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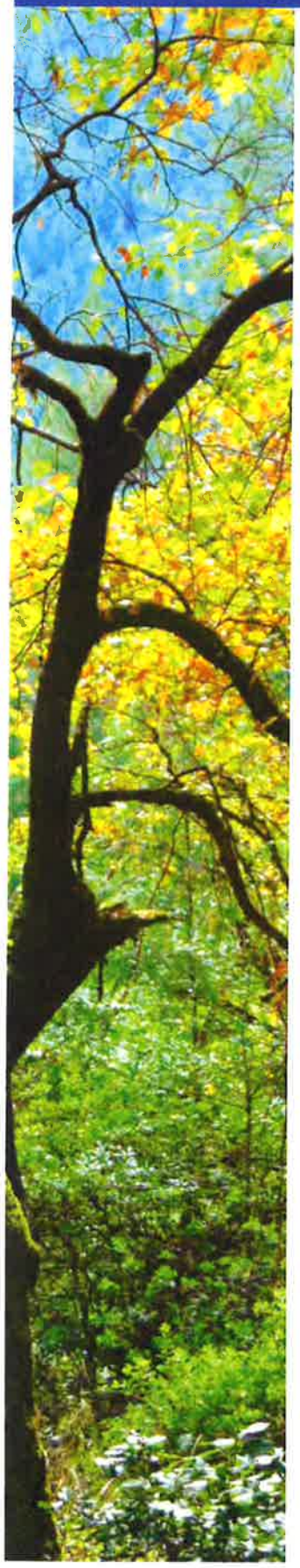

Protecting Trees from Sudden Oak Death before Infection

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Phytophthora ramorum, an introduced invasive plant pathogen that causes sudden oak death, has killed over a million tanoak, coast live oak, Shreve oak, and California black oak trees along the California coastal region from Monterey through Humboldt Counties. Most trees infected with *P. ramorum* will eventually die, including prized landscape trees. Be aware that *P. ramorum* can infect California bay laurel trees in advance of oak and tanoak infection and that the symptoms of bay laurel infection are not obvious. This publication provides advice to landowners, land managers, arborists, foresters, and the general public about protecting trees from sudden oak death in areas where trees are not currently infected by *P. ramorum*, but where it is suspected that the pathogen will infect trees in the future because infested areas are nearby. Such areas might include, for example, those at the outer edges of the known infested areas in California. Other publications, such as the UC IPM publication *Sudden Oak Death* (Swain and Alexander, 2010), outline measures you can take to care for trees in areas where the pathogen is already known to be present on oaks and tanoaks. To determine whether this information is appropriate to your situation, review the next section for the best ways to find out whether your trees are already infected or whether infected trees exist in your area.

First Steps for Tree Protection

First, determine whether your tanoak, coast live oak, Shreve oak, canyon live oak, or California black oak trees are already infected with *P. ramorum*. Other oak species, such as valley oak, blue oak, and Oregon white oak, are not susceptible to infection. Symptom guides are available at the California Oak Mortality Task Force Sudden Oak Death Web site (http://www.suddenoakdeath.org), but since many other tree disease symptoms closely resemble those caused by *P. ramorum*, 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 (see table 1).

It may be hard to determine whether *P. ramorum* is present in nearby landscapes. Maps are often inadequate and hard to update since the pathogen infects new stands of trees every year. Being observant and sensitive to your landscape and its changes is crucial, since there are warning signs to watch for.

If one or several of the following warning signs are present, submitting samples for official determination may be warranted, with the protective measures described below to follow depending on the results.

- **If nearby bay laurel trees display symptoms of infection (see fig. 1).** Bay laurel trees in a given area of California are usually infected before tanoaks are infected, so they serve as an advance warning of disease presence. However, this warning is subtle, since the symptoms are inconspicuous and resemble those caused by other pathogens. To get a better idea of the disease presence in your area, take many samples from many trees, and sample annually.
- **If large areas of dead live oaks or tanoaks (larger than approximately ¼ acre) exist within 1 to 3 miles of your property.** Many pathogens can cause occasional mortality of suppressed understory tanoaks, but large-scale mortality or mortality of more than one large, seemingly healthy tanoak can be a sign of the presence of *P. ramorum.* Since this funguslike pathogen needs moisture to survive and reproduce, it often becomes established near riparian areas and then moves into other areas of the forest, especially those with high concentrations of bay laurel trees. If you see dead tanoak stands or large groups of dead tanoaks near your property, this could be an indication that the pathogen is nearby. Sampling symptomatic bay laurel or tanoak trees to confirm its location is essential.

