



April 2007

## Protecting Your Oak Trees from Sudden Oak Death

*Phytophthora ramorum*, an introduced, invasive plant pathogen that causes Sudden Oak Death, has killed over a million tanoak, coast live oak, Shreve's oak, and California black oak trees along the California coastal region from Monterey through Humboldt Counties. Not every tree infected by *P. ramorum* will die, but many will, potentially including prized landscape trees. Over the last seven years, scientists have learned a few things about how to maximize a tree's chances of resisting a *P. ramorum* infection. This guide is designed to help you help your backyard oak trees.

### ***First Steps***

The first step is to determine whether your tanoak, coast live oak, Shreve's oak, or California black oak trees are not already infected with *P. ramorum*. Symptom guides are available at [www.suddenoakdeath.org](http://www.suddenoakdeath.org). However, many other tree disease symptoms closely resemble those caused by *P. ramorum*, so symptoms alone are not sufficient for diagnosis; laboratory confirmation is required. Your County Agriculture Department or UC Cooperative Extension office can help you obtain and submit a sample to an approved laboratory for free testing.

If your trees are disease-free, the best way to keep them healthy is to avoid introducing pathogens to them in the first place. Educate yourself on where *P. ramorum* is distributed in California at [www.suddenoakdeath.org](http://www.suddenoakdeath.org). Is *P. ramorum* established in your area or in nearby watersheds? If you must travel or recreate in infested areas, thoroughly clean your shoes, vehicles, tools, equipment, and pets before returning to uninfested areas. *P. ramorum* can also be transported on plants bought in nurseries, so when purchasing plants, check them carefully for leaf-spots, and avoid plants that look thin or off-color. Bring questionable specimens to the attention of the nursery owner. If you buy a *P. ramorum* host, you may want to leave it outside for two months before outplanting to be sure that no symptoms of *P. ramorum* infection show up. The pathogen can move unpredictably and quickly, so if it is established nearby and your oak trees are particularly important to you, consider the following preventative treatment options.

### ***Chemical Control of P. ramorum Infection***

To date, the most promising treatment for individual oak and tanoak trees vulnerable to *P. ramorum* is a systemic fungicide called phosphonate (trade name Agri-Fos®), especially when used in conjunction with removal of nearby California bay laurel trees (see last page). *Agri-Fos® is only effective on tanoak and oak tree species and is not effective on other tree types such as Pacific madrone or California bay laurel.*

Phosphonate is a neutralized form of phosphorous acid (H<sub>3</sub>PO<sub>3</sub>). Although it was initially investigated as a potential fertilizer, phosphonate soon became recognized for its systemic fungicidal properties. Systemic fungicides work by traveling through the tree's transport system to all parts of the tree (as opposed to killing only the pathogens with which the fungicide comes into initial direct contact). Phosphonate fungicide stimulates the tree's resistance to pathogen invasion and pathogen growth.

## - Knowing When to Chemically Treat

The usual symptom indicating that *P. ramorum* has infected the tree is the presence of one or more discolored areas of dead bark, called “cankers,” located on the trunk. These cankers commonly occur anywhere on the trunk from ground level to eye level (on tanoaks, they can be anywhere on the woody parts of the tree except the roots). The cankers often exude a more or less viscous, sap-like substance—the tree’s active response to the infection—that can bleed and run from the canker down the trunk or can stain moss on the trunk brown. Removing the bark from the canker location will reveal a patch of dead (brown) tissue beneath.

Phosphonate fungicide is most effective as a preventative treatment on trees that are not yet infected. In some cases of very recent infections, phosphonate can help slow the progress of the infection, potentially prolonging the tree’s life. However, the stage of infection is extremely difficult to gauge: the pathogen can infect a large proportion of the bark (and even move into the sapwood) before external symptoms appear. This is especially true of tanoak. The cankers in the picture below right, for example, were not visible until the bark was removed. Thus, only treat tanoaks that are definitely uninfected at the time of treatment. In the case of true oaks, cankers should be few in number (one or two) and extremely small (dime-sized or smaller and covering less than 10% of tree circumference) for there to be any hope of slowing tree decline.



Tanoak stem with many cankers



Small cankers beneath tanoak bark

## - Methods of Chemical Treatment

Since phosphonate is a systemic fungicide, the applicator must apply the product in such a way that the tree will “accept” it and distribute it throughout its transport system. Two means for doing this exist: injections into the tree and topical sprays. Injections use less product but are more difficult to apply, since the applicator must use a syringe or hydraulic injector that can apply constant pressure for a certain length of time, so that the tree does not reject the product. Sprays are simpler to use, but they require an additional product mixed with the phosphonate fungicide. This product is Pentra-Bark®, a surfactant that enables the fungicide to better penetrate the bark. The spray method also requires more product, and drift may damage leaves, mosses, or lichens that are inadvertently treated.

We recommend that homeowners utilize spray application because of the technical difficulties involved with the injection method. We encourage homeowners to consult the following resources for guidance before treating trees.

