sporangia are produced from foliar

Table 1. APHIS list of proven hosts regulated for *P. ramorum* as of March 3, 2008.
For an updated list visit: www.aphis.usda.gov/plant_health/plant_pest_info/pram/ (accessed on April 25, 2008)

Scientific Name	Common Name	Scientific Name	Common Name
Acer macrophyllum	Bigleaf maple	*Lonicera hispidula*	California honeysuckle
A. pseudoplantanus	Planetree maple	*Laurus nobilis*	Bay laurel
Adiantum aleuticum	Western maidenhair fern	*Magnolia doltsopa*	Michelia
A. jordanii	California maidenhair fern	*Maianthemum racemosum*	False solomon's seal
Aesculus californica	California buckeye	*Parrotia persica*	Persian ironwood
A. hippocastanum	Horse chestnut	*Photinia fraseri*	Red tip photinia
Arbutus menziesii	Madrone	*Pieris spp.*	Pieris—all species
Arctostaphylos manzanita	Manzanita	*Pseudotsuga menziesii var. menziesii*	Douglas fir
Calluna vulgaris	Scotch heather	*Quercus agrifolia*	Coast live oak
Camellia spp.	Camellia—all species	*Q. cerris*	European turkey oak
Castanea sativa	Sweet chestnut	*Q. chrysolepis*	Canyon live oak
Fagus sylvatica	European beech	*Q. falcate*	Southern red oak
Frangula purshiana	Cascara	*Q. ilex*	Holm oak
Fraxinus excelsior	European ash	*Q. kelloggii*	California black oak
Griselina littoralis	Griselinia	*Q. parvula var. shrevei*	Shreve oak
Hamamelis virginiana	Witch hazel	*Rhododendron spp.*	Rhododendron—all species
Heteromeles arbutifolia	Toyon	*Rosa gymnocarpa*	Wood rose
Kalmia spp.	Mountain laurel—all species	*Salix caprea*	Goat willow
Lithocarpus densiflorus	Tanoak	*Sequoia sempervirens*	Coast redwood
		Syringa vulgaris	Lilac

lesions and are wind blown to susceptible hosts, where they infect aboveground portions directly or produce motile zoospores that spread in soil and water. Zoospores also infect foliage given proper environmental conditions. Chlamydospores also are produced on foliar lesions and serve as resting structures for the organism (**Figure 2**).

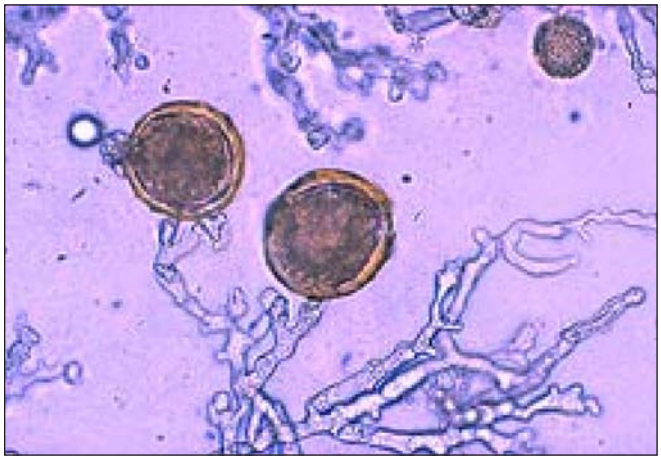

Figure 2. *P. ramorum* chlamydospores.
Photo by UC-Davis.

Infection of oak stems and trunks may result from the accumulation of infectious propagules in the water or soil, although this has not yet been proven. As the pathogen colonizes the phloem, a sticky, reddish sap exudes from the bark that is characteristic of this disease (**Figure 3**). Foliar infection of oaks rarely occurs. *P. ramorum* requires two mating types to produce the sexual reproductive structure, the oospore, which has yet to be observed in the field. Symptoms on other hosts often consist of diffuse, water-soaked leaf lesions (**Figure 4**). Infected leaves may drop off soon thereafter. Infection usually moves from the petiole down to the twig, and may result in blighting or wilting. Optimal growth for *P. ramorum* occurs in wet environments with mild to moderate temperatures (18°–22°C). Sporangia production occurs during rainy periods.

It is important to note that other *Phytophthora* species and pathogens can infect plants and cause similar symptoms. In addition, abiotic conditions, such as fertilizer burn, sun scorch, and root damage may lead to foliar symptoms that resemble those of *P. ramorum*, particularly in the nursery.

Figure 3. Reddish ooze characteristic of susceptible oaks infected by *P. ramorum*. *Photo by Steve Oak.*

Figure 4. Water soaked and necrotic lesions on a rhododendron, a major foliar host for *P. ramorum*. *Photo by Steve Oak.*

Management

Prevention

The most cost effective and practical management strategy for controlling *P. ramorum* in nurseries is to make certain that incoming stock has been certified to be clean of *P. ramorum*. Workers and staff should also be aware of the pathogen, its symptoms, and hosts so that authorities can be alerted if this disease is noticed in the nursery.

Susceptible nursery stock should be checked regularly for symptoms, especially following periods of heavy rain. Personnel should be trained to recognize symptoms of *P. ramorum* and other mimics. Suspect stock should be carefully examined for other possible causes of disease. Scouting of nearby forests should occur if suitable hosts are present. Infected plants should be removed immediately, with the surrounding litter layer and soil being removed during cooler periods when the pathogen is least active or dormant. Nearby hosts should also be destroyed.

Cultural Practices

It follows from above that proper sanitation of all equipment, boots, car tires, and tools should be maintained to prevent pathogen spread. Injuries to oaks and other hosts and soil movement should be avoided. Nursery water should be monitored for presence of the pathogen, and excessive watering and overhead irrigation should be avoided. Nursery stock should be positioned away from low-lying areas to limit proliferation and spread of the pathogen in standing water and arranged in a fashion that promotes proper airflow. Fertilization may also favor infection by this pathogen and should be used sparingly. If plants are propagated in the nursery, cuttings should be made from disease-free plants and grown in disinfected pots. Any plant material that may be or has been symptomatic should be collected and either composted or burned to eradicate the pathogen. Boots, tools, and car tires should be washed and disinfected with bleach or Lysol when working in areas known to be infested with *P. ramorum*.

Landscape

Any confirmed infected landscape plants must be immediately isolated and destroyed according to federal regulations. Confirmation of infection can only be performed by federal and state laboratories, or authorized university disease clinics and research laboratories, such as the C. Wayne Ellett Plant and Pest Diagnostic Clinic at The Ohio State University.