

Sudden Oak Death Guidelines for Arborists

A plant disease known as Sudden Oak Death is threatening coastal forests in California and Oregon. Currently found in 14 coastal counties from Monterey to Humboldt and in a small portion of southwest Oregon, the disease is caused by the pathogen *Phytophthora ramorum*. Sudden Oak Death has resulted in the death of over a million tanoak, coast live oak, California black oak, Shreve oak, and canyon live oak trees. In addition, more than 100 other plant species are susceptible to the organism, yet most of these species suffer only minor damage, limited to leaf spots or twig dieback. This guide provides practical information for arborists on treatments, oak tree health, safety issues, and how to work on host plants without spreading the pathogen.

Pathogen biology

Phytophthora ramorum prefers moist environments and mild temperatures. During wet periods, the organism is most active and therefore most likely to start new infections. Therefore, the risk of movement and spread of the organism is greatest in muddy, wet areas and during rainy weather. *P. ramorum* spores can be found in living, dying, or recently dead plants as well as in infested waterways and soil, and may be transported to new areas when infected plant material or infested soil is moved. The pathogen also spreads via wind-blown rain.

Quarantine regulations

Movement and disposal of all plant materials (except seeds and acorns) of *Phytophthora ramorum* host species are regulated by the California Department of Food and Agriculture (CDFA) and the U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS). Quarantine regulations have been enacted for Alameda, Contra Costa, Humboldt, Lake, Marin, Solano, Sonoma, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, Mendocino and Monterey Counties (see map). There are no restrictions within this 14-county zone, but before moving susceptible plant material out of the quarantine area, you must contact your county agricultural commissioner for a permit. Restrictions and exceptions are provided at the CDFA and APHIS websites. Additionally, all nurseries in CA, OR and WA are under regulation for *P. ramorum*.

While not legally required within the 14 infested counties, thorough cleaning of tools and equipment between jobs and careful safeguarding of susceptible species while transporting is recommended.

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California
Oak Mortality
Task Force

Cultural treatments

California bay laurels greatly contribute to disease spread to oaks. If oaks dominate the site and are the preferred species, consider removing CA bay laurels whose canopies are within 15 feet of the trunks of valued oaks. CA bay laurels are prolific sprouters so continued maintenance or herbicide stump application may be necessary to eliminate regrowth. Combining bay removal with chemical treatments (see below) may be a viable option if the oaks are very high-value and if the removal of the CA bay laurel will not diminish landscape value. Keep in mind that bays are important for many wildlife species, and should the oaks be lost, bay trees may be the only remaining mature trees. Bay removal is most effective as a preventative treatment.

For isolated infestations (more than 25 miles from known infested areas), a more aggressive, inoculum reduction approach may be worthwhile. In heavily infested areas, inoculum levels are thought to be too high to reduce via removal of infected plant material and duff, but in cases where the pathogen appears to be detected at a very early stage these efforts may prevent pathogen spread. *P. ramorum* sporeloads may be reduced through the removal of known infected trees and neighboring symptomatic hosts and the clean-up of host litter from under the canopy before winter rains enhance spore dispersal. Before implementing any aggressive removal treatments with an aim of reducing inoculum loads, you should first confirm: (1) the presence of *P. ramorum* through laboratory testing; and (2) the distribution and relative abundance of the pathogen in the area.

Chemical treatments

Agri-Fos® (systemic fungicide) and Pentra-Bark™ (surfactant) were approved in 2003 by the California Department of Pesticide Regulation (DPR), under a FIFRA Section 24c Special Local Needs Label, as a treatment for oaks* and tanoaks that are at high risk of contracting *Phytophthora ramorum*. Agri-Fos® is not a universal “cure;” this treatment will not cure trees when *P. ramorum* is already established. Designed primarily for use on high-value trees in yards and gardens, Agri-Fos® is a preventive treatment, and is most effective for inhibiting infection in uninfected trees. Agri-Fos® is systemic; it is translocated through the tree and is thought to enhance the tree’s defensive mechanisms. Agri-Fos® requires an estimated 4-6 weeks to be assimilated by the plant before resistance to the pathogen is fully attained.