Figure 1. Common symptoms of *Phytophthora ramorum* infection on leaves of California bay laurel. *Photo:* Chris Lee.

If your trees and nearby forests are disease-free, the best way to keep them healthy is to avoid introducing the pathogen. Educate yourself at www.suddenoakdeath.org about where *P. ramorum* is distributed in California and how to avoid its introduction. 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 to be sure you do not transport the pathogen in infested soil. Make sure you do not move any plants or plant parts (including firewood) from infested to uninfested areas; plants and plant parts can be infectious even if no disease symptoms are visible.

Phytophthora ramorum can also be transported on plants bought in nurseries, so when purchasing plants, check them carefully and avoid plants that have leaf spots or off-color foliage (see "Nursery Guide for Diseases Caused by *Phytophthora ramorum* on Ornamentals" [Tjosvold et al. 2005] or photos of symptoms at www.suddenoakdeath.org). Bring questionable specimens to the attention of the nursery owner. If you buy a plant that can host *P. ramorum,* you may want to leave it in the pot for two months

before planting to be sure that no symptoms of *P. ramorum* infection show up.

The pathogen can move unpredictably, so if it is established relatively nearby in your region and your oak trees are important to you, consider the following preventive treatment options.

Encouraging Tree Health: Forest Stewardship and Integrated Pest Management across the Landscape

Managing *P. ramorum* in forested landscapes is challenging because of its introduced, invasive nature. Effective management of an invasive species such as *P. ramorum* requires an effort at overall good forest stewardship—an effort that takes into consideration the broader ecological context of your site, no matter what the scale.

Because tree health is largely influenced by competition with other trees for water, sunlight, and nutrients, good cultural care of individual trees and entire stands will foster tree vigor and resistance to many forest insect and disease pests. Such care is an important part of integrated pest management (IPM), an approach to pest management that also emphasizes the following elements: careful monitoring of pest populations; understanding and using the pest's life cycle requirements against it; the use of biological rather than chemical controls when possible; and tolerating low levels of pest populations rather than adhering to an eradication-type approach. Although fostering good tree health is not sufficient to protect trees from *P. ramorum* (as it often is with native forest pests), several of these other elements make up part of a good IPM program for protecting trees against the effects of *P. ramorum*.

For example, pre- and post-treatment monitoring is critical for protecting trees and stands against *P. ramorum*. As detailed in the section above, you must know where in your area *P. ramorum* is before you can know which tree protection steps will be most effective. Similarly, you can sometimes use certain aspects of *P. ramorum's* life cycle against it, as in the removal of bay laurel trees, the main carrier for the pathogen (see "Bay Laurel Removal," below), or as in controlling site humidity, which is speculated to create a less favorable environment for this water-loving pathogen. Although no known biological control for *P. ramorum* exists, one proven technique employs a systemic fungicide that stimulates the trees' natural defense response against the pathogen rather than killing the pathogen on contact like many fungicides (see "Phosphonate Control," below). All of these techniques can be used as part of an integrated program of protecting landscapes without excessive use of chemicals.

Keeping Your Native Oak Trees Healthy

Having adapted to California's Mediterranean climate, native oak trees require a somewhat different regimen of care than most ornamental plants. To protect oak tree health, you should maintain as natural an environment as possible, leaving them undisturbed with no supplemental watering or fertilization. Additional oak tree care guidelines are posted on the California Oak Mortality Task Force and California Oak Foundation Web sites, http://www.californiaoaks.org/html/oak_tree_care.html and http://nature.berkeley.edu/comtf/html/maintaining__oak_tree_health.html.

Tree care techniques such as pruning and mulching are within the purview of other tree care guides (see the References) and are only marginally addressed here.

