



Ramorum Blight and Dieback (Sudden Oak Death)

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Ramorum Blight and Dieback, also known as 'sudden oak death', is a serious quarantine disease caused by an oomycete (Protist), *Phytophthora ramorum*. It has killed thousands of Tanoak (*Lithocarpus densiflorus*) and oak (*Quercus* spp.) trees, particularly Coast live oak (*Quercus agrifolia*) and California black oak, in California and Oregon since it was first detected in 1995. In North America, the disease is currently established in localized areas in California and Oregon, mainly in forested areas or in small remnants of mature forests. The first report of this disease in Canada was the detection of infected rhododendrons in a British Columbia (B.C.) nursery in June 2003. Strict regulatory control measures are in place to eradicate the pathogen, if detected in nurseries and to ensure that the disease does not become established in Canada, and to facilitate the movement of host plants and plant products within Canada and internationally.

The name Sudden Oak Death was used initially to describe the rapid dieback and mortality of *P. ramorum* infected Tanoak and several oak species, particularly Coast live oak, in California. Now, the name Ramorum Blight and Dieback has been used to better describe the wide range of symptoms caused by the pathogen on various hosts. Damage to ornamental host plants such as camellia and rhododendron typically consists of foliar blights and leaf spots. Severity is variable, ranging from cosmetic damage to severe leaf and stem blight, defoliation, canker, dieback and eventual death of the host plant.

Causal organism

The causal organism *Phytophthora ramorum* (*P. ramorum*) is an oomycete (fungal-like) that belongs to the Kingdom Protista. Researchers at the University of California have determined that *P. ramorum* is closely related to *Phytophthora lateralis*, the cause of Port-Orford cedar root rot. *Phytophthora ramorum* was first described as a pathogen of ornamental *Rhododendron* and *Viburnum* in Germany and The Netherlands.

There are two mating types of *P. ramorum* - European isolates belong to the A1 mating type, while most North American isolates belong to the A2 mating type. In Europe, the disease is not known to cause mortality in oaks, but does cause mortality in some ornamental plants, including *Rhododendron* and *Viburnum*.

Geographical and host distribution

The current known distribution (establishment) of *P. ramorum* includes the western USA and Europe. For the most recent information on the North American geographical distribution of *P. ramorum*, please refer to the [California Oak Mortality Task Force Web Site](#).

The pathogen has a wide host range with well over 200 species belonging to nearly 80 plant genera, confirmed as susceptible to *P. ramorum*. Both in Canada and the USA, host plants are regulated based on the susceptibility of specific plant species within each genus. New hosts are being investigated and added to the list as new data become available. For an up-to-date list of regulated plant species in Canada, please refer to the Canadian Food Inspection Agency ([CFIA website](#)). For an up-to-date list of regulated plant species in the USA, please refer to the [United States Department of Agriculture website](#). For additional information on *P. ramorum*, please refer to the [California Oak Mortality Task Force Web Site](#).

Life cycle of the organism

Ramorum blight and dieback has been observed in three main forest types in California: Mixed Evergreen-Bay-Arbutus, Tanoak-Douglas fir and Coast-Redwood. Research indicates that infections on foliar hosts, such as arbutus, bay laurel, huckleberry, rhododendron and buckeye, do contribute to a rapid build-up of the pathogen in the environment, serving as a reservoir of inoculum (spores) which in turn infects woody tissues of oaks and tanoak. It is possible that the understory infection on the leaves of host plants occurs prior to the infection of woody tissues of oaks and tanoak.

There is evidence that *P. ramorum* spreads by airborne spores carried by wind-blown rain. Sporangia and chlamydospores are commonly produced on infected foliage. *Phytophthora ramorum* is active in wet and cool weather with the optimum growth at 20°C. Disease development is favoured by cool temperatures with relatively high moisture.

Symptoms

Symptoms vary from leaf spots, undefined leaf lesions, leaf/shoot/stem blights, bleeding or oozing tree-trunk cankers to dieback, depending on the host plant. These symptoms can be confused with other types of damage caused by other pathogens, frost, sunburn, etc.

On rhododendron, symptoms on leaves appear as dark brown to black lesions with “fuzzy” margins, usually on leaf edges or tips. On some species, the lesions may exhibit a concentric ring pattern (Figure 1A). Blight on twigs/shoots first appears as brown to black lesions which spread along the twig to cause dieback.

On camellias, brown to dark-brown lesions with diffuse margins usually appear on leaf tips and edges (Figure 1B).

