CALIFORNIA OAK MORTALITY TASK FORCE REPORT
JULY 2008

MANAGEMENT

The Basin Complex fire in Big Sur is burning in areas with elevated fuels due to Sudden Oak Death mortality. To date, most of the burn area has contained older dead trees; however, the fire is moving north toward Palo Colorado and vicinity where more recent SOD mortality has occurred. The fine fuels from attached leaves on these recently killed trees can increase the difficulty of fire suppression. A map of the current fire perimeter and the location of 2003 – 2007 Sudden Oak Death tree mortality has been developed by USDA Forest Service, Forest Health Protection.

An 80 acre fire along Saint Helena Road in Napa County ignited on 5/16 when the green stem of a coast live oak infected with the Sudden Oak Death pathogen fell onto a power line. Costing approximately $100,000 to suppress, the fire caused local power outages and disrupted commuter traffic; however no homes were damaged.

The US Fish and Wildlife Service has pre-approved SOD eradication treatment (up to 250 acres per agency per year for the next 5 years) on US Forest Service and Bureau of Land Management terrestrial TES habitat (northern spotted owl and marbled murrelet) lands in SW Oregon. This pre-approval will simplify the consultation process, allowing agencies to respond to infested sites more quickly, thereby maximizing eradication efforts. For more information on the agreement, go to http://www.suddenoakdeath.org/pdf/Monthly%20Reports/Jul08Files/FinalSOD-BO_5-9-08.pdf or contact Ellen Goheen at egoheen@fs.fed.us.

MONITORING

***P. ramorum* has been recovered from two Washington watersheds in 2008.** The Washington State Department of Agriculture (WSDA) reconfirmed *P. ramorum* in the Sammamish River at the original 2007 positive site on 2/14/08 and 5/9/08, and in the Rosedale Stream (also found positive in 2007) on 4/18/08 at a new confluence in a field below a previously *P. ramorum*-positive nursery.

FUNDING

The Oregon legislature approved $427,000 in funding for efforts to eradicate Sudden Oak Death in Oregon. The funding is critically needed due to an expansion of the infested area in Oregon and a proposal by Oregon Department of Forestry and cooperators to intensify eradication efforts.

Senate Bill 1668 (Migden), which establishes the "Marin-Sonoma Sudden Oak Death Intervention and Assistance Act of 2008," has been approved by the California Senate. The Bill directs the California Department of Forestry and Fire Protection to develop a focused program that would reduce SOD impacts in Marin and Sonoma Counties. It also authorizes the use of Proposition 84 funds for local research, public education, detection, treatment, and monitoring of the disease, and encourages Marin and Sonoma Counties to assist the state in developing a cost-share program to help landowners with the removal of dead or diseased trees in order to reduce fire risks. If passed, local governments could apply for Proposition 84 funding to help cover SOD-related activities. SB 1668 does not address Sudden Oak Death in the other 12 infested counties. It will be heard by the CA Assembly next.

FEATURED RESEARCH

The Potential of Commercial Algaecides to Manage *Phytophthora ramorum* in Waterways

S. N. Jeffers & G. C. Colburn; Department of Entomology, Soils, and Plant Sciences; Clemson University; Clemson, SC 29634-0315.

For many years, species of *Phytophthora* were thought to be true fungi and often are referred to as lower fungi and water molds. However, scientists have learned after studying these microorganisms for many years that species of *Phytophthora* have several characteristics that are quite different from true fungi. For example, they reproduce sexually by producing oospores; they reproduce asexually by releasing motile, biflagellate zoospores from sporangia; the nuclear state of the thallus is diploid; and cell walls are composed primarily of cellulose. In more recent years, scientists demonstrated through the use of molecular genetics that species of *Phytophthora* as well as other oomycetes belong to an entirely different kingdom of organisms than do true fungi and that they are more closely related to golden and brown algae than to true fungi. Consequently, we have initiated a project to determine if *P. ramorum* and other species of *Phytophthora* are sensitive to commercially available algaecides. If so, we will determine if algaecides can be used to manage *P. ramorum* and other species of *Phytophthora* that occur naturally in waterways.

