



CALIFORNIA OAK MORTALITY TASK FORCE REPORT MAY 2009

MONITORING

***P. ramorum* has once again been confirmed in McKinleyville's Mill Creek**

(Humboldt County). The pathogen was recovered by the UC Davis Rizzo Lab from leaf baits deployed and recovered in February. If this sample can be grown in pure culture, it will be genetically analyzed to determine the pathogen strain. This is the fourth year that *P. ramorum* has been recovered from McKinleyville streams with no obvious symptomatic hosts (the second year for Mill Creek). Of the two streams from which the pathogen has been recovered, Widow White Creek drains directly into the ocean, while Mill Creek drains into the Mad River a short distance from the ocean. Both streams primarily drain developed residential areas. Few *P. ramorum* wildland hosts are present at the Mill Creek site; the area is vegetated mostly with Sitka spruce, alder, willow, and eucalyptus. The Humboldt County Department of Agriculture has begun plans for further symptomatic host surveys along the streams this spring.

The Nevada Department of Agriculture's "Sudden Oak Death Pathogen

(*Phytophthora ramorum*) Survey in Nevada Forest Environments: a Five-Year Summary" has been released. The annual survey, conducted from 2004 – 2008, was based on plant distribution in major NV forest environments. Approximately 500 samples in total were collected from *P. ramorum* hosts in 364 forest locations and 26 urban forest sites. Those areas sampled were considered high-risk because of their proximity to nurseries and/or residential areas. All samples were negative for *P. ramorum*; however, results did identify *Phytophthora cactorum* and *P. citricola* on maple trees and other tree species from urban forest samples. These pathogens are believed to be the primary cause of the bleeding cankers identified on these trees species, as well as the death of the maple trees found in northern Nevada.

RESEARCH

The USDA Forest Service, UC Berkeley researchers, the Midpeninsula Regional Open Space District (MROSD), and the San Francisco Public Utilities Commission have undertaken a project to determine if acorns from tanoaks that are genetically resistant to *P. ramorum* could be used to reforest areas where tanoaks have been decimated by the disease. To implement the study, the MROSD partnered with the USDA Forest Service, Pacific Southwest Research Station by committing open-space land, \$60,000, and staff and volunteer time for the project.



Thousands of tanoak acorns gathered from MROSD land in the fall of 2007 and 2008 were grown into saplings and are being tested for *P. ramorum* resistance at the UC Berkeley Garbelotto lab and in the field. Tanoaks showing possible genetic resistance to the pathogen have already been identified. On March 19, 2009, acorns from the



possibly resistant trees were planted at MROSD's Skyline Ridge Open Space Preserve in the hills above Palo Alto, where Sudden Oak Death is present. Staff will monitor the health of the trees as they grow. While early results are encouraging, it will likely take years before any definitive answers can be found.

This study has highlighted the fact that little is known about tanoak genetics and reproduction; therefore, participating researchers will also be studying these complexities in search of answers. MROSD staff and volunteers will help observe what pollinators are present this summer while tanoaks are blooming. MROSD hopes that by helping SOD scientists through activities such as counting pollinating insects and birds, gathering acorns, and committing resources to their research, solutions can be found to prevent the spread of SOD for the health of the environment and protection of California's trees. For more information on this project, go to

http://www.openspace.org/plans_projects/SOD.asp.

Fichtner, E.J.; Lynch, S.C.; and Rizzo, D.M. 2009. Survival, dispersal, and soil-mediated suppression of *Phytophthora ramorum* in a California redwood-tanoak forest. *Phytopathology* 99:608-619.

Abstract: Because the role of soil inoculum of *Phytophthora ramorum* in the sudden oak death disease cycle is not well understood, this work addresses survival, chlamydospore production, pathogen suppression, and splash dispersal of the pathogen in infested forest soils. Colonized rhododendron and bay laurel leaf disks were placed in mesh sachets before transfer to the field in January 2005 and 2006. Sachets were placed under tanoak, bay laurel, and redwood at three vertical locations: leaf litter surface, litter-soil interface, and below the soil surface. Sachets were retrieved after 4, 8, 20, and 49 weeks. Pathogen survival was higher in rhododendron leaf tissue than in bay tissue, with >80% survival observed in rhododendron tissue after 49 weeks in the field. Chlamydospore production was determined by clearing infected tissue in KOH. Moist redwood-associated soils suppressed chlamydospore production. Rain events splashed inoculum as high as 30 cm from the soil surface, inciting aerial infection of bay laurel and tanoak. Leaf litter may provide an incomplete barrier to splash dispersal. This 2-year study illustrates annual *P. ramorum* survival in soil and the suppressive nature of redwood-associated soils to chlamydospore production. Infested soil may serve as primary inoculum for foliar infections by splash dispersal during rain events.

