CALIFORNIA OAK MORTALITY TASK FORCE REPORT
MAY 2008

MONITORING

Multiple *P. ramorum*-positive plant samples have been confirmed outside of a Jackson, MS nursery. The samples were taken on two different dates, from three different host genera. An Emergency Action Notification has been issued; however, due to possible surface contamination of the samples by silt from flooding prior to collection, further regulatory action has not yet been taken. Follow-up sampling is being conducted to determine the presence or absence of the pathogen in other vegetation near the original positive plants.

The nursery adjacent to this site was first determined as positive for *P. ramorum* June 7, 2006, with a positive *Camellia* sp. Water samples on the nursery were positive for *P. ramorum* on December 17, 2006; January 16, 2007; March 29, 2007; and April 18, 2007. Plants were once again determined as positive for *P. ramorum* on March 23, 2007 (*Camellia japonica* 'Debutante'). The first PCR *P. ramorum*-positive sample taken off nursery property was a stream bait obtained in March 2008 from a ditch receiving nursery runoff (The ditch traverses private land, and then empties into Hog Creek, a small tributary of the Pearl River.); however, isolations were negative. Follow-up monitoring efforts were implemented, including monthly baiting of the ditch and Hog Creek through March 2008 and vegetation surveys of the ditch environs in spring 2007 and March 2008.

The first follow-up vegetation survey of the ditch was conducted in May 2007 during a time of the year when environmental conditions were not conducive to pathogen recovery. The results were negative. Monthly water baiting surveys conducted from May through November 2007 were also negative. In December, water baiting efforts resulted in a nested and real-time PCR positive, which led to a supplemental vegetation survey of the ditch vicinity. Symptomatic willow foliage was collected during the supplemental survey. The samples yielded nested and real-time PCR positives. Water bait PCR positives followed in January, February (both in the ditch and in Hog Creek), and March 2008 (ditch only); some of these bait positives also yielded *P. ramorum* cultures.

The December 2007 willow positive was followed by a February 2008 survey which tracked the detection and destruction of infected magnolia plants in the nursery that month. The survey also included soil samples from inside and outside the nursery; water from the ditch inside and outside the nursery, and from Hog Creek; and vegetation samples from the ditch vicinity. Vegetation samples were sent to Clemson University (CU) for culturing with replicates to the Mississippi State University (MSU) clinic for ELISA screening. MSU reported ELISA positives for multiple vegetation samples from outside the nursery, and extracted DNA for APHIS diagnostics. APHIS reported PCR positives from multiple vegetation samples (*Quercus* and *Rubus* foliage). CU reported negative isolation results from replicate samples of the same genera, and positive water samples by filtration and culturing from both inside and outside the nursery. In one water

sample, CU reported that *P. ramorum* propagule counts were exceeded only by those obtained from known positive California streams in infested areas.

A survey was conducted on April 1, 2008 and included water samples from inside and outside the nursery as well as natural landscape vegetation samples from outside the nursery. The area adjacent to the ditch with the previously identified positive willow was unavailable for sampling due to flooding of Hog Creek; consequently, samples were taken from higher ground proximal to the ditch and Hog Creek. All vegetation samples collected were negative. Water samples collected from the ditch on nursery property were positive. Another survey of the ditch was conducted April 29, 2008. Results from the survey are pending. For more information, contact Jonathan Jones at Jonathan.M.Jones@aphis.usda.gov.

REGULATIONS

***Cercis chinensis* (Chinese redbud) and *Magnolia* (*Michelia*) *figo* (banana shrub)** have both been reported positive for *P. ramorum*. The USDA Animal and Plant Health Inspection Service (APHIS) is reviewing the findings, and plans to add each species to the list of hosts regulated for *P. ramorum* in early May. *Cercis chinensis* was found positive at a previously positive British Columbia nursery on November 16, 2007. Other genera found positive at the facility included *Magnolia*, *Salix*, *Rhododendron*, and *Vaccinium*. The nursery was also found to have an infested irrigation pond. Canadian regulatory officials suspect that the infected plants were the result of overhead irrigation using the infested pond water. The nursery is currently under aggressive eradication orders. The *Magnolia figo* was found during a compliance agreement inspection at a Contra Costa County, CA nursery.

USDA APHIS, in cooperation with industry representatives and state regulatory agencies, has been exploring alternative real-time PCR diagnostics for *P. ramorum* testing based on a different genetic locus than the ITS region currently targeted. After extensive testing, new-to-the-program real-time PCR tests will be supported which combine use of the current ITS real-time PCR, CFIA's Elicitin/5.8S (IC), and ARS's Cox real-time PCR assays. Labs participating in the National Plant Protection Laboratory Accreditation Program are expected to have suitable sensitivity and selectivity for incorporating the new diagnostics into their programs. Confirmation laboratories will retain conventional PCR assays (nested-PCR and other multiplex) for resolution of inconclusive samples. USDA APHIS is using the new diagnostics, and expects to post the protocols in May. For more information, contact Jonathan Jones at Jonathan.M.Jones@aphis.usda.gov.