Many commercial algaecides contain copper compounds as active ingredients. *Phytophthora* spp. and other oomycetes are known to be sensitive to copper-based fungicides, so it was logical to test the efficacy of copper-based algaecides against *Phytophthora* spp. that occur in waterways. Many of the commercially available algaecides are registered for use in diverse water environments, and water treated with these products may be used for swimming, fishing, watering livestock, and irrigating turf and ornamental plants immediately after treatment. Therefore, these algaecides appear to be relatively safe for people, animals, and the environment.

To date, we have tested the sensitivity of *P. ramorum* to two commercially available algaecides: Captain (which contains copper carbonate) and K-Tea (which contains elemental copper derived from copper-triethanolamine complex and copper hydroxide); both products are manufactured by SePRO Corporation in Carmel, IN. All experiments were conducted in the quarantine facility at the USDA-ARS Foreign Disease and Weed Science Research Unit at Ft. Detrick in Fredrick, MD. Chlamydospores, sporangia, and zoospores from two isolates of *P. ramorum* (an A1 isolate from Europe and an A2 isolate from the USA) were exposed to the labeled rates of the algaecides for various lengths of time. Both isolates were equally sensitive to the two algaecides used in our experiments. Zoospores were most sensitive and were not recovered after exposure to the algaecides for 30 minutes. Likewise, sporangia were not recovered after 4 hours of exposure, and chlamydospores were not recovered after 8 hours of exposure. We are in the process of testing the sensitivity of other species of *Phytophthora* to these two algaecides under laboratory conditions. In the coming months, we will be testing the efficacy of algaecides to eliminate *P. ramorum* and other species of *Phytophthora* from naturally-infested water. In summary, algaecides appear to have good potential for managing *P. ramorum* in waterways.

NURSERIES

WSDA has completed sampling at 40% of Washington's 2008 USDA annual certification survey sites. *P. ramorum* has been found infecting *Viburnum tinus* plants at three nurseries, one in Snohomish County and two in Clark County. All three nurseries tested negative in previous years. The USDA Confirmed Nursery Protocol (CNP) was enacted at each site; however, one of the Clark County sites was released when a delimiting survey failed to turn up additional PCR positive samples. Under the USDA Potentially Actionable Suspect Sample Policy, nurseries with only one PCR positive are not subject to the CNP. The nursery will be monitored for further symptoms, but is not under quarantine at this time. *P. ramorum* was confirmed at the second Clark County site on 5/20/08 at the outlet of a pond near the center of the retail nursery, as well as at a culvert under a nearby street just before the ditch passes under the road. The CNP is underway at the nursery, and follow-up monitoring of the ditch is under consideration. For more information, contact Brad White at bwhite@agr.wa.gov.

As of 6/27/08, the Oregon Department of Agriculture has inspected and processed 13,797 samples from 336 grower sites. *Phytophthora* continues to be detected at high levels within the industry this year; having been detected at 57.1% of sites surveyed and in 8.4% of samples tested. At this same point during the 2007 survey, *Phytophthora* had been detected at 42.1% of the grower sites surveyed and in 4.5% of the samples tested.

P. ramorum has been detected in four nurseries and in one landscape site so far. At four of the five sites, the infected host species was *Rhododendron*. At the fifth site, *P. ramorum* was detected in *Pieris* 'Japanese'. In the first positive nursery, additional *P. ramorum* positives were detected in the potting media and soil during delimitation surveys. In the second positive nursery, additional *P. ramorum* positives were detected in a cull pile, in the soil beneath an infected block, and in a block of *Arctostaphylos uva-ursi* during delimitation surveys. In the other two nurseries, no additional *P. ramorum* has been found, although soil samples remain in process from the latest site. A rhododendron from a fifth nursery tested PCR-positive for *P. ramorum*. As required by the USDA APHIS Potentially Actionable Suspect Sample (PASS) protocol, additional samples were collected from the nursery to verify the PCR-positive test result. All of these samples tested negative for *P. ramorum.* Per the PASS protocol, no regulatory action was taken at the nursery. All other *P. ramorum*-positive sites in Oregon have been positive by both PCR and culture plating.

In the landscape site, one soil sample was received from the positive location; no plant samples were collected because the site consisted of a single, infected rhododendron plant with no other susceptible plants nearby. For more information, contact Nancy Osterbauer at nosterba@oda.state.or.us.