Resource	Guidance/advice offered
Garbelotto Research Lab, UC Berkeley ( <a href="http://www.nature.berkeley.edu/garbelotto">www.nature.berkeley.edu/garbelotto</a> )	Detailed guidelines on both spray and injection treatments
California Oak Mortality Task Force ( <a href="http://www.suddenoakdeath.org">www.suddenoakdeath.org</a> )	Information about all aspects of Sudden Oak Death, including symptoms, host plants, research, and county contacts
County Agriculture Commissioner ( <a href="http://www.cdfa.ca.gov">www.cdfa.ca.gov</a> )	Information about regulations, fungicide application, and how to submit samples
UC Cooperative Extension ( <a href="http://ucanr.org">http://ucanr.org</a> )	General information, technical advice, and help with recognizing Sudden Oak Death symptoms
Certified Arborists ( <a href="http://www.isa-arbor.com">www.isa-arbor.com</a> )	Purchase and professional application of phosphonate fungicide treatment

### - Applying Phosphonate Fungicide Spray

You will need the following equipment in order to treat your tree with phosphonate fungicide spray:

- Agri-fos® systemic fungicide
- Pentra-bark® surfactant
- Liquid measuring devices (measuring cup)
- Plastic mixing containers (bucket or tank)
- Sprayer: hydraulic or pump-type, handheld or backpack-mounted
- Water
- Gloves
- Safety glasses or face shield

When applying the Agri-Fos®/Pentra-Bark® mixture to trees, wear gloves, safety glasses, and long sleeves (and, if desired, a face shield; the mixture may drift and can irritate the skin).

Mix Agri-Fos® with Pentra-Bark® and water in the proportion specified on the label, which yields one gallon of spray mix: **62.4 oz (1.9L) Agri-Fos® + 62.4 oz. (1.9 L) water + 3.2 oz (95 ml) Pentra-Bark®**. Mix in the following order: water, then Pentra-Bark®, then Agri-Fos®, so that the Pentra-Bark® will dissolve properly in the water and will not precipitate out at the bottom of the sprayer. Gently shake and pour into sprayer.

Apply the treatment solution to the tree trunk, on all sides, as high as you can reach without spraying foliage. Spray until the treatment solution begins to run down the bark of the tree. Thoroughly apply solution to cracks, splits, and multiple trunks. Try to avoid spraying foliage of the target tree or other plants in the vicinity, since the spray mixture severely damages foliage.

**- Safety**

Agri-Fos® is registered for use against *P. ramorum* in California. It is not classified as a hazardous substance, although anyone applying it should read and follow the precautions on the product label. Since phosphorus is a naturally occurring element essential for tree health, spraying Agri-Fos® on uninfected trees or other tree types will not hurt them.

You must dispose of any leftover product that you do not want either on the site of use or at an approved waste disposal facility. Both Agri-Fos® and Pentra-Bark® have indefinite shelf lives before they are mixed together; however, after mixing, they should be used within a few weeks. If you store the spray mixture for a few days or few weeks, re-agitate the sprayer upon retrieval from storage to ensure the chemicals are properly dissolved before application.



Applying Agri-fos® spray mixture

Prior to spraying, you may want to tarp adjacent plants that you want to protect from drift. Although you should make sure vehicles, tools, pets and other valuables are not in the drift zone, at the concentrations used for this application, Agri-Fos® is non-toxic even to fish, which are very sensitive to chemicals in the environment. Nor does Agri-Fos® normally reach groundwater, since it binds strongly to targeted tree bark and to soil particles and is subsequently biodegraded.

**- Treatment Schedule**

Apply Agri-Fos® and Pentra-Bark® in the spring or fall. This is when trees’ vascular systems are most active. Follow the initial treatment up with a second treatment six months later. Thereafter, treat every year and a half.

<b>Example treatment schedule</b>		
	<b>Example 1 (spring start)</b>	<b>Example 2 (fall start)</b>
<b>Initial application:</b>	Spring 2007	Fall 2007
<b>Second application:</b>	Fall 2007	Spring 2008
<b>Booster:</b>	Spring 2009	Fall 2009
<b>Booster:</b>	Fall 2010	Spring 2011
<b>Booster:</b>	Spring 2012	Fall 2012

## - Where to Obtain Phosphonate Fungicide in California

Homeowners in California can obtain Agri-Fos® systemic fungicide and Pentra-Bark® surfactant through the following distributors<sup>1</sup>.