NURSERIES

The Oregon Department of Agriculture (ODA) began inspections and testing for the 2008 USDA APHIS Annual Certification Survey in March. As of April 29th, testing has been completed on 6,279 samples collected from 153 nursery growing areas. *Phytophthora* species have been detected at 60 percent of the sites surveyed, a 12 percent increase over last year. The number of *Phytophthora*-infected samples has also increased

from 6 percent in 2007 to 9 percent in 2008. Oregon has been experiencing a long, cool, wet spring which may be contributing to the increased presence of *Phytophthora*. *P. ramorum* has been found infecting *Rhododendron* plants at three nurseries, one in Clackamas County and two in Washington County. *P. ramorum* had previously been detected at the Clackamas County nursery in 2005 and in one of the Washington County nurseries in 2006 and 2007. The USDA Confirmed Nursery Protocol has been enacted at both nurseries.

ODA has also been busy recruiting nurseries to participate in the Grower Assisted Inspection Program (GAIP), which is intended to assist nurseries in identifying and implementing site-specific appropriate best management practices in an effort to minimize nursery-related *Phytophthora* disease issues. Funding for this project has been provided by the USDA Natural Resources Conservation Service. To date, 17 nurseries have volunteered to join the program.

CA has had eleven positive nurseries (four producers, two wholesalers/producers, one production/retail, and four retailers) confirmed *P. ramorum*-positive in 2008. Four of the positive nurseries were located in Los Angeles (2), San Diego, and Santa Barbara Counties and five were located in the quarantined counties of Contra Costa (2), San Mateo, Alameda, and Humboldt. Five of the nine nurseries have been positive in previous years, and one ships interstate. There was also a nursery in Riverside County with one PCR positive identified during a compliance agreement sampling. The positive lot is being held and resampled as outlined in the recently amended USDA Potentially Actionable Suspect Sample Policy. This nursery will not be considered positive unless another sample is determined positive for *P. ramorum*.

RESEARCH

Dodd, Richard S.; Hüberli, Daniel; Mayer, Wasima; Harnik, Tamar Y.; Afzal-Rafii, Zara; and Garbelotto, Matteo. 2008. Evidence for the role of synchronicity between host phenology and pathogen activity in the distribution of sudden oak death canker disease. New Phytologist. DOI: 10.1111/j.1469-8137.2008.02450.x.

Summary

• Variations in synchronicity between colonization rate by the pathogen and host phenology may account for unexplained spatial distribution of canker disease. The hypothesis that synchronous pathogenicity and host development are necessary for incidence of sudden oak death disease was tested by correlating seasonal variations in host cambial phenology and response to inoculation with *Phytophthora ramorum.*

• Response to infection was estimated by inoculating branch cuttings from coast live oak (*Quercus agrifolia*) trees at nine dates through a full annual cycle in 2003–2004. Host phenology was estimated from measurements of bud burst and cambial activity in spring 2006.

• Lesions were largest in the spring soon after the cambium resumed activity. A moderate genetic component to lesion size was detected. Variation among trees in date of largest lesions correlated with variation in timing of bud burst and cambial phenology.

• The data support the hypothesis that active host cambial tissue is a necessary requisite for successful infection with the pathogen that causes sudden oak death canker disease. Genetic variation in host phenology will buffer coast live oak against epidemics of this disease.

Frankel, Susan J.; Kliejunas, John T.; and Palmieri, Katharine M., technical coordinators. 2008. Proceedings of the sudden oak death third science symposium. Gen. Tech. Rep. PSW-GTR-214. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 491 p. Available online at: http://www.fs.fed.us/psw/publications/documents/psw_gtr214/.

The Sudden Oak Death Third Science Symposium provided a forum for current research on Sudden Oak Death/*Phytophthora ramorum*. Topics covered in the 117 papers and posters submitted included biology, genetics, nursery and wildland management, monitoring, ecology, and diagnostics.

Jiang, Rays H.Y.; Tripathy, Sucheta; Govers, Francine; and Tyler, Brett M. 2008. RXLR effector reservoir in two *Phytophthora* species is dominated by a single rapidly evolving superfamily with more than 700 members. PNAS _Vol. 105 No. 12: 4874–4879.