Agri-Fos® may be used with Pentra-Bark™ penetrant and applied to the trunk and lower limbs (avoiding the leaves) for absorption through the bark or injected into the tree with a drill and an injector. For injection, holes into the wood are drilled approximately every 6” around the circumference of the tree and the material applied under pressure. Refrain from repeatedly drilling and injecting smaller-diameter trees over the course of a multi-year treatment. If applying to the bark, trees with thick accumulations of moss will need to be scraped free of moss prior to application, and surrounding plants will need to be protected from any spray drift. The optimal treatment routine for coast live oaks calls for two applications the first year followed by one application annually thereafter. It is recommended to treat in the fall and then in the spring, or spring then fall the first year. Annual follow up treatments should be only in the fall, avoiding times when trees are not physiologically active. Always apply the material according to the label.

* Treatment recommendations for oak species are based on research trials with coast live oak. Efficacy data for other oak species is not yet available.

Selection of candidate trees for chemical treatment: Since Agri-Fos® must be used on healthy trees and *P. ramorum*'s distribution and activity is patchy and somewhat unpredictable, it is difficult to determine which trees are worth treating. Summarized below are some general guidelines. Treatment may be warranted for healthy, high-value oak and tanoak trees within 3 miles of known infested plants (e.g., CA bay laurel, oaks, or others). Conversely, treatment is NOT recommended in areas distant (more than 3 miles) from infested areas.

If symptoms indicate *P. ramorum*, or if the pathogen is CDFA confirmed, consider treating the adjoining high value, non-symptomatic oaks to reduce the likelihood of infection. Tanoaks, however, if they are within 200 yards of any infested plant, should be considered already infested and are not suitable for preventative treatments.

Trees with poor form, poor growth, a spiral growth pattern, an abundance of decay pockets, punk knots, and other malformations on the lower stem will not adequately intake the material and should not be treated. Trees whose vigor has been compromised by other diseases or injuries should not be treated.

Use of insecticides: The use of insecticides to prevent *P. ramorum* infection or to prolong the life of infected trees has not been demonstrated in scientific studies to be beneficial. Insecticides do not prevent pathogen infection and tree death, as the pathogen alone is capable of killing trees.

NOTE: Trees with advanced symptoms (e.g., multiple bleeding areas, extensive beetle attack, numerous *Hypoxylon* fruiting-bodies on the bark surface, and/or a sparse or brown canopy) cannot be saved, although some will survive through natural resistance. Some trees will maintain a green canopy despite displaying many of the above signs and symptoms. Sparse foliage may be due to other factors, such as oak worm.

Tree removal issues

Oak and tanoak trees infected or killed by *P. ramorum* are prone to rapid decay and unpredictable failure. Arborists and other tree care professionals need to be very cautious about climbing *P. ramorum*-infected or killed trees. Infected green trees, as well as trees killed by *P. ramorum* and/or secondary pests, are at increased risk of trunk and limb breakage. Prior to the removal of Sudden Oak Death-infected trees or when working in areas where diseased trees are present, provide a “tailgate safety talk” that covers points discussed below to inform crews of special precautions for working in structurally compromised trees.

A study of the failure potential of coast live oak trees found a strong association between advanced symptoms of *P. ramorum* and branch, scaffold limb, bole, and root crown failures. At least one third of these failures occurred in live trees and stems. The failure rate for infested coast live oak and tanoak was more than 10 times greater than healthy trees. Wood decay was present in almost all failures and was the most consistent and important factor influencing failure potential. Trees with indications of wood decay or deterioration because of beetles and *Hypoxylon* should be removed if they jeopardize emergency access/egress, life, or property. Evaluate structural hazard potential and remove those trees that pose a risk to people, property, pets, livestock, etc. Also consider removing recently killed trees as well as brush and other dead material to lessen the fire hazard potential.