But as mentioned before, simply fostering the general health of oak and tanoak trees will not on its own protect them against *P. ramorum* infection. This is because *P. ramorum* is not a native pathogen of American forests. Most native pathogens have evolved side by side with native trees, and as part of this process, the trees have been naturally selected for the buildup of defenses, so that native pathogens can successfully attack them only when they are stressed and weakened. North American

oak and tanoak trees have not, however, developed defenses against non-native pathogens such as *P. ramorum.*

Phytophthora ramorum, therefore, does not preferentially target stressed trees. However, in many forests the overcrowding and prolonged lack of fire that endanger forest health also facilitate the transmission of *P. ramorum*, since tree-to-tree distance is small and the density of infectious trees is higher. Bay laurel and tanoak, the most important infectious hosts for *P. ramorum* in California, can regenerate and grow in crowded, shady conditions. Likewise, when humidity is higher, *P. ramorum* persistence and reproduction may be encouraged. Good plans for improving tree and stand health as a whole often go hand-in-hand with protection against sudden oak death. To this end, when making plans for a given property one should consider the whole range of forest health issues, including such issues as reducing hazardous fuels, mitigating erosion problems, and encouraging appropriate vegetation on the site.

For trees close to infected ones, good cultural practices that provide maximum health and resistance are important, but because of the foregoing considerations, protecting against *P. ramorum* may require approaches that are different from those used when dealing with other diseases. For instance, pruning twigs and small branches appears to be inconsequential, but pruning larger branches or stems may facilitate infection by *P. ramorum*. It takes 3 to 4 months in order for a pruning wound to recover, so pruning in California should occur 3 to 4 months before the warm and rainy spring conditions from April-June.

The techniques outlined in this publication have been most effective on small scales, i.e., on individual trees or at the level of the individual backyard. Testing is underway on larger, landscape-level scales. There is no guarantee in any individual case that these techniques will prevent *P. ramorum* infection or lessen its impacts on individual trees. But when used thoughtfully as part of a larger, integrated program of vegetation management on one's property, they may provide a good chance of doing so.

Consult the resources in table 1 for a list of resources to help you make decisions about protecting your trees from *P. ramorum*. You can also discuss your issues with a professional arborist.

Bay Laurel Removal and Other Sanitation Measures

Research shows 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 laurel trees. This is because *P. ramorum* produces more spores on California bay laurel than on other tree species, and the spores can then be blown or washed down to other trees.

Based on this research, we recommend that if you live in or near an area infested with

Table 1. Resources for information on sudden oak death biology and management

Resource	Guidance or advice offered
Garbelotto Research Lab, U.C. Berkeley http://www.nature.berkeley.edu/garbelotto	detailed guidelines on spray and injection treatments
California Oak Mortality Task Force http://www.suddenoakdeath.org	information about all aspects of sudden oak death, including symptoms, host plants, research, and county contacts
Local county agricultural commissioner http://www.cdfa.ca.gov	information about regulations, fungicide application, and how to submit samples
U.C. Cooperative Extension http://ucanr.org	general information, technical advice, and help with recognizing sudden oak death symptoms
Certified arborists http://www.isa-arbor.com	purchase and professional application of phosphonate fungicide treatment
U.C. Integrated Hardwood and Range Management Program http://danr.ucop.edu/ihrmp	information about oak tree care, regeneration, conservation, and stewardship

P. ramorum, removal of bay laurel trees growing near your oaks—within 2.5 meters at a minimum but ideally at least 5 meters from the trunks—can be effective in decreasing the risk of oak infection. Bay laurels may also increase the transmission risks for tanoak trees, so their removal may also help prevent *P. ramorum* infection on tanoak (however, be aware that tanoaks may become infected even when bay laurels are absent). We are not recommending widespread removal of bay laurel, but rather removal of those growing in proximity to oaks you want to protect, those in strategic locations for the protection of other oaks on your property, or those growing in only small numbers on your property. In some situations, pruning a large bay laurel branch that extends toward an oak may be enough to decrease the chances of infection for that oak. Be aware that bay laurel regrows prolifically from stump sprouts when cut, and the sprouts will require long-term maintenance or chemical control.

