



Sudden Oak Death Guidelines for California Landscapers & Gardeners

A plant disease known as Sudden Oak Death is threatening coastal forests in California and Oregon. The disease is caused by the exotic, quarantine pathogen *Phytophthora ramorum*, which has killed millions of tanoak and oak trees in California. Many common garden plants (such as rhododendron and camellia) are also susceptible to this

pathogen, exhibiting leaf spots and twig dieback when infected. These plants can serve as sources for inoculum that facilitate pathogen spread; therefore, nursery growers, landscapers, and homeowners need to be aware of symptoms and management recommendations. This guide provides science-based information on oak tree health, treatment options, and how to work with host plants without spreading the pathogen.

Pathogen biology

P. ramorum can be found in living, dying, or recently dead plants, and its spores can be found in soil, water, and infected plant material. The pathogen prefers moist environments and moderate temperatures. Weather patterns also play a role in pathogen activity and infection rates. During wet periods, the organism is most active; therefore, the risk of pathogen spread is greatest in muddy conditions and rainy weather. *P. ramorum* may also be transported to new areas when infested plants or soil are moved. Sudden Oak Death is primarily a forest disease. It has only affected landscaped yards when they are located along the urban/wildland interface, where remnant forest trees have been incorporated into private gardens.

Quarantine regulations

Because *P. ramorum* may be spread through the movement of infested soil and plant material, State and federal regulations are in place to help stop the inadvertent spread of the pathogen to uninfested areas. *P. ramorum*-susceptible plant species and materials are regulated by the California Department of Food and Agriculture (CDFA) and the US Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS). Many common horticultural plants are hosts for *P. ramorum*; consequently, the pathogen has been detected in nurseries in California, other states, and other countries.



Currently, California nurseries, within infested counties and with susceptible plant species, fall under regulation for the pathogen. While susceptible plants can be shipped nationwide and internationally, current federal regulations require that the operating nursery possess a USDA *P. ramorum* Compliance Agreement, which requires annual inspections for California, nurseries with host plants on-site before shipping is permitted. Additionally, all shipments of *P. ramorum* host plants from California's quarantined counties must be inspected monthly and approved prior to movement out of the quarantined area.

California's quarantined area is composed of the 16 counties with wildland *P. ramorum* outbreaks (Curry County, Oregon also has a wildland outbreak.). There are no restrictions on the movement of affected plants or plant material within the 16-county zone; however, before moving susceptible plant material out of the quarantined area, you must either possess a USDA *P. ramorum* Compliance Agreement or contact the respective County

Agricultural Commissioners for a permit. Information on restrictions and exceptions, as well as regulated plants, plant parts, and counties, can be found on the CDFA (www.cdfa.ca.gov and APHIS (www.aphis.usda.gov) web sites.



Hosts, symptoms, and diagnosis

P. ramorum affects different species in different ways. It can be lethal to tanoak, coast live oak, California black oak, Shreve's oak, canyon live oak, madrone and some manzanitas, yet it may cause only a minor leaf or needle disease in hosts such as California bay laurel, coast redwood, and Douglas-fir. Many landscaping plants, such as rhododendron, camellia, pieris, viburnum, and lilac are also hosts for the pathogen. The list of species and varieties known to be susceptible continues to grow; check www.suddenoakdeath.org for an up-to-date host list.

Because other organisms and injuries can produce symptoms that look similar to those produced by a *P. ramorum* infection, visual identification alone is inadequate to determine pathogen presence. A lab test is required for absolute certainty. Below are some steps that can help you determine if *P. ramorum* is likely and whether to submit a sample for further testing.

(1) Determine if your plant is a known susceptible species. Check the most recent list of affected plants online at www.suddenoakdeath.org but note that this list is continually expanding.

(2) Determine if you are in an infested area. Check the online maps at www.suddenoakdeath.org or contact staff in your local County Extension, Agricultural Commissioner, or California Department of Forestry and Fire Protection (CALFIRE) office. If you are outside of an infested area, your plant could still be infected with *P. ramorum*, particularly if it was recently purchased.

(3) Compare the *P. ramorum* symptoms found online with those found on your plant. Check other known susceptible species nearby. Do they have leaf spots or other *P. ramorum* symptoms? Symptomatic oak, California bay laurel, camellia, and rhododendron photos are featured here. More symptomatic host photos can be found online at www.suddenoakdeath.org.

The probability that your plant is infected with *P. ramorum* will be greater if it is a known susceptible species, if it exhibits typical symptoms, and if it is located in an infested area where other trees and plants are showing symptoms. Contact your local Cooperative Extension or County Agriculture office for more information and assistance in collecting and submitting a sample for laboratory testing.