RESEARCH

Brasier, C.M. 2008. The biosecurity threat to the UK and global environment from international trade in plants. Plant Pathology Letter to the Editor DOI: 10.1111/j.1365-3059.2008.01886.x.

Native plant communities, woodlands and landscapes in the UK and across the world are suffering from pathogens introduced by human activities. Many of these

pathogens arrive on or with living plants. The potential for damage in the future may be large, but current international regulations aimed at reducing the risks take insufficient account of scientific evidence and, in practice, are often highly inadequate. In this Letter I outline the problems and discuss some possible approaches to reducing the threats.

Cushman, J. Hall and Meentemeyer, Ross K. 2008. Multi-scale patterns of human activity and the incidence of an exotic forest pathogen. Journal of Ecology 96, 766–776. DOI: 10.1111/j.1365-2745.2008.01376.x.

Summary:
1. Plant pathogens can have major impacts on diverse taxa and ecological systems world-wide, and some of the most conspicuous of these are invasive non-native species. Although many factors are known to influence the distribution and abundance of plant pathogens, the extent to which humans play a role is less well-known but still critical for understanding the dynamics of invasive pathogens in natural systems.

2. One invasive pathogen of great concern world-wide is *Phytophthora ramorum*, which causes Sudden Oak Death, an emerging forest disease. Here, we examined the influence of humans and a range of environmental factors on the distribution of *P. ramorum* at three distinct spatial scales in northern and central California.

3. At the local scale, *P. ramorum* more commonly occurred in soil on hiking trails used heavily by humans than in soil from adjacent areas off trails. These results support the hypothesis that humans dispersed the pathogen within already infected areas and into areas lacking local sources of inoculum.

4. At the landscape scale, using a network of 202 randomly located plots across a 275 km^2 area, we found that forests on public land open to recreation exhibited higher prevalence of disease in a critical infectious host tree (bay laurel, *Umbellularia californica*), than forests on private lands. Infection levels were also higher in plots surrounded by large amounts of forest with warm climatic conditions and greater potential soil moisture. Although prevalence of diseased canker hosts (*Quercus agrifolia, Q. kelloggii and Lithocarpus densiflora*) was positively associated with dominance of bay laurel and rainy season temperatures, it was not significantly related to public access, and we hypothesize that this occurred because our study area was in the early stages of infection.

5. At the regional scale, the probability of disease occurrence at 165 sites distributed across the geographic range of *P. ramorum* in California increased significantly as human population density increased in the surrounding area. Chances of infection also increased significantly with precipitation and presence of bay laurel.

6. *Synthesis*. Our results suggest that human activity – along with temperature, moisture and host composition – is associated with increased prevalence of an influential exotic forest pathogen. These results indicate that there may be conflicts between humans and disease, and that efforts to address this issue may require aggressive management of human activity.

The following thirty-one abstracts on *P. ramorum* and related topics are being presented at the 2008 APS Centennial Meeting in Minneapolis, MN July 26-30th. View all APS abstracts (PDF).

Overview Presentations:

Hansen, E. 2008. *Phytophthora* – A day late and a dollar short. Phytopathology 98:S187.

Hansen, E. 2008. A historical review of *Phytophthora* diseases. Phytopathology 98:S196.

Rizzo, D.M. 2008. *Phytophthora ramorum*: A recent discovery with a large impact. Phytopathology 98:S197.

***P. ramorum* - Diagnostics:**

Mavrodieva, V.A.; Negi, S.; Picton, D.; Levy, L.; Tooley, P.; Shishkoff, N.; and Luster, D. 2008. Development and validation of a tissue based panel for the *P. ramorum* proficiency testing program. Phytopathology 98:S100.

Schoedel, B. and Avila, F.J. 2008. Specific immunodetection of *Phytophthora ramorum* and *P. kernoviae*. Phytopathology 98:S141.

Sudarshana, P.; Shukla, R.; Abad, G.; Olson, B.R.; and Palm, M. 2008. A summary of diagnostics conducted by the USDA-APHIS-PPQ Molecular Diagnostic Laboratory. Phytopathology 98:S152.