The foliage of bay laurel can be highly infectious, so if you are performing bay thinning, pruning, or removal in an area where *P. ramorum* may be present, dispose of foliage on the property rather than transporting it elsewhere. Proper disposal of potentially infected bay laurels includes burning (if locally allowed) or chipping and broadcasting the chips on a small area where it can decompose rapidly. Chipping infected bay laurel branches can contaminate the chipper, which must be cleaned with Lysol or a 10 percent bleach solution prior to use in an uninfested area to prevent artificial spread. Composting following the California Integrated Waste Management Board guidelines for commercial composting in California is an alternative way to dispose of infected plant material. These guidelines specify that temperatures in compost piles must reach at least 131°F for a minimum of 3 days for closed systems and aerated static piles; for windrows, temperatures must reach 131°F for a minimum of 15 days with at least 5 turnings during that time. Certain municipal compost facilities in California can also accept this material. *P. ramorum* does not compete well with other microorganisms, so composting to approved temperatures kills the pathogen. However, compost piles left underneath overhanging inoculum sources, such as the crowns of bay laurel trees or piles to which additional infected green waste is introduced, can become reinfected.

Other sanitation techniques include eliminating stems of recently dead oaks and tanoaks from the local area. Paying attention to dying or recently dead oaks and tanoaks is important not only from a sanitation perspective (i.e., to reduce infectious plant material), but also because trees displaying advanced symptoms of sudden oak death can be broken by wind very easily, posing a threat to property and people. Infected boles should be sectioned into small logs and placed in a sunny area to dry before being piled up. Smaller boles and branches should be chipped, and chips should be broadcasted in a small area, preferably a dry, sunny one. Rapid drying of woody material is key to eliminating the presence of *P. ramorum*. Once dead oak boles are dry, they can be used as firewood; however, they should not be transported to an area where the disease is not present. Infected firewood should be stored where it will stay dry prior to use.

Other Nonchemical Treatments

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 scientifically proven or effective treatments for sudden oak death other than the Agri-Fos–based (phosphonate) ones (see below). Researchers at U.C. Berkeley, for instance, have shown that treatments involving compost teas or mineral amendments (such as lime, Azomite, or crushed shells) were largely ineffective in slowing the growth of stem cankers and preventing infection (Garbelotto and Schmidt 2009).

Phosphonate Control

To date, the most promising treatment for individual oak and tanoak trees vulnerable to *P. ramorum* is the systemic fungicide phosphonate (trade name Agri-Fos). Agri-Fos is effective only on tanoak and true oak tree species (i.e., coast live oak, California black oak, and Shreve oak) and is not effective or has not been tested on other tree hosts such as Pacific madrone or California bay laurel. It has not been tested on canyon live oak.

Phosphonate is a neutralized form of phosphorous acid (H_3PO_3). 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. Phosphonate fungicide stimulates the tree's resistance to pathogen invasion and pathogen growth through a combination of effects, including the production of defense compounds in the treated trees and the thickening of protective plant cell layers.

Will Your Trees Benefit from Phosphonate Treatment?

Phosphonate fungicide is most effective as a preventive treatment on trees that are not yet infected. However, the stage of infection is extremely difficult to gauge. In some cases of very recent infections, phosphonate can help slow the progress of the infection, potentially prolonging the tree's life.

The usual symptom of *P. ramorum* infection is the presence of one or more discolored areas of dead bark, or cankers, located on the trunk. On coast live oak, 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. Cankers often exude a viscous, saplike substance—the tree's active response to the infection—that can run down the trunk or stain moss or bark on the trunk and turn it brown. Removing the bark from the canker location will reveal a patch of dead (brown) tissue beneath (see figs. 2 and 3).

