



## Sudden Oak Death <sup>1</sup>

Philip F. Harmon and Carrie L. Harmon<sup>2</sup>

Sudden oak death is a new disease capable of causing a range of symptoms from leaf spots to plant death on many woody hosts. Because sudden oak death is a new disease, much about the pathogen, host range, and the disease epidemiology is unknown.

### Causal Agent and Geographic Distribution

Sudden oak death is caused by *Phytophthora ramorum*. The historical origin of the pathogen is unknown, but it was first described in Europe on ornamental *Rhododendron* sp. and *Viburnum* sp. in 2001. In 2002 the pathogen was reported in California and Oregon and has since been found in western Canada.

### Host Range

Various symptoms have been produced on more than 40 species of native and cultivated ornamental plants infected with the pathogen (Table 1). The list is not exclusive as many plant species have not yet been tested. It is likely that species closely related to susceptible hosts also could be infected by *P.*

*ramorum*. Additional hosts will be identified as the pathogen is spread to new areas.

### Disease Symptoms

Symptoms of this disease vary from host to host; however, roots of plants infected with *P. ramorum* typically appear healthy. Known hosts and observed symptoms are listed in Table 1. Symptoms may progress rapidly after infection or may not be visible for significant periods of time. Symptom progression is favored by temperatures near 20°C.

### Leaf Lesions

Leaf lesions typically begin where moisture accumulates on a leaf surface, such as at the leaf tip or petiole (depending on orientation on the plant), along the midvein, or around the margin. Lesions may first appear water-soaked, and a water-soaked margin may be visible on rapidly expanding lesions (Fig. 1). Blighted leaf tissue typically turns tan to brown and may have a reddish tinge (Fig. 2). Lesions commonly expand from the midvein in an angular fashion (Fig.3).

1. This document is PP197, one of a series of the Plant Pathology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date March 2004. Visit the EDIS Web Site at <http://edis.ifas.ufl.edu>.

Table 1 and images included in this document were adapted from Davidson, J. M., Werres, S., Garbelotto, M., Hansen, E. M., and Rizzo, D. M. 2003. Sudden oak death and associated diseases caused by *Phytophthora ramorum*. Online. Plant Health Progress doi:10.1094/PHP-2003-0707-01-DG.

2. Philip F. Harmon, assistant professor, Plant Pathology Department. Carrie Harmon, plant pathology coordinator, Southern Plant Diagnostic Network, Plant Pathology Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611.



**Figure 1.** Leaf lesions on *Kalmia latifolia* (mountain laurel). Note the symptom occurs at the leaf tip, and the lesion has a water-soaked border. Credits: Plant Management Network



**Figure 2.** Tan to reddish brown leaf lesions typical of sudden oak death on *Camellia* sp. Credits: Plant Management Network

### Bleeding Cankers

Cankers are sunken or swollen lesions on branches and trunks of woody plants. Cankers may occur beneath the bark and can be difficult to distinguish. Cankers caused by *P. ramorum* often ooze red sticky sap (Fig. 4). Some bacterial pathogens can cause sap to bleed from cankers, but sap from these cankers has a foul odor. Vascular discoloration is revealed when the bark and outer

cambial layer are removed (Fig. 5). Vascular discoloration on mature tan oak is characteristically bright red (Fig. 6).



**Figure 3.** Angular lesions caused by *P. ramorum* on leaves of *Camellia* sp. Credits: Plant Management Network



**Figure 4.** Bleeding canker symptom on coast live oak caused by *P. ramorum*. Credits: Plant Management Network





**Figure 5.** Vascular discoloration of *Rhododendron* sp. caused by *P. ramorum*. Credits: Plant Management Network



**Figure 6.** Canker and vascular discoloration on a mature tan oak. Credits: Plant Management Network

### Shoot Tip and Stem Blight

Stem blight often begins at a shoot tip and progresses toward the base of the plant, but infection may occur at any point on a stem and move up or down the plant. Blighted stems appear brown to black and may be killed, resulting in death of attached leaves (Fig. 7). Early symptoms of shoot tip

blight may include formation of a “shepherds crook” (Fig. 8).



**Figure 7.** Stem dieback of *Rhododendron* sp. caused by *P. ramorum*. Credits: Plant Management Network



**Figure 8.** Shepherds crook symptom on tan oak sapling. Credits: Plant Management Network

## General Wilt

Viburnum species are among the most susceptible hosts and typically exhibit wilting symptoms that can mimic drought stress. As symptoms progress, individual branches and eventually the entire plant may collapse and die.

## Spread of the Pathogen and Control Options

The fungus can be spread by movement of infected host material, infested soil, irrigation water, and wind-blown rain. Unintentional movement of infected but asymptomatic nursery stock is a potential means of pathogen dissemination. Because this is a new pathogen, the best option for controlling spread of the disease is preventing the introduction and establishment of the pathogen in new areas. Quarantines and eradication programs in conjunction with extensive surveys are the most effective way to deal with potential introductions. Eradication efforts include burning and deep burial of infected plant material.