Summary: Pathogens secrete effector molecules that facilitate the infection of their hosts. A number of effectors identified in plant pathogenic *Phytophthora* species possess N-terminal motifs (RXLR-dEER) required for targeting these effectors into host cells. Here, we bioinformatically identify>370 candidate effector genes in each of the genomes of *P. sojae* and *P. ramorum*. A single superfamily, termed avirulence homolog (*Avh*) genes, accounts for most of the effectors. The Avh proteins show extensive sequence divergence but are all related and likely evolved from a common ancestor by rapid duplication and divergence. More than half of the Avh proteins contain conserved C-terminal motifs (termed W, Y, and L) that are usually arranged as a module that can be repeated up to eight times. The *Avh* genes belong to the most rapidly evolving part of the genome, and they are nearly always located at synteny breakpoints. The superfamily includes all experimentally identified oomycete effector and avirulence genes, and its rapid pace of evolution is consistent with a role for Avh proteins in interaction with plant hosts.

Kaminski, K. and Wagner, S. 2008. In vitro Inoculation Studies for Estimating the Susceptibility of Ornamental Plants to *Phytophthora ramorum*. J. Phytopathology. DOI: 10.1111/j.1439-0434.2008.01399.x

Abstract: Susceptibility evaluation of plant species towards *Phytophthora ramorum* is essential for pest risk assessment of the pathogen in Europe. An in vitro inoculation method on detached leaves and twigs was used to estimate the susceptibility of some leading ornamental plant species in Germany. Ratings in susceptibility of plant species and cultivars were classified according to the degree of symptoms caused by *P. ramorum*. *Buxus* sp., *Hedera helix*, *Vaccinium corymbosum* and *V. macrocarpon* were classified as

not susceptible whereas most *Calluna vulgaris* cultivars, *Erica carnea* 'Schneekuppe', *E. gracilis*, *Vaccinium myrtillus* and *Vaccinium oxycoccus* ranged in the 'highly susceptible' category. *Erica carnea* 'Rubinfeuer' and *E. cinerea* were classified as moderately susceptible whereas *E. x darleyensis* and *Rhododendron simsii* were classified as slightly susceptible. Different susceptibility reactions between cultivars were only found for *R. simsii* and *C. vulgaris*. Symptom development was effected by wounding only for *R. simsii*, *V. corymbosum*, and *V. oxycoccus*.

Waring, Kristen M. and O'Hara, Kevin L. 2008. Redwood/tanoak stand development and response to tanoak mortality caused by *Phytophthora ramorum*. Forest Ecology and Management 255 (2008) 2650–2658. Available online at www.sciencedirect.com

Abstract: Coast redwood (*Sequoia sempervirens*) and tanoak (*Lithocarpus densiflorus*) form mixed-evergreen forests along the northern California coast. In the mid-1990s, an introduced pathogen (*Phytophthora ramorum*) began causing extensive mortality of tanoak in these forests. This research reconstructed stand development patterns occurring in stands with and without the pathogen, measured stand responses to tanoak mortality, and developed projections of future stand development and structure in the presence of *P. ramorum*. Redwood forms an upper canopy layer while tanoak forms a multicohort lower canopy, resulting in distinct vertical stratification patterns. Individual redwood tree response patterns to tanoak mortality included crown expansion, increased basal sprouting, and increased basal area growth. Future stand structures will likely have greater proportions of redwood relative to tanoak.

MEETINGS AND TRAINING SESSIONS

A free one-day Sudden Oak Death wildland training session will be held on May 8th at Thomas Fogarty Winery in Woodside. New this year to the training is an afternoon field station specifically addressing bay pruning and other activities to keep oak trees healthy. The session is free of charge and open to all interested parties. Continuing education credits will be available. For additional details, see the Calendar of Events below.

Free Sudden Oak Death preventative treatment training sessions are being held on the UC-Berkeley campus 5/14, 6/11, and 7/9. For additional details, see the Calendar of Events below.

RELATED RESEARCH

Wickland A.C.; Jensen C.E.; and Rizzo, D.M. 2008. Geographic distribution, disease symptoms and pathogenicity of *Phytophthora nemorosa* and *Phytophthora pseudosyringae* in California, USA. Forest Pathology DOI: 10.1111/j.1439-0329.2008.00552.x.

Summary: During the course of surveys for *Phytophthora ramorum* in coastal forests of California and Oregon, *P. nemorosa* and *P. pseudosyringae* were frequently isolated from

foliage and stems of the same hosts as *P. ramorum.* Both species ranged from central California to Oregon within 50 km of the Pacific Ocean. Both were also found in the Sierra Nevada Mountains. *Phytophthora nemorosa* was primarily found infecting trees in coast redwood forests and was most often isolated from bay laurel leaves (*Umbellularia californica*), bleeding cankers on the main bole of tanoak (*Lithocarpus densiflorus*), and leaf and small stem tissue of redwood (*Sequoia sempervirens*). *Phytophthora pseudosyringae* was primarily isolated from hosts found in coast live oak woodlands. Bay laurel was the most common host while infection of coast live oak (*Quercus agrifolia*) stems was less frequent. Inoculation studies confirmed the pathogenicity of *P. nemorosa* and *P. pseudosyringae* on their most common hosts.