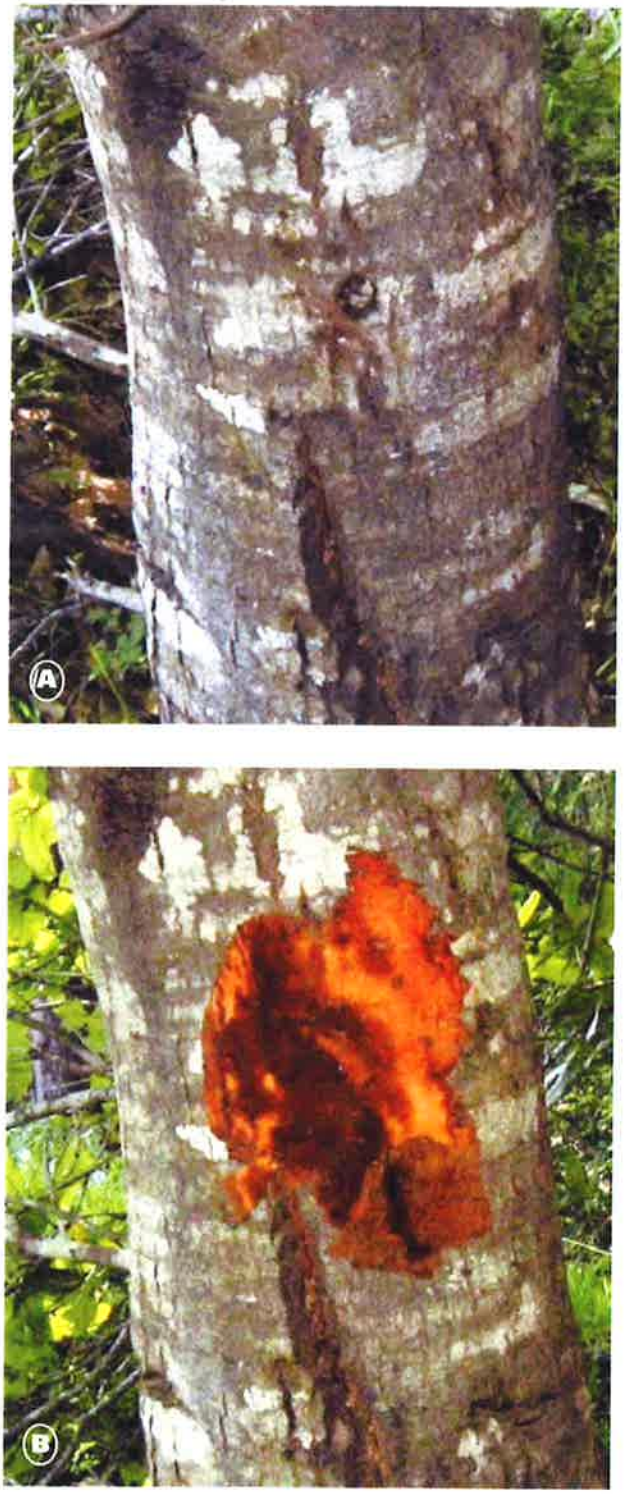

Figure 2. Small canker on tanoak (A, small dark areas on upper middle portion of stem) and after bark removal (B). Canker images are for illustration purposes only. Bark removal to this extent is not recommended; the wound created could serve as an entry point for pathogens. *Photos:* Chris Lee.

