Sudden oak death (SOD) and ramorum blight are caused by *Phytophthora ramorum*, a non-native water mold (oomycete) that originates from parts of Asia. Sudden oak death was given its name due to the appearance that entire trees were dying in just 2 to 4 weeks (Fig 1). In reality, the disease progresses over an extended period, estimated at more than 2 years after initial infection. Ramorum blight is nonlethal, typically causing foliar browning and wilting.

*Phytophthora ramorum* is currently only established in forests of California and Oregon, where it has killed tanoak and other oak species. In 1995, the pathogen was first detected in the U.S. in California’s San Francisco Bay Area, where it caused widespread tanoak mortality.

Currently, *P. ramorum* is established in 18 California counties as well as in Oregon’s Curry and Lincoln counties. The pathogen has also been detected and contained in other U.S. nurseries. Surveys for *P. ramorum* are ongoing, including in Utah, and state and federal quarantines exist for proven hosts and associated plants to limit human-assisted spread.

**INTRODUCTION**

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**IMPACT**

Tanoak and oak (*Quercus* spp.) are dominant tree species in California’s redwood and mixed conifer/hardwood forests. Death of these trees caused by SOD impacts forest ecosystems by altering species composition, decomposition rates, and nutrient cycling. To date, SOD has killed 63% of tanoaks in parts of California’s Monterey County, and 90% to 100% in some areas of Point Reyes National Seashore. Although the resulting dead trees can increase fuel for fires, wildfires

**Quick Facts**

- *Phytophthora ramorum* is a pathogen that causes sudden oak death (SOD) on susceptible oaks and ramorum blight on foliage of approximately 120 additional hosts. It has not been found in Utah.
- *Phytophthora* species are fungal-like organisms called oomycetes and are more closely related to diatoms and brown algae than fungi.
- SOD results in large cankers (death of tissue) on the tree trunk that kills the tree.
- In California and Oregon, SOD has killed more than 1 million tanoak and oak trees and has greatly impacted coastal ecosystems.
- Once established, this pathogen is extremely difficult, if not impossible, to eradicate or control.
- Long-distance spread by humans can occur from moving infested nursery plants and soil.

**Fig. 1.** Coast live oak killed by sudden oak death (*Phytophthora ramorum*). 1
have been shown to significantly reduce P. ramorum occurrences. In Oregon, more than $22 million has been spent identifying and treating P. ramorum-infested areas, and California property values have decreased from tree losses. Nurseries in California and Oregon growing susceptible host plants are subject to federal quarantines, and many nurseries testing positive for P. ramorum that transport outside state lines have ceased producing plants that are susceptible, such as rhododendron, camellia, pieris, kalmia, and viburnum.

In Utah, the likelihood of this pathogen causing widespread damage is low due to Utah’s arid climate and lack of widespread oak forests, which is counter to that needed by this pathogen. Isolated pockets of P. ramorum may occur where moisture conditions are favorable, such as in higher-humidity nursery or greenhouse settings.

**Table 1. Phytophthora ramorum Host Trees and Shrubs**

**Oak Hosts**
- tanoak (Notholithocarpus densiflorus)
- coast live oak (Quercus agrifolia)
- European turkey oak (Q. cerris)
- canyon live oak (Q. chrysolepis)
- southern red oak (Q. falcata)
- holly oak (Q. ilex)
- California black oak (Q. kellogii)
- Shreve’s oak (Q. parvula var. shrevei)

**Non-oak Hosts**
- California bay laurel (Umbellularia)
- Oregon grape (Berberis aquifolium)*
- European beech (Fagus sylvatica)
- European ash (Fraxinus excelsior)
- witch hazel (Hamamelis virginiana)
- Douglas-fir (Pseudotsuga menziesii)*
- wood rose (Rosa gymnocarpa)
- lilac (Syringa vulgaris)
- English yew (Taxus baccata)
- whortleberry (Vaccinium myrtillus)*
- Various species of the following genera:
  - fir (Abies)*, maple (Acer)*, fern (Adiantum)*, manzanita (Arctostaphylos)*, huckleberry (Vaccinium)*, mountain laurel (Kalmia), rhododendron and azalea (Rhododendron), viburnum (Viburnum), larch (Larix) and others

* Denotes a Utah native species

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**PLANT HOSTS**

*Phytophthora ramorum* attacks 130 host species from 34 genera. In the U.S., tanoak and coast live oak are the primary trunk hosts, and California bay laurel is the primary reservoir of inoculum (foliar host). Oaks from the red or intermediate groups are affected, but oaks from the white group, which includes Utah’s gambel oak (*Quercus gambelii*), are typically not susceptible to SOD. In Europe, *P. ramorum* attacks European larches and plantation Japanese larch (*Larix kaempferi*), and the primary foliar host is rhododendron. Known hosts are included in Table 1.