Treatments

While there is no known cure for infected trees, the phosphonate compound Agri-Fos® is registered with the California Department of Pesticide Regulation as a preventative treatment for *Phytophthora ramorum* on oak and tanoak trees. Although not a cure, it can help protect high-risk, susceptible trees from infection, as well as suppress disease progression if applied in the very early stages of infection. Agri-Fos® may be injected directly into the trunk or mixed with the surfactant PentraBark®, and sprayed on the trunk for absorption through the bark. The optimal treatment routine for oaks calls for two applications the first year followed by one application annually thereafter. It is recommended to treat either in the fall then spring, or spring then fall the first year. Follow up treatments should be only in the fall annually (avoid treatments when temperatures are very low). If risk is minimal, meaning low abundance of infections or host species in the area, follow-up treatments can be applied bi-annually.

Determining which trees to treat can be challenging because of unpredictable pathogen activity and patchy disease distribution. Generally, you should treat healthy, high-value oak or tanoak trees within 150ft of known infested plants, or if they are surrounded by California bay laurel trees and there are known infections between 150ft and 1000ft away. In areas where infested plants are not already present, this preventative oak treatment is not recommended since the risk of oak infection is minimal. When deciding whether or not to use Agri-Fos® to help slow the spread of the pathogen in a recently infected tree, be sure the infection (canker) covers less than 5% of the trunk circumference, that there is no browning of the foliage, and that secondary attacks by insects and fungi have not already begun.



Bleeding cankers on a coast live oak trunk (Photo by Matteo Garbelotto, University of California, Berkeley)



Bay laurel leaf spots (Photo by Matteo Garbelotto, University of California, Berkeley)



Camellia symptoms (Photo by Cheryl Blomquist, California Department of Food & Agriculture)



Rhododendron leaf spots (Photo by B. Moltzan, Missouri Department of Conservation)

Other treatment options: Insecticides were commonly used in 2000 during the initial disease outbreak; however, it is now known that insect attacks are secondary to pathogen infection. Insecticide application is not recommended. Other treatment options, such as soil amendments, have not been found effective under controlled experiments; they are also not recommended.

Oak care considerations

Sudden Oak Death is caused by a virulent, exotic pathogen, capable of killing healthy trees. Even though you may not prevent a *P. ramorum* infection, keeping oaks healthy (i.e., by creating favorable growing conditions, avoiding disturbances to the root zone, avoiding unnecessary pruning, pruning properly, avoiding harmful landscaping and gardening practices, and mitigating environmental stress) may alleviate many other more common problems of oaks in landscapes. Although native oaks are well-adapted to their local environment, various climatic events and disturbances within the root zone can cause stress and increase vulnerability to pest attack. Drought, unusually wet springs, regular and frequent irrigation, root loss, poor drainage, soil compaction, and pavement are common factors causing stress. Maintaining or restoring favorable growing conditions and avoiding disturbances are the best ways to maintain tree health.

Pruning of oak trees should be avoided or minimized in *P. ramorum*-infested areas, as wounds may serve as pathogen entry points, and attract bark beetles. Arboricultural work and equipment may also transport infectious spores to uncontaminated sites. Prune only as necessary and avoid excessive foliage removal. Removing more than 20% of a mature oak's foliage can impair its health. If possible, avoid pruning in winter and spring months, when there is increased risk of pathogen spread. Work with clients to schedule pruning of *P. ramorum*-infected trees, shrubs, and host species during the dry summer months.

Plant selection and placement

The listing of a species as a *P. ramorum*-regulated plant does not preclude it from a well-designed garden. Many native plants are susceptible to the pathogen; however, they are also well-suited to many California gardens, their symptoms are minor and non-lethal, and they contribute negligibly to pathogen spread. On the other hand, some species, including California bay laurel, rhododendrons, and camellias, have been shown to support substantial *P. ramorum* sporulation on their leaves, which may contribute greatly to the spread of the pathogen. Additionally, the summer watering necessary to keep some non-native species alive under an oak tree may severely predispose the oak to other diseases. In all cases, it may be prudent to plant *P. ramorum* host plants at least 15 feet away and downslope from any susceptible oaks, and to only plant species with similar watering requirements (i.e., drought-tolerant species) near these trees.