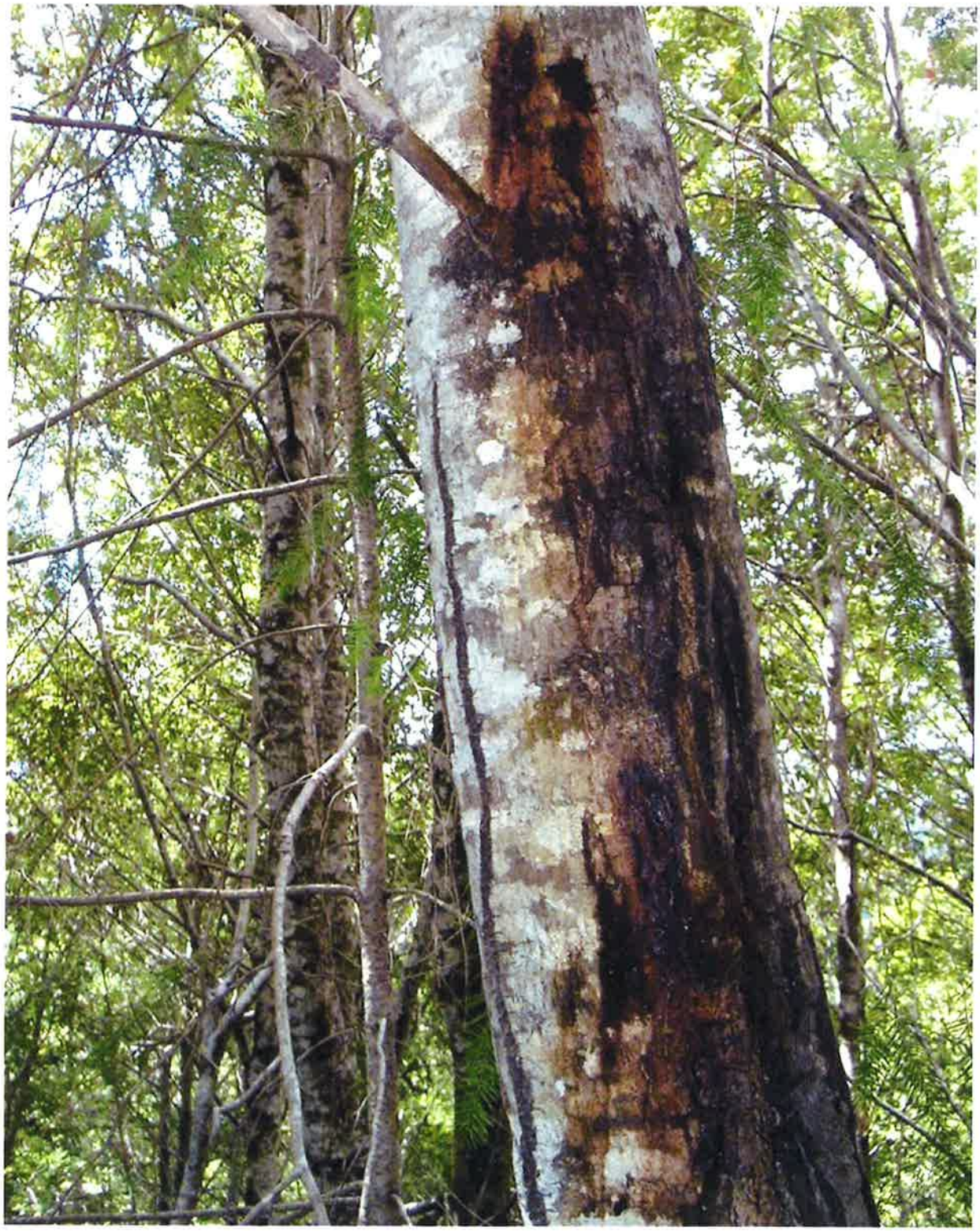

Figure 3. Bleeding cankers on a small tanoak stem.
Photo: Chris Lee.

The presence of other fungal growths (such as the black "carbon balls" caused by secondary fungi) or of insect holes or tunnels, although they can sometimes be associated with this pathogen, are not a definitive sign of it and can be associated with a wide variety of disease or damage conditions.

Many people have questions about the use of Agri-Fos as a preventive versus a curative treatment. As our knowledge now stands, the answers to these questions differ somewhat depending on whether the treatment tree is a tanoak or a coast live oak. (Little is known about Agri-Fos treatment for black oak.) Following are recommendations by species to help guide the decision to treat or not to treat.

- For coast live oaks, use Agri-Fos as a preventative treatment or where symptoms are extremely limited. Scientists now understand that the pathogen can infect a large proportion of the bark (and even move into the sapwood) before external symptoms appear. 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.
- For tanoaks, use Agri-Fos only as a preventative treatment. Once tanoaks are infected, phosphonate treatment is usually insufficient to halt the course of the infection. Hence, it is recommended that you consider treating only tanoaks that are uninfected (no visible bleeding) at the time of treatment. As a guideline, use Agri-Fos only on trees in definitely uninfested areas at least 100 yards from the nearest known infected trees.