Distributor	Address	Telephone	Web site
<b>Adachi Nursery</b>	5166 Sobrante Avenue, El Sobrante, CA 94803	(510) 223-6711	www.florists.ftd.com/adachi
<b>Armstrong Garden Center</b>	1430 South Novato Boulevard, Novato, CA 94945	(800) 55-PLANT or (626) 914-1091	www.armstronggarden.com
<b>BioScape</b>	4381 Bodega Avenue, Petaluma, CA 94952	(707) 781-9233	www.Bioscape.com
<b>Bokay Nursery</b>	30 Hitchcock Road, Salinas, CA 93901	(831) 455-1868	www.bokaynursery.com
<b>Capital Nursery</b>	4700 Freeport Boulevard, Sacramento, CA 95822	(916) 455-2601	www.capitalnursery.com
<b>Highlands Soil and Water</b>	425 Alta Street, Building 16, Gonzales, CA 93926	(925) 324-0039	www.healthysoil.com
<b>Ladera Garden Center</b>	3130 Alpine Road, Suite 380, Portola Valley, CA 94028	(650) 854-3850	N/A
<b>Mid City Nursery</b>	3635 Broadway Street, American Canyon, CA 94503	(707) 642-4167	www.midcitynursery.com
<b>Monterey Lawn and Garden Products</b>	P.O. Box 35000, Fresno, CA 93745	(559) 499-2111	www.montereylawngarden.com
<b>Purity Products</b>	4 Maxwell Court, Santa Rosa, CA 95401	(707) 546-2585	N/A
<b>Sunnyside Nursery</b>	130 Sir Francis Drake Avenue, San Anselmo, CA 94960	(415)-453-2701	www.sunnysideofmarin.com

<sup>1</sup>Southern California distributors are not included for reasons of space and because the general area is not yet infested. Additionally, some businesses listed above have multiple locations. Mention of commercial products does not constitute endorsement by the University of California, UC Cooperative Extension Service, or USDA. Always follow the manufacturer's directions, restrictions, and precautions on the product label. Agri-Fos® Systemic Fungicide and Pentra-Bark® are registered trademarks of Agrichem Manufacturing Industries Pty, Ltd.

Agri-Fos® averages around \$80 per gallon from these distributors. Various distributors package the product differently and in different sizes, so comparison shopping is helpful. A mature coast live oak tree requires on average between 1-6 L (¼-2 gal) of spray mixture to treat (\$20-\$160 on average per application<sup>2</sup>); average-sized tanoaks may require significantly less.

<sup>2</sup>Homeowners may purchase and apply Agri-Fos® themselves. However, those who choose to hire certified tree care professionals for application should remember that labor costs are a consideration additional to the cost of materials presented here.



## **Cultural Control of *P. ramorum* Infection**

No data shows conclusively that any cultural techniques can prevent *P. ramorum* infection or lessen its impacts on individual trees. However, one possible useful strategy is implied by research showing that coast live oak trees growing near California bay laurel (also called pepperwood or Oregon myrtlewood) trees are at more risk of *P. ramorum* infection than those growing far from bay. This is because *P. ramorum* reproduces more readily on California bay laurel than on any other tree species, and the spores can then be blown or washed to other trees. Given this, it's reasonable to think that if you live in or near an area infested with *P. ramorum*, removal of bay laurel trees growing near your oaks may decrease the risk of oak infection. Bay laurel provides the same transmission risks for tanoak trees as well, so bay removal may also help prevent *P. ramorum* infection on tanoak.



California bay laurel

Although researchers are currently trying to expand the range of useful treatments aimed at preventing infection of plants by *P. ramorum* or designed to prolong the life of trees already infected by it, there are currently no recognized treatments for Sudden Oak Death other than the Agri-Fos®-based ones. UC Berkeley, for instance, has shown that treatments involving compost teas or mineral amendments (such as lime, Azomite, or crushed shells) were largely ineffective in slowing down the growth of girdling stem cankers and in preventing infection.

Other people have tried surgical removal of the bleeding cankers caused by *P. ramorum* on oak and tanoak trees. By cutting out all visible traces of the canker, this technique may have prolonged the life of some trees. However, since *P. ramorum* may extend farther into the tree's wood than is visible—and since many *P. ramorum*-caused cankers, especially on tanoak, do not show up on the outside of the bark—it is probably impossible to remove every canker manually. The homeowner should also keep in mind that a tree that is operated upon in this way will still be susceptible to new infections in the future. Since wounded trees are more likely to be infected by other pathogens, treating trees chemically is on the whole more likely to keep your tree's infection from getting worse as well as keeping the tree generally healthy.

## **Keeping Your Oak Trees Healthy**

Having adapted over thousands to years to California's Mediterranean climate, oak trees require a somewhat different regimen of care than most ornamental plants. Once you have done everything you can to insure that your oak trees are protected against *P. ramorum*, maintain as natural an environment as possible. Leave them undisturbed with no supplemental water or fertilizer. Additional oak tree care guidelines are posted on the California Oak Mortality Task Force and California Oak Foundation web sites at the following addresses:

[http://nature.berkeley.edu/comtf/html/maintaining\\_oak\\_tree\\_health.html](http://nature.berkeley.edu/comtf/html/maintaining_oak_tree_health.html)

[http://www.californiaoaks.org/html/oak\\_tree\\_care.html](http://www.californiaoaks.org/html/oak_tree_care.html)