Fungicides have not been evaluated for management of this disease. It is possible that fungicides that prevent and control diseases caused by other *Phytophthora* spp. may be effective, but no data are available at this time.

**Table 1.** Known hosts, plant part infected, and potential impact of *Phytophthora ramorum*.

Host species <sup>1</sup>	Family	Common name	Location <sup>2</sup>	Plant part infected and impact
<i>Acer macrophyllum</i>	Aceraceae	Big leaf maple	CA	foliar lesions; long term impact unknown
<i>Toxicodendron diversilobum</i>	Anacardiaceae	Poison oak	CA, OR	Limited stem canker; long term impact unknown
<i>Lonicera hispidula</i>	Caprifoliaceae	Honeysuckle	CA	foliar lesions; long term impact unknown
<i>Viburnum</i> spp. <sup>3</sup>	Caprifoliaceae	Viburnum	CA, OR, E	Stem lesions
<i>Arbutus menziesii</i>	Ericaceae	Madrone	CA	branch cankers, foliar lesions; death of regeneration and possibly large trees
<i>Arctostaphylos manzanita</i>	Ericaceae	Manzanita	CA	stem and branch cankers, foliar lesions; dieback of branches
<i>Kalmia latifolia</i>	Ericaceae	Mountain laurel	E	foliar lesions; long term impact unknown
<i>Pieris</i> spp. <sup>4</sup>	Ericaceae	Andromeda	CA, OR, E	stem cankers and foliar lesions; long term impact unknown
<i>Rhododendron</i> spp. <sup>5</sup>	Ericaceae	Ornamental rhododendron	CA, OR, E	stem and branch cankers, foliar lesions; dieback and death of plants
<i>Vaccinium ovatum</i>	Ericaceae	Evergreen huckleberry	CA, OR	stem and branch cankers, foliar lesions; dieback of canes and possible death of plants
<i>Lithocarpus densiflora</i>	Fagaceae	Tanoak	CA, OR	stem and branch cankers, foliar lesions; death of large trees, saplings and regeneration
<i>Q. chrysolepsis</i>	Fagaceae	Canyon live oak	CA	Stem cankers, death of saplings, possible death of large trees
<i>Q. kelloggii</i>	Fagaceae	California Black oak	CA	stem cankers; death of large trees
<i>Q. parvula</i> var. <i>shrevei</i>	Fagaceae	Shreves oak	CA	stem cankers; death of large trees
<i>Quercus agrifolia</i>	Fagaceae	Coast live oak	CA	stem cankers; death of large trees
<i>Aesculus californica</i>	Hippocastanaceae	California buckeye	CA	foliar lesions; long term impact unknown
<i>Umbellularia californica</i>	Lauraceae	Bay laurel, Oregon myrtle	CA	foliar lesions; long term impact unknown
<i>Pseudotsuga menziesii</i>	Pinaceae	Douglas-fir	CA	branch cankers, foliar lesions; death of new shoots and small branches
<i>Rhamnus californica</i>	Rhamnaceae	Coffeeberry	CA	foliar lesions; long term impact unknown
<i>Rhamnus purshiana</i>	Rhamnaceae	Cascara	OR	foliar lesions; long term impact unknown
<i>Heteromeles arbutifolia</i>	Rosaceae	Toyon	CA	branch cankers, foliar lesions; branch dieback, long term impact unknown

**Table 1.** Known hosts, plant part infected, and potential impact of *Phytophthora ramorum*.

Host species <sup>1</sup>	Family	Common name	Location <sup>2</sup>	Plant part infected and impact
<i>Rubus spectabilis</i>	Rosaceae	Salmon berry	OR	Foliar lesions; long term impact unknown (Kochs Postulates in progress)
<i>Sequoia sempervirens</i>	Taxodiaceae	Coast redwood	CA	branch cankers, foliar lesions; death of sprouts, decline of saplings
<i>Camellia</i> spp. <sup>6</sup>	Theaceae	Camellia	CA, E	Leaf lesions; long term impact unknown

1 Cultures of *P. ramorum* have been obtained from all hosts with the exception of *A. manzanita*.

2 Location from which *P. ramorum* has been observed on named host to date. CA, California; OR, Oregon; E, Europe.

3 Viburnum species from which *P. ramorum* has been recovered include: *V. bodnantense*, *V. fragans*, *V. plicatum*, and *V. tinus*.

4 Pieris species and cultivars infected by *P. ramorum* include: *P. formosa* var. *forrestii* and *P. japonica*.

5 Rhododendron species and cultivars from which *P. ramorum* has been isolated include: *Rhododendron catawbiense*, *R. macrophyllum*, Catawbiense Grandiflorum, Catawbiense Boursalt, Schneewolk, Colonel Coen, Gomer Waterer, and Cunninghams White.

6 Camellia species and cultivars from which *P. ramorum* has been isolated include: *Camellia japonica* (Kramers Supreme, Kumasaka, Mrs. Charles Cobb, and Silver Waves); and *Camellia sasanqua* (Bonanza).