Researchers have observed differences between true oaks and tanoaks in the susceptibility and spread of sudden oak death. For both groups of trees, waves of infections are recorded in years with abundant warm spring rainfall, while very limited infection occurs in dry years. Nonetheless, while individual true oaks may remain healthy in a grove even after multiple waves of infections, a single wave of infection can affect a large number, or even all, of the tanoaks growing on the same site. This is because *P. ramorum* sporulates well from tanoak but not from true oaks; thus, it can spread from tanoak to tanoak but not from true oak to true oak. For this reason, phosphonate treatments are recommended for individual true oaks that have few to no symptoms, even within infested groves, while tanoak treatments are recommended only if the entire stand or grove is healthy and infection is at least over 100 yards away.

Figure 4. Topical application of Agri-Fos systemic fungicide to a tanoak stem. *Photo:* Radoslaw Glebocki.

Figure 5. Injection application of Agri-Fos systemic fungicide to a tanoak stem. *Photo:* Radoslaw Glebocki.

Methods of Phosphonate Treatment

Since phosphonate is a systemic fungicide, the applicator must apply the product in such a way that the tree will absorb it and distribute it throughout its transport system. There are two ways of doing this: topical bark applications (fig. 4). and injections into the tree (fig. 5). Each method has advantages and disadvantages. Injections use less phosphonate, and the amount used is consistent from tree to tree; for example, since the treatment requires 10 milliliters of Agri-Fos for every 6 inches of tree circumference, a tree with a 20-inch diameter (63 inches in circumference) will use 100 milliliters of Agri-Fos. Injections cause no chemical drift in the environment. However, injections are more difficult to apply, since the applicator must use a syringe or hydraulic injector that applies constant pressure over enough time for the tree to absorb the material. Absorption takes place more quickly on sunny or windy days, when the tree's transport system is most active. Injections must be prefaced with drilling a hole through the bark to the sapwood to accommodate an injector every 6 inches around the tree; although the holes are small, they are visible and could theoretically serve as an entry point for fungi and other pathogens, at least for a short time until the tree heals the wounds.

Topical bark applications are simpler to perform and involve no wounding, but they require mixing with Pentra-Bark, a surfactant that enables the fungicide to better penetrate the bark. The bark application method also requires more product (some inevitably being lost to the breeze or by running off the bark), and application is less consistent because the sprayer's visual judgment determines when enough product has been applied. Furthermore, for very large trees, it may be difficult to deliver enough product via the bark application method for effective treatment. Additionally, drift may burn leaves, mosses, or lichens that are inadvertently treated (in fact, product absorption is improved if mosses are removed from the bark before application).

Because of the technical details and specialized equipment involved, we recommend attending a training session prior to attempting the injection method, although it is not difficult. The bark application method, however, is relatively straightforward and will be discussed in this guide in more detail. Consult the resources in table 1 before treating trees and to obtain more detailed instructions for using the injection method.

Applying Phosphonate Fungicide Using the Topical Bark Application Method

You will need the following equipment in order to topically treat a 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 household latex or rubber gloves, safety glasses, shoes with socks, 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 1 gallon of spray mix: 62.4 ounces (1.9 l) water plus 3.2 ounces (95 ml) Pentra-Bark plus 62.4 ounces (1.9 l) Agri-Fos. Mix in the given 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 in the mixing container and pour into the sprayer.

Apply the treatment solution to the tree trunk, on all sides, as high as you can reach without spraying foliage. Applying spray to branches will not hurt, but it is not an effective use of material. Spray until the treatment solution begins to run down the bark of the tree. Thoroughly apply the 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 burns foliage.

Safety

Agri-Fos is registered for use against *P. ramorum* in California. Anyone applying it must 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 generally not hurt them.

It is important to mix only the amount of Agri-Fos you need for each use. Both Agri-Fos and Pentra-Bark have indefinite shelf lives before they are mixed together; however, after mixing, they should be used within a month. Consequently, you must dispose of any leftover product that you do not want at an approved waste disposal facility. If you store the spray mixture for a few days or few weeks, reagitate the sprayer upon retrieval from storage to ensure the chemicals are properly dissolved before application.