**DAMAGE AND SYMPTOMS**

**Sudden Oak Death**

On primary hosts, cankers form on the trunk and lower branches that ooze and bleed dark black to red or amber sap (Fig. 2). These cankers kill the phloem tissue, eventually girdling the tree and turning foliage brown (Fig. 3).

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**Fig. 2.** Bark scraped away to expose sudden oak death canker (death of bark and phloem). Dark ooze would appear on the intact bark above the canker.¹

**Fig. 3.** Oaks with sudden oak death showing brown foliage and death.¹
**Ramorum Blight**

Symptoms vary depending on the host plant, and confirmation requires laboratory analysis of infected material, as damage from several other diseases or injuries is very similar. They typically include brown lesions on the foliage or brown leaf tips that may be edged with a black line and yellow halo (Fig. 4). In extreme cases, ramorum blight can be lethal to young plants, and on California bay laurel, the tips and edges of leaves older than 1 year are most susceptible. On rhododendron, lesions are identical on the upper and lower leaf surfaces.

**Phytophthora ramorum** requires water for spore dispersal, and hosts can become infected via windblown spores or spores in soil or water. Reproduction is asexual and produces three types of microscopic spores. Sporangia release from infected foliage and are dispersed by splashing or wind-driven rain. Upon landing on the host, they either germinate and cause infection directly, or in free water, they release zoospores that cause infection. Sporangia are short-lived, but can disperse up to 2 miles in extreme, wet winds. Chlamydospores form within dead tissue and wood debris and are important for long-term survival in drought, heat, and cold, as well as long-distance dispersal via infected soil on shoes, cars, and equipment. In favorable conditions, chlamydospores can germinate and infect directly or they can produce a sporangium.

California bay laurel (also known as Oregon myrtle) and tanoak are most susceptible to *P. ramorum* infections in spring and summer, forming “transmission highways,” where infested trees produce an unusual overabundance of pathogen spores that disperse broadly across the landscape. Spores can survive in potting media and soil in the absence of a host for at least 33 months.

**MONITORING AND PREVENTION**

Scientists conduct wide-scale monitoring for *P. ramorum* via aerial surveys and stream water analyses. Individuals can inspect plants by looking for bleeding cankers, brown leaf spotting, and black-margined leaves with halos. Note that these symptoms are shared by many pathogens and do not implicitly indicate the presence of *P. ramorum*.

To prevent introduction into Utah, be cautious when visiting infested forested areas of California and Oregon. During the wet, rainy, and cool seasons, stay on established trails and avoid collecting plants, firewood, acorns, leaves, soil, or water, especially where symptomatic plants exist. Remove soil and plant material from bikes, shoes, and clothes, then rinse with water and spray with disinfectant before leaving the site. Wash debris from off-road vehicles and campers before leaving the area. As this pathogen is particularly well-adapted to spread from nursery stock, always list declarable items when traveling abroad, including all plant material. Visit the U.S. Customs and Border Protection website to learn what items are prohibited and restricted-entry.

**DISEASE CYCLE**

**SOD** has not been detected in Utah, so there is no need to manage for *P. ramorum* at this time. Where it occurs, professional applicators have used products containing phosphorous acid (phosphite) to reduce canker growth. When purchasing susceptible host plants, inspect leaves for symptoms, and purchase plant material from reputable nurseries devoid of this pathogen. Greenhouse operations and nurseries can place a 1-inch gravel layer on the soil surface to kill *P. ramorum* inoculum via soil solarization. In general, exposing soil to 122 °F for 30 minutes, 104 °F for 2 days, or 95 °F for 4 days will kill *P. ramorum* spores.
REFERENCES AND FURTHER READING


**Image Credit**

*1 Joseph O’Brien, USDA Forest Service, Bugwood.org*

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