Coast live oak trees are also prone to summer branch failure. Reduced moisture content in infected trees may contribute to branch failure. The wood of *P. ramorum*-infested trees appears to decay rapidly, often resulting in failure within a few months of dying. Diseased trees heavily colonized by bark and ambrosia beetles and the *Hypoxylon* fungus may fail before they have died (while they are still green). Trees that are hazardous to

life, property, roads, campgrounds and other high use areas should be felled without delay. Arborists should pay special attention to Sudden Oak Death trees with internal decay or other structural defects that could increase failure potential or threaten the safety of tree workers.

Cut tree stumps as close to the ground as practical. Stump grinding is not recommended because the equipment may become contaminated by soil and result in pathogen spread when used at another location. The operation of vehicles or heavy equipment in such areas may lead to further disease spread when soil is disturbed and moved around. If at all practical, schedule tree removals from June to October when conditions are warm and dry, and avoid removing diseased trees when moist conditions favor pathogen spread – November to May.

Debris disposal

Proper disposal of infested material contributes toward limiting pathogen spread. In generally-infested areas, leaving *P. ramorum*-infested or killed oak trees on site has not been shown to increase the risk of infection to adjacent trees. Removal from the property is only recommended if it is the first infected tree to be detected in the area, if fire risk is high, or for aesthetic or other reasons. Whenever possible, leave tree debris on site in a safe area where woody debris will not become dislodged, endanger children, contaminate uninfected hosts, or constitute a fire hazard. When infected oaks are cut down and left on site, chip the branches and cut and split the wood. To prevent pathogen spread via muddy boots or equipment, avoid chipping in wet weather. Stack woodpiles in sunny locations to promote rapid drying. Do not leave firewood and chips in an area where they might be transported to another location (e.g. curbside).

Try to dispose of infested materials down slope of, and away from host species. Most dead oaks in rural areas are not easily disposed of due to the steep or rugged terrain or lack of access. Such trees may be felled or left to fall on their own, depending on whether there is a target of value. Leaving infected trees intact on site may benefit wildlife. Dead trees on the edge of oak woodlands adjacent to grass or brush areas (transition zones) can increase fire risk and encourage canopy fires in woodlands. Such trees should be cut up and moved 10 to 30 feet away from the remaining trees, depending on slope. If chipping is not possible, reduce fire hazard by lopping and scattering branches so they lay close to the ground at least 30 feet away from any structure, driveway, roadside, or propane tank (consult your local fire department).

If debris cannot be left on site, infested material should be disposed of at an approved and permitted dump facility. Quarantined materials may move within the quarantine area (in California, the 14 infested counties), but not into non-quarantine areas without approval of the county agricultural commissioner. Do not sell host plants, firewood, wood chip or bark mulch, or compost that originated within the quarantine area without first contacting your local agricultural commissioner's office. As a buyer, check the source of all such material.

Sanitation measures to minimize pathogen spread

As a precaution against spreading the pathogen, clean and disinfect pruning tools after use on confirmed or suspected infested trees or in known infested areas. Sanitize tools before pruning healthy trees or working in pathogen-free areas. Clean chippers and other vehicles of mud, dirt, leaves, organic material, and woody debris before leaving a *P. ramorum* site and before entering a site with susceptible hosts.

Before working

- Inform crews about the arboricultural implications of *P. ramorum* and sanitation practices when they are working in infested areas.
- Provide crews with sanitation kits. (Sanitation kits should contain the following: Chlorine bleach [10/90 mixture bleach to water] or Clorox Clean-up® or Lysol®, scrub brush, metal scraper, boot brush, and plastic gloves).
- Sanitize shoes, pruning gear, and other equipment before working in an area with susceptible species.

While working

- When possible, work on *P. ramorum*-infected and susceptible species during the dry season (June-October) or ask customers to allow flexible scheduling so work may be done during dry spells. When working in wet conditions, keep equipment on paved, graveled, or dry surfaces and avoid mud.
- Work in disease-free areas before proceeding to infested areas.
- If possible, do not collect soil or plant material (wood, brush, leaves, and litter) from host trees in the quarantine area. Within the quarantine area, host material (e.g., wood, bark, brush, chips, leaves, or firewood) from tree removals or pruning of symptomatic or non-symptomatic host plants should remain on site to minimize pathogen spread.