RESOURCES

Oregon State University's (OSU) Extended Campus (Ecampus), in partnership with the Oregon Department of Agriculture (ODA), has launched an online *Phytophthora* course that provides training to nursery growers about *Phytophthoras*. The free course includes three modules: biology, symptoms, and diagnosis; disease management; and *P. ramorum*. For an optional $100 fee, nursery growers can earn a Certificate of Mastery after successfully completing an online exam. A Spanish version of the online course will also be launched soon. To access the Ecampus "*Phytophthora* Online Course: Training for Nursery Growers," visit http://ecampus.oregonstate.edu/phytophthora. Jennifer Parke, Jay Pscheidt, and Richard Regan, OSU; Jan Hedberg, ODA; and Niklaus Grunwald, USDA ARS Horticultural Crops Research Lab authored the course.

"The Collection and Care of Acorns: A Practical Guide for Seed Collectors and Nursery Managers," written and compiled by Dr. Frank Bonner, is available on the USDA Forest Service website at: http://www.nsl.fs.fed.us/COLLECTION%20AND%20CARE%20OF%20ACORNS.pdf. The illustrated guide explains how to estimate seed crops; collect, clean, and store acorns; perform simple seed quality tests; and prepare acorns for planting.

PERSONNEL

Sirirat (Tia) Chullakorn will be replacing Bradley Marshall as the Environmental Director for the Kashia Band of Pomo Indians at Stewarts Point Rancheria. Prior to her appointment with the Kashia, Tia worked as the Environmental Coordinator for the Augustine Band of Cahuilla Indians. Tia can be reached at (707) 591-0580 ext. 113 or tia@stewartspointrancheria.com. As of April 1, 2008, Bradley has accepted a Tribal Outreach Coordinator position at the Phoebe A. Hearst Museum of Anthropology, UC Berkeley.

Radek Glebocki was recently hired as Sudden Oak Death Field Technician for UC Cooperative Extension Humboldt-Del Norte after graduating form Humboldt State University with a BS in Forestry – Resource Conservation. His work primarily involves early detection and monitoring of the spread of *P. ramorum* in Mendocino, Humboldt, and Del Norte Counties. Previously Radek worked on desert restoration projects, as well

as on monitoring of Dutch Elm Disease and gypsy moth. Radek can be reached at (707) 445-7351 or rglebocki@ucdavis.edu.

The USDA Agricultural Research Service has hired Takao Kasuga, a research molecular geneticist, to conduct research on *P. ramorum*. Prior to his new position, Takao studied fungal development and evolution at UC Berkley using comparative genomic and transcriptomic approaches. He also worked on the soybean-*Phytophthora sojae* interaction at the Samuel Roberts Noble Foundation, OK, and population studies of forest pathogens *Cronartium flaccidum* and *Heterobasidion annosum* at the University of Aberdeen, Scotland. In his new position, he plans to initiate a project to decipher the mechanism of plant-*P. ramorum* interactions in order to facilitate management of the pathogen. Takao, based out of UC Davis, can be reached at (530) 752-4721 or kasugat@berkeley.edu. He welcomes collaborative opportunities and suggestions.

CALENDAR OF EVENTS

5/4 – Bringing Back the Natives Free Garden Tour; 3 Sudden Oak Death talks will be provided throughout the day.; Registration is required in order to receive a guidebook, which contains garden addresses, maps, and directions. The Tour is expected to fill up, so register early at: www.bringingbackthenatives.net.

5/8 – Free one-day COMTF Sudden Oak Death/*P. ramorum* Wildland Training Session; Thomas Fogarty Winery; 19501 Skyline Blvd.; Woodside, CA 94062; 8. a.m. – 3 p.m.; The session includes indoor morning lectures and afternoon outdoor interactive stations. Bring your own lunch. For more information, contact Katie Palmieri at: Palmieri@nature.berkeley.edu or (510) 847-5482. To register, go to the COMTF website Calendar of Events at http://nature.berkeley.edu/comtf/html/wildland_trainings_spring_2008.html.

5/14 - Sudden Oak Death (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.

6/11 - Sudden Oak Death (SOD) Treatment Workshop; Tolman Hall "Portico," UC Berkeley Campus; 1 – 3 p.m.; Pre-registration is required. This class is free. For more information, see the 5/14 listing above.

7/9 - Sudden Oak Death (SOD) Treatment Workshop; Tolman Hall "Portico," UC Berkeley Campus; 1 – 3 p.m.; Pre-registration is required. This class is free. For more information, see the 5/14 listing above.