Prior to spraying, you may want to tarp adjacent plants to protect them from drift. The Agri-Fos mixture is very sticky, so you should also make sure vehicles, tools, pets and other valuables are not in the drift zone. Any drift should not 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 (for topical treatment) or in the fall (for injection treatment). At this time of year, trees will not use the phosphorus in the product for making new leaves, but the tree is still physiologically active and will transport the product throughout its system. If applying topically in the spring, do so before bud break so that the tree uses the phosphonate for tree defense rather than for making new leaves. Injection treatments should be applied in the fall (between August and November). Follow the initial treatment with a second treatment 6 months later in the spring or fall (depending on the season of initial application). Thereafter, treat every year in the fall for oaks and tanoaks that are especially prized or at high risk for infection (e.g., those surrounded by high densities of bay laurel) or once every 2 years in the fall for trees not at high risk.

As noted before, some infected tanoaks may not display visible symptoms, so if you know that the tanoaks you desire to treat are close (less than 100 yards) to already infected trees, Agri-Fos application is much less likely to succeed. Recommendations may change as new research information becomes available.

Table 2. Wholesale distributors of Agri-Fos systemic fungicide in California

Distributor	City	Telephone	Web site
BioScape	Petaluma	707-781-9233	http://www.bioscape.com
Highlands Soil and Water	Gonzales	925-324-0039	http://healthysoil.com
Monterey Chemical	Fresno	559-499-2100	http://montereychemical.com
Target Specialty Products	San Jose	408-293-6032	http://target-specialty.com
Univar Inc.	San Jose	498-953-1610	http://www.univarusa.com

Where to Obtain Agri-Fos

Homeowners in California can obtain Agri-Fos systemic fungicide and Pentra-Bark surfactant through most independent garden centers in the greater Bay Area. If a local garden center does not have the product on hand, or if a homeowner lives outside the Bay Area, the local garden center can easily obtain Agri-Fos from one of the distributors listed in table 2.

Currently, Agri-Fos is sold at a wide variety of prices from wholesale and retail sources. Various distributors package the product differently, in different sizes, and with and without Pentra-Bark, so comparison shopping is helpful. Treating a large-diameter, mature coast live oak tree (18 to 48 inches in diameter) requires on average from 1 to 6 liters of spray mixture (about $20 to $160 per application, exclusive of equipment costs), whereas smaller trees may require less. An 18-inch-diameter tree requires 90 milliliters of Agri-Fos (approximately $1.60 exclusive of equipment costs) when administered by injection; a 48-inch-diameter tree requires 250 milliliters (approximately $5.60 exclusive of equipment costs). Although considerably less Agri-Fos is required for injection than for topical application, injectors are more expensive to buy (at the quantity required to treat an average tree) than are hand or backpack sprayers.

Landowners may purchase and apply Agri-Fos themselves. Those who choose to hire certified tree care professionals for application should remember that labor costs must be added to the cost of materials and equipment presented here.

Conclusion

There is much still to learn about treating trees to help them resist *P. ramorum*. This is why the best defenses include knowing where the disease is, avoiding traveling in infested areas to the extent possible, and avoiding the long-distance movement of host plant material. In vulnerable areas, however, treatment with Agri-Fos or by targeted removal of bay laurel may help you to be proactive in making your prized trees as resilient as possible to this damaging pathogen.

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Measurement Conversion Table

U.S. Customary	Conversion factor for U.S. Customary to Metric	Conversion factor for Metric to U.S. Customary	Metric
	Length		
inch (in)	2.54	0.394	centimeter (cm)
foot (ft)	0.3048	3.28	meter (m)
yard (yd)	0.914	1.09	meter (m)
mile (mi)	1.61	0.62	kilometer (km)
	Area		
acre (ac)	0.4047	2.47	hectare (ha)
	Volume		
fluid ounce (fl oz)	29.57	0.034	milliliter (ml)
pint, liquid (pt)	0.473	2.11	liter (l)
quart, liquid (qt)	0.946	1.056	liter (l)
gallon (gal)	3.785	0.26	liter (l)
gallon per acre	9.36	0.106	liter per hectare (l/ha)
Fahrenheit (°F)	°C = (°F − 32) ÷ 1.8	°F = (°C x 1.8) + 32	Celsius (°C)

Warning on the Use of Chemicals

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

Do not place containers containing pesticide in the trash nor pour pesticides down sink or toilet. Either use the pesticide according to the label or take unwanted pesticides to a Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Hazardous Waste Collection site nearest you.

Dispose of empty containers by following label directions. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

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