On viburnum, brown to black lesions can appear on leaves, but lesions often occur at the stem base leading to wilting and then death of the plant.

On oak, the disease is characterized by a rapid decline (dieback) and leaves turn brown suddenly and stay on the branch for up to a year. Bleeding or oozing cankers develop on the lower trunk and branches. Ooze from cankers is sticky, very dark reddish (Figure 2A) and smells fermented. When the surface of the cankered bark is chipped away, the infected bark tissue below shows thick dark zone lines (Figure 2B) clearly separating the affected tissue from the uninfected area in the cankered region.

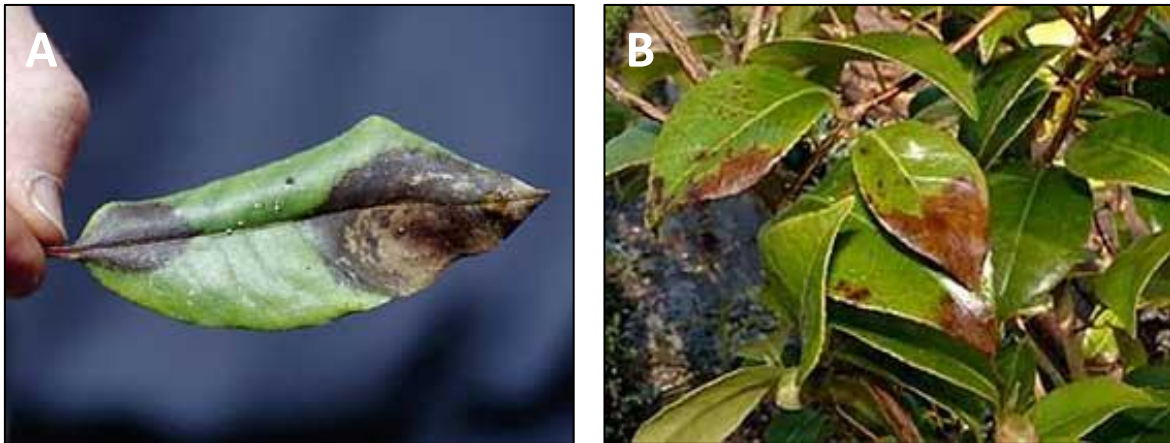


Figure 1. Leaf blight on *Rhododendron* (A) and *Camellia* (B). Photo credit: Joseph O'Brien, USDA Forest Service, www.forestryimages.org (A) and Steve Ashby, Department of Environment, Food and Rural Affairs United Kingdom (B).



Figure 2. Bleeding canker on coast live oak (*Quercus agrifolia*) (A) and sudden oak death canker showing clear zone line on inner bark of tan oak (*Lithocarpus densiflorus*) (B), caused by *P. ramorum*.

For a complete list of symptoms and related information, visit the California Oak Mortality Task Force homepage at <http://www.suddenoakdeath.org/>. An excellent diagnostic guide is available on this site with descriptions and pictures of symptoms on many host plants.

Spread

Numerous sporangia are produced on mature lesions when environmental conditions are favourable; leaf wetness for more than 10 to 12 hours and moderate temperatures are favourable for sporangial production. Sporangia are dispersed by rain and/or overhead irrigation water and long distance dispersal up to several miles can occur in wind currents. Upon contact with host plants, sporangia and/or small motile spores (zoospores) released from sporangia germinate and infect the plants in the presence of free moisture on plant surfaces. Disease development is favoured by moderate temperatures and wet, humid conditions. If wet weather continues, rapid development and multiple reproductive/infection cycles of the pathogen can cause complete foliar blight and defoliation of potato within a few days.

Tubers become infected at any stage of their development if heavy rains wash spores from leaves through the soil or if the tubers come into contact with diseased vines during harvest.

Phytophthora infestans is an obligate pathogen and, thus, requires a host plant or plant tissue for its survival between seasons. It can survive on infected tubers in soil, cull piles or storage. Planting infected seed potatoes is one of the common pathways of introducing disease in the field. Seed-pieces with mild infection often result in the emergence of infected/symptomatic plants. Heavily infected seed-pieces rapidly decay in soil and, as a result, no plant emerges.