Zeller, K.A.; DeVries, R.M.; and Levy, L. 2008. Head-to-head comparisons of sensitivity and specificity among 5 real-time PCR assays diagnostic for *Phytophthora ramorum*. Phytopathology 98:S179.

***P. ramorum* - Genetics:**

Goss, E.M. and Grunwald, N.J. 2008. Ancient isolation and independent evolution of the three clonal lineages of the sudden oak death pathogen *Phytophthora ramorum*. Phytopathology 98:S61.

***P. ramorum* – Nurseries:**

Grunwald, N.J.; Larsen, M.; and Goss, E.M. 2008. Genotypic diversity of *Phytophthora ramorum* in U.S. nurseries. Phytopathology 98:S63.

Parke, J.L.; Grunwald, N.; Lewis, C.; and Fieland, V. 2008. A systems approach for managing *Phytophthora* diseases in production nurseries. Phytopathology 98:S121.

Roubtsova, T.V. and Bostock R.M. 2008. Impact of episodic root stress on the susceptibility of *Rhododendron* sp. and *Viburnum tinus* to *Phytophthora ramorum*. Phytopathology 98:S136.

Shishkoff, N. 2008. Sporulation on plant roots by *Phytophthora ramorum*. Phytopathology 98:S145.

***P. ramorum* – Wildlands:**

Brennan, J.; Cummins, D.; Kearney, S.; Choiseul, J.; Cahalane, G.; and Nolan, S. 2008. Investigating the threat of *Phytophthora ramorum* to Ireland: The current situation. Phytopathology 98:S25.

Dileo, M.V.; Bostock, R.M.; and Rizzo, D.M. 2008. Ecophysiological factors mitigating *in planta* survival of *P. ramorum* in California bay laurel. Phytopathology 98:S46.

Fichtner, E.J.; Rizzo, D.M.; Kirk, S.; Whybrow, A.; and Webber, J. 2008. Root infections of *Phytophthora ramorum* and *Phytophthora kernoviae* in UK woodlands. Phytopathology 98:S53.

Jinek, A.; Simard, M.; Brière, S.C.; Watson, A.K.; Tweddell, R.J.; and Rioux, D. 2008. Susceptibility of six eastern Canadian forest species to *Phytophthora ramorum*. Phytopathology 98:S75.

Nagle, A.M.; Garbelotto, M.; and Bonello, P. 2008. Differences in constitutive and induced expression of two phenolic compounds in coast live oaks susceptible and resistant to infection by *Phytophthora ramorum*. Phytopathology 98:S111.

Parke, J.L.; Oguchi, A.; Fichtner, E.J., and Rizzo, D.M. 2008. Viability of *Phytophthora ramorum* after passage through slugs. Phytopathology 98:S121.

***P. ramorum* – Treatments:**
Colburn, G.C. and Jeffers, S.N. 2008. Toxicity of commercial algaecides to *Phytophthora ramorum*. Phytopathology 98:S40.

Other *Phytophthoras*:

Ahonsi, M.O.; Banko, T.J.; Doane, S.R.; Demuren, A.O.; Copes, W.E.; and Hong, C.X. 2008. *Phytophthora nicotianae* zoospores evade pressure and agitation stress but are completely destroyed by CO(2) injection. Phytopathology 98:S10.

Hwang, J.; Oak, S.W.; and Jeffers, S.N. 2008. Variation in population density and diversity of *Phytophthora* species in streams within a forest watershed. Phytopathology 98:S70.

Ivors, K.L. and Greene, M.D. 2008. Identifying *Phytophthora* species isolated from stream baits in North Carolina. Phytopathology 98:S72.

Kim, S.; Nikolaeva, E.V.; Park, S.; and Kang, S. 2008. First report of *Phytophthora hedraiandra* in Pennsylvania. Phytopathology 98:S82.

Kong, P. and Hong, C. 2008. Quorum sensing operates in *Phytophthora nicotianae*. Phytopathology 98:S85.

McLaughlin, I.M.; Jeffers, S.N.; and Waldrop, T.A. 2008. Long-term effects of fuel reduction treatments on the incidence of *Phytophthora* spp. in soil of a hardwood forest in the southern Appalachian Mountains. Phytopathology 98:S102.

Olson, H.A. and Benson, M. 2008. Characterization of *Phytophthora* in North Carolina greenhouse ornamentals. Phytopathology 98:S116.