Nurseries confirmed as having infected plant material are required to follow the Confirmed Nursery Protocol for *P. ramorum*, which includes the destruction of infected plants. Despite these safeguards, when making a purchase from a nursery, it is still prudent to assess a plant's overall health, checking for any symptoms. After purchasing a host plant, keep the plant in a holding area, away from other landscape plants, for a period of eight weeks. Should the plant be infected, this will allow time for disease symptom expression to occur before placing the plant in the landscape. Whenever possible, refrain from planting *P. ramorum* host species near susceptible oaks and tanoaks, as well as California bay laurel trees.

If you have lost or removed a *P. ramorum*-infected tree and want to replant at the same site, it is important to choose a plant that will suit your needs and adapt well to the location. There are many resources available that can guide you in making the right choice. Check for any local ordinances or guidelines that govern tree replacement or planting. Currently, *P. ramorum*-resistant planting stock is not available. Replanting the same species of tree that was lost may result in the new tree contracting the disease. Coast live oaks do not seem to become infected by *P. ramorum* until they reach at least 4" in diameter. Species in the white oak group, such as valley oak, Garry oak, and blue oak are not known to be susceptible to *P. ramorum*.

Plant removal

It has been determined that California bay laurel, as well as other trees and shrubs, may be a source of infection for neighboring oaks. Depending on the particular site characteristics, removal of California bay laurel may be advisable as a preventative measure.

Infected oaks (*Quercus* species only) do not spread the pathogen to other plants and need not be removed as a disease control measure; however, structurally unsound trees should be removed if they pose a threat to life or property. The decision to remove a hazardous tree ultimately lies with the property owner. In order to get an objective assessment of hazardous conditions, contact a certified arborist or other qualified professional. Always consult city or county officials regarding local tree ordinances before deciding to remove trees. Experienced tree service technicians should conduct tree felling, as infected trees may have an abundance of structural wood decay. In the event of an acute emergency, such as a visible increase in a tree's lean or hearing a tree splitting, contact your city arborist or local fire or police department.

If you do remove an infected plant or dead tree, please see the **Debris disposal** section for further guidelines.

Debris disposal

Disposal of infested material is extremely important because branches, twigs, and leaves from California bay laurel, tanoak, rhododendron, and other host plants may harbor the pathogen. If infested plant debris or infected live plants are moved, they may inadvertently transfer the pathogen to uninfested areas. For this reason, we recommend that plant material remain on-site. If plant material must be transported, the vehicle bed should be tightly tarped or enclosed. See the **Quarantine regulations** section for more details on moving plant material. Alternatively, infested material may be piled and burned during the burning season. If burning is prohibited, small material left on-site should be chipped and spread out in a thin layer in a sunny location to promote drying. Larger pieces should be kept on-site and used for firewood. Woodpiles should be left to dry away from other vegetation and stored in a dry location during the rainy season. Do not leave infested material in an area where it might be transported (e.g. along a roadside). While composting is another alternative for disposing of infested material, it is only effective in pathogen elimination when it reaches temperatures consistent with commercial requirements, making it a challenging option for homeowners.

Sanitation measures to minimize pathogen spread

The following precautionary measures are recommended to help limit the inadvertent spread of *P. ramorum*:

- Prepare and use sanitation kits consisting of: chlorine bleach and water (10:90 mixture of bleach:water), Clorox Clean-up®, or Lysol®; a scrub brush, metal scraper, or boot brush; and plastic gloves. Tools used in tree removal and pruning may become contaminated and should be disinfected with Lysol® spray, a 70% or greater solution of alcohol, or a Clorox® solution (1 part Clorox®:9 parts water, or Clorox Clean-up®). Remember that these products are corrosive to metal and fabric, so rinse your gear with water after sanitation to remove corrosives. If equipment such as chainsaws cannot be treated with disinfectants, consider running them through a non-host plant before leaving the infested site to break free any lodged material.
- When possible, work on *P. ramorum*-infested and -susceptible species during the dry season or ask customers to allow flexible scheduling so work may be done during dry periods. When working in wet conditions, keep equipment on paved or dry surfaces and avoid mud.
- Do not collect soil or plant material (wood, brush, leaves, litter, etc.) from host trees in the quarantined 16-county area without first contacting the local agricultural commissioner for approval.
- Sanitize shoes, pruning gear, and other equipment before working in an area with susceptible plants. Before leaving a *P. ramorum*-infested site, use all reasonable methods to sanitize gear and equipment. Scrape, brush, and/or hose off accumulated soil and mud from clothing, gloves, boots, and shoes. Remove mud and plant debris by blowing out or power washing trucks and other vehicles. If complete on-site sanitation is not possible, finish decontaminating at a local power wash facility or an isolated area in your equipment yard. Clean, orderly vehicles and equipment are good business, and prevent pathogen and insect spread.