Nationwide, late blight has become more difficult to control. This is believed to be due to the introduction of new and aggressive genotypes (strains) of the pathogen. *Phytophthora infestans* consists of two distinct mating type populations, mating types A1 and A2, which are necessary for sexual reproduction and emergence of new and aggressive strains. Thick-walled resting spores (oospores) are produced as a result of sexual reproduction, and are capable of surviving for many years in dead vines and in soil. Both A1 and A2 mating types are present in Canada. In B.C., studies conducted from 2010 to 2015 indicate that the genotype US-23 (mating type A1) being the predominant strain, has been replaced with US-8 (mating type 2) in the Fraser Valley region of the lower mainland.

Potential for disease spread to B.C.

Strict regulatory control measures are in place in the USA to prevent the spread of *P. ramorum*, and Canadian quarantine regulations have been established to prevent the introduction of the disease into Canada on nursery stock, soil or other host materials. There is a high risk that *P. ramorum* will have a serious impact on B.C.'s horticulture and forestry sectors and the environment due to its wide host range and the presence of a suitable climate. Prevention of its introduction and rapid eradication efforts, should the disease be introduced, are key to protect these industries from losses caused by *P. ramorum*.

How can you prevent the introduction of this disease into B.C.?

To help prevent the introduction of *P. ramorum*, do not transport infected or potentially infected host material and soil that are taken from areas where the pathogen is known to occur. Plants exported from the regulated counties in the U.S. should be accompanied by a Phytosanitary certification. Contact the CFIA local office regarding quarantine restriction information on movement of hosts and associated materials. Be aware of the symptoms. On arrival and in-house, visually inspect host plants, and report possible cases to your local office of the CFIA, Canadian Forestry Service (CFS), or Ministry of Agriculture, Food and Fisheries (BCAGRI).

The Canadian Nursery and Landscape Association (CNLA) is running a comprehensive voluntary *P. ramorum* certification program for commercial nurseries. It was launched as a stand-alone program in the fall of 2004 and today is a module of the [Clean Plants](#) Program. The key components of the program are nursery sampling and testing for *P. ramorum*, implementation of best management practices, and independent third-party audits to ensure nursery compliance. The program reduces the risk of *P. ramorum* being introduced and/or established at a nursery and, thereby, protects the garden centres and landscapers that purchase planting stock from the nursery.

Proactive

Preventing the introduction and spread of *P. ramorum* is the key to minimize its impact on the nursery and environment.

Commercial nurseries are advised to adopt the recommended Best Management Practices (BMPs) and the *P. ramorum* Nursery Certification Program to safeguard the industry.

Plant species belonging to the genera *Rhododendron*, *Camellia*, *Viburnum*, *Pieris*, *Kalmia* and *Magnolia* are considered highly susceptible to *P. ramorum* (i.e. high-risk hosts) and nurseries are advised to take extra precaution when handling these plants.

Scout for visible symptoms, particularly during spring, early summer and fall when the pathogen is active. If suspected, immediately notify the local office of the CFIA, CFS, or BCAGRI.

Dimethomorph (Acrobat 50 WP or Forum), fosetyl-AL (Chipco Aliette), mandipropamid (Micora), and metalaxyl-M (Subdue MAXX) and are registered for preventative use in nurseries and landscape plantings. Please strictly follow manufacturer's label instructions, according to the [Pest Management Regulatory Agency](#), and best management practices when using these chemicals.

Both in California and Oregon, quarantines have been put in place for areas where *P. ramorum* is established to limit the spread of the disease, and eradication measures continue in Curry County, Oregon. These regulations pertain to nursery plants of known hosts or their close relatives, wood products and soil. An import policy D-01-01 titled, "Phytosanitary Requirements to Prevent the Entry of *Phytophthora ramorum*" (<http://www.inspection.gc.ca/english/plaveg/protect/dir/d-01->

[01e.shtml](#)) has been implemented to prevent the introduction of *P. ramorum* into Canada (CFIA – revised June, 2013).

Disease Confirmation and Regulatory Action

If the disease is suspected, please contact the local CFIA office or B.C. Ministry of Agriculture and Food, before submitting suspected samples to the [Ministry of Agriculture and Food - Plant Health Laboratory](#) or to a federal (CFIA) plant diagnostic laboratory.

For Further Information

[Sudden Oak Death Information Page \(Canadian Food Inspection Agency\)](#)

[Sudden Oak Death Import policy \(Canadian Food Inspection Agency\)](#)

[List of regulated species in Canada \(Canadian Food Inspection Agency\)](#)

[Canadian *P. ramorum* Certification Program - Canadian Nursery Landscape Association](#)

[The California Oak Mortality Task Force](#)

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