After working

- Use all reasonable methods to sanitize personal gear and crew equipment before leaving a *P. ramorum*-infested site. 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 chipper trucks, chippers, bucket trucks, fertilization and soil aeration equipment, cranes, and other vehicles.
- Restrict the movement of soil and leaf litter under and around infected trees as spores may be found there. Contaminated soil, particularly mud, on vehicle tires, boots, shovels, stump grinders, trenchers, etc., may result in pathogen spread if moved to a new, uninfested site. Remove or wash off soil and mud from these items before use at another site. If complete on-site sanitation is not possible, complete the work at a local power wash facility or an isolated area in your equipment yard. Maintaining clean, orderly vehicles and equipment is good business, and prevents pathogen and weed-seed spread.
- Tools used in tree removal/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® to 9 parts water or Clorox Clean-up®). Remember that these products are corrosive to metal and fabric. Rinse your gear after sanitation.

Tree care considerations

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, is prudent for the general health of oaks. However, these efforts may not prevent Sudden Oak Death. This disease is caused by a virulent pathogen, capable of killing healthy trees.

Although native oaks are well-adapted to their local environment, various climatic events, irrigation, and disturbances within the root zone can cause stress and increase vulnerability to pest attack. Drought, unusually wet soil conditions, 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: Pruning of host plants should be avoided or minimized as wounds may serve as entry sites for this disease and attract bark beetles. Also, arboricultural tools and equipment may 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 or shrubs, or host species during the dry months of June through October. Strictly follow arboricultural pruning standards (ISA Pruning Standards and ANSI A300). If pruning of major limbs (over 4 inches diameter) or stems is necessary, it may be helpful to remove bay branches from the proximity (within 8 feet).

Preliminary research also suggests that amending the top organic layer of soil near susceptible oaks with a commercial grade compost may help prevent *P. ramorum* from spreading through soil splash.

References and resources

- Distribution of Sudden Oak Death: kellylab.berkeley.edu/SODmonitoring/OakMapper.htm
- Treatment recommendations: Forest Pathology and Mycology Laboratory, Matteo Garbelotto, UC-Berkeley, <http://www.cnr.berkeley.edu/garbelotto/english/treatment.php>
 - Garbelotto, M. (2007) Phosphite treatments to control sudden oak death in California oaks and tanoaks. *Arborist News*, August: 32-33. <http://www.cnr.berkeley.edu/garbelotto/downloads/ArbNews2007.pdf>
 - Garbelotto, M., Schmidt, D., & Harnik, Y. (2007) Phosphite injections and bark application of phosphite + Pentrabark control Sudden Oak Death in Coast Live Oak. *Arboriculture & Urban Forestry* 33(5): 309-317. <http://www.cnr.berkeley.edu/garbelotto/downloads/AandUF2007.pdf>
- Failure potential in coast live oak: Phytosphere Research, Ted Swiecki, http://phytosphere.com/publications/Phytophthora_case-control2006-2007.htm
- Drying infested wood to destroy the pathogen: ceres.ca.gov/foreststeward/html/treenotes.html
- California Department of Food & Agriculture (CDFA): www.cdfa.ca.gov/index.htm
- USDA, Animal & Plant Health Inspection Service (APHIS): http://www.aphis.usda.gov/plant_health/plant_pest_info/
- General information of Sudden Oak Death: The California Oak Mortality Task Force (COMTF), www.suddenoakdeath.org

NOTE: The recommendations above are based on the best science and professional judgment currently available. Studies conducted on the use of Agri-Fos® and Pentra-Bark™ against *P. ramorum* are relatively new and ongoing; therefore recommendations are subject to change. Studies on insecticide effectiveness and cultural treatments are also limited. Reference herein to these specific commercial products does not constitute or imply its favoring by the COMTF. Before choosing to use any chemical application, always consider potentially adverse environmental impacts.