Santamaria, L. and Mmbaga, M.T. 2008. A survey for Phytophthora diseases in mid-Tennessee nurseries: Identification and characterization. Phytopathology 98:S140.

Wang, S.; Lyles, L.; Garneni, S.; Carlos, W.J.; and McKie, P. 2008. *Phytophthora* species associated with silver maple bleeding canker in northern Nevada. Phytopathology 98:S166.

Weiland, J.E.; Nelson, A.H.; and Hudler, G.W. 2008. Aggressiveness of *Phytophthora cactorum* and *Phytophthora citricola* isolates on European beech and lilac. Phytopathology 98:S168.

Widmer, T.L. 2008. Comparing New Zealand and United Kingdom isolates of *Phytophthora kernoviae*. Phytopathology 98:S171.

Miscellaneous:

Levesque, C.A.; de Cock, A.W.A.M.; Robideau, G.; Desaulniers, N.; and Bala, K. 2008. The Oomycota. Phytopathology 98:S184.

The Ecological Society of America 93rd Annual Meeting will be held August 3 – 8, 2008 at the Midwest Airlines Center in Milwaukee, Wisconsin. The following five *P. ramorum* papers will be presented at the meeting. View all ESA papers (PDF).

Cobb, Richard C.; Lynch, Shannon C.; Metz, Margaret R.; Meentemeyer, Ross; and Rizzo, David M. 2008. Apparent competition among host species and feedbacks on disease severity in the sudden oak death pathosystem.

Ellis, Alicia M. and Meentemeyer, Ross K. 2008. Incorporating effects of landscape heterogeneity on pathogen dispersal into spatially-explicit disease models.

Hall, Kim; Albers, Heidi J.; Collins, Brad; Guillozet, Kathleen; Haim, David; Martin, Danielle; Norlander, Daniel; Peterson, Ebba; Shaw, David; and Thompson, Matt. 2008. Ecological and economic impacts of Sudden Oak Death in Oregon with an emphasis on barrier zones and quarantines.

Meentemeyer, Ross; Cunniffe, Nik J.; Hunter, Richard D.; Rizzo, Dave M.; Cook, Alex R.; and Gilligan, Christopher A. 2008. Spread of sudden oak death: Application of stochastic epidemic modeling to realistic landscapes.

Metz, Margaret R.; Frangioso, Kerri M.; Wickland, Allison C.; Meentemeyer, Ross K.; and Rizzo, David M. 2008. Effects of sudden oak death on plant community structure and regeneration in the Big Sur ecoregion of California.

MEETINGS AND TRAINING SESSIONS

The final Sudden Oak Death preventative treatment training session is being held on the UC-Berkeley campus on 7/9. For additional details on this free event, see the Calendar of Events below.

RELATED RESEARCH

Dobrowolski, M.P.; Shearer, B.L.; Colquhoun, I.J.; O'Brien P.A.; and StJ. Hardy, G.E. 2008. *Phytophthora cinnamomi* with prolonged use of fungicide. Plant Pathology DOI: 10.1111/j.1365-3059.2008.01883.x.

To test the hypothesis that resistance in *Phytophthora cinnamomi* to control by the fungicide phosphite (phosphonate) would arise in sites with prolonged use of phosphite, 30 *P. cinnamomi* isolates were collected from a range of sites with different phosphite-use histories, including phosphite-treated and untreated avocado orchards, and phosphite-treated and untreated native vegetation sites. The colonizing ability of these isolates was tested by different inoculation methods against a range of host tissues, treated and untreated with phosphite, including mycelial stem inoculation on clonally propagated *Leucadendron* sp., mycelial root inoculation of lupin seedlings and zoospore inoculation of *Eucalyptus sieberi* cotyledons. Isolates from avocado orchards with a long history of phosphite use were, on average, more extensive colonizers of the phosphite-treated *Leucadendron* sp., lupin seedling roots and *Eucalyptus sieberi* cotyledons. These isolates did not colonize untreated plant tissue (*Leucadendron* sp.) more extensively than isolates from sites with no history of phosphite use and no isolates were resistant to control by phosphite. Analysis of all isolates with microsatellite markers revealed the majority were from a single clonal lineage. Selection for decreased sensitivity to phosphate *in planta* has taken place within asexual clonal lineages of *P. cinnamomi* in sites with prolonged use of phosphite.

Durán, A.; Gryzenhout, M.; Slippers, B.; Ahumada, R.; Rotella, A.; Flores, F.; Wingfield, B.D.; and Wingfield, M. J. 2008. *Phytophthora pinifolia* sp. nov. associated with a serious needle disease of *Pinus radiata* in Chile. *Plant Pathology.* DOI: 10.1111/j.1365-3059.2008.01893.x.

During the course of the past three years, a new disease of *Pinus radiata*, referred to as 'Daño Foliar del Pino' (DFP) has appeared in the Arauco province of Chile and subsequently spread to other areas. The disease is typified by needle infections, exudation of resin at the bases of the needle brachyblasts and, in younger trees, necrotic lesions in the cambium, which eventually girdle the branches. The disease causes the death of young seedlings and mature trees can also succumb after a few years of successive infection, probably hastened by opportunistic fungi such as *Diplodia pinea*. Isolations on selective medium for *Phytophthora* spp. led to the consistent isolation of a *Phytophthora* sp. from needle tissue. DNA sequence comparisons for the ITS rDNA and cox II gene regions, and morphological observation showed that this oomycete represents a previously undescribed species for which the name *Phytophthora pinifolia* sp. nov. is provided. This new species is characterized by unbranched sporangiophores, and non-papillate, sub-globose to ovoid sporangia that are occasionally caducous with medium length pedicels. Despite using a number of sporulation techniques, oogonia/antheridia were not observed in isolates of *P. pinifolia*. Pathogenicity trials with *P. pinifolia* showed that it is pathogenic to *P. radiata* and causes rapid death of the succulent apical parts of young plants. *Phytophthora pinifolia* is the first *Phytophthora* known to be associated with needles and shoots of a *Pinus* sp. and its aerial habit is well matched with the occurrence and symptoms of DFP in Chile.

RESOURCES

The COMTF has updated the Sudden Oak Death Guidelines for Arborists. To access this new information, go to: http://nature.berkeley.edu/comtf/pdf/arborist_guidelines.pdf.

Chapter 3, "The Disease Cycle, Sources of inoculum, dispersal, infection, colonization, survival" in Sudden Oak Death and *Phytophthora ramorum*: A Summary of the Literature by John T. Kliejunas has been posted to the COMTF website. The chapter includes a diagrammatic disease cycle for *P. ramorum,* courtesy N. Ochiai, S. Lucas and J. Parke, Oregon State University. To access the new chapter, as well as prior chapters, go to: http://nature.berkeley.edu/comtf/html/sod_literature_summary.html.

Frankel, Susan J.; Kliejunas, John T.; Palmieri, Katharine M., technical coordinators. 2008. Proceedings of the Sudden Oak Death Third Science Symposium. Gen. Tech. Rep. PSW-GTR-214, Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. 491 p.

The Proceedings of the Sudden Oak Death Third Science Symposium are now available free of charge. To order a hard copy or CD, email your full mailing address in block form along with your preferred format of the Proceedings, to rschneider@fs.fed.us. You can also mail your request to Richard Schneider, Publishing Services, Rocky Mountain Research Center, 240 West Prospect Road Fort Collins, CO 80526-2098, USA. There is a one book and one CD limit per person (at no charge). Financial support for this publication was provided by: USDA Forest Service, Pacific Southwest Research Station.

THANK YOU

The COMTF would like to extend a thank you to the fifth grade class at Trinity School in Menlo Park. They donated $127.48 of their community service

funds to fighting Sudden Oak Death. After researching a number of environmental issues, nominating causes for donations, class discussions, and voting, they decided to divide their money between fighting air pollution and Sudden Oak Death.

CALENDAR OF EVENTS

7/9 - SOD Treatment Workshop; Tolman Hall "Portico," UC Berkeley Campus; 1 – 3 p.m.; Pre-registration is required. This class is free. To register, email SODtreatment@nature.berkeley.edu, and provide your name, phone number, affiliation (if applicable), and the date for which you are registering. For more information, contact Katie Palmieri at (510) 847-5482 or palmieri@nature.berkeley.edu.