Shishkoff, N. 2009. Propagule production by *Phytophthora ramorum* on lilac (*Syringa vulgaris*) leaf tissue left on the surface of potting mix in nursery pots. *Plant Disease* 93:475-480.

Abstract: Lilac leaf tissue infected with *Phytophthora ramorum* was placed on top of potting mix in pots and exposed to different watering regimes or different temperatures to determine if it could serve as a source of inoculum. If pieces of infected leaf were placed in pots containing healthy lilac plants kept under constantly moist conditions or under twice-a-day trickle irrigation for 1 month, inoculum production from infected tissue declined for the first 4 days but declined significantly less steeply under constantly moist



conditions. At the end of the experiment, 28% of plants exposed to moist conditions developed root infections, whereas only 6% exposed to trickle irrigation did. If infected leaf pieces were placed on the surface of potting mix in pots containing lilacs and watered for 5 min one, two, or three times a day, inoculum production in the first 4 days declined but declined significantly more slowly in pots watered three times a day. If 0 to 16 leaf pieces were placed on the surface of potting mix in pots containing healthy lilacs under constantly moist conditions, leaf number significantly influenced the incidence of root infection. The effect of temperature was more difficult to quantify. At 10 or 15°C, propagules included zoospores whereas, at 20 or 25°C, they were predominantly sporangia. These results confirm the importance of detached leaves as inoculum producers under greenhouse conditions.

RELATED RESEARCH

Bobev, S.G.; Van Poucke, K.; and Maes, M. 2009. Disease Notes: First Report of *Phytophthora citricola* on *Cornus mas* in Bulgaria. Volume 93, Number 5, Page 551. DOI: 10.1094/PDIS-93-5-0551A.

Abstract: Cornelian cherry dogwood (*Cornus mas*) is a widespread species in Bulgaria and some cultivars with large fruits are the subject of propagation. In the springs of 2007 and 2008, severe, unusual damage was observed on sporadically scattered plantlets of ‘Kazanlashki’ (known also as ‘Kazanlaker’) in a nursery located near Vratza in northwestern Bulgaria. Symptoms were identical in both years and expressed on the leaves, young shoots, and adjacent rootstock wood. Dark brown, necrotic leaf spots initiated most often from the leaf periphery and quickly covered more than half of the leaf area. Necrosis of the leaves and shoots spread toward the older woody tissues and the plantlets died within a couple of weeks. Isolations from symptomatic leaves, shoots, and rootstocks (three to five samples per plant organ) on potato dextrose agar always revealed a fungus-like organism that formed relatively fast-growing white, radial, petaloid colonies. Numerous, ovoid to obpyriform, noncaducous, semipapillate sporangia occasionally with two papilla were observed after 1 or 2 days of incubation at 20°C in nonsterile soil extract (1). Average sporangium size was 39 (35 to 45) × 31 (20 to 35) μm with a ratio between both parameters of approximately 1.26. The pathogen's paragynous antheridia and smooth-walled spherical oogonia (20 to 32 μm in diameter) yielded spherical aplerotic to almost plerotic oospores on V8 medium with an average size of 25 μm. The morphological data identified the organism as *Phytophthora citricola* (1). Isolates had identical cultural and morphological characteristics, and pathogenicity was tested by laboratory inoculations carried out in 2007 (two isolates) and twice in 2008 (three isolates). Separately, detached leaves of *C. mas* seedlings and ‘Kazanlashki’ were wiped with 70% ethanol, punctured with a needle, and the wounds inoculated with 5-mm mycelial plugs from a 7-day-old V8 growth plate. Sterile V8 plugs were placed onto similar wounds of control leaves. Leaf samples were incubated at 20°C in a humidified chamber. Necrosis similar to that observed in the field became visible around the mycelia plugs 4 days after inoculation. The necrotic lesions enlarged to 20 to 25 mm in diameter within the next 2 days, whereas the control leaves did not show any symptoms. Subsequently, the pathogen was reisolated solely from all the mycelium-inoculated



samples. By means of the same inoculation method, pathogenicity was also demonstrated on shoots and mature fruits of *C. mas*. DNA was isolated from mycelium of an isolate and the internal transcribed spacer (ITS) region was amplified using ITS6 and ITS4 primers. The PCR product was sequenced (GenBank Accession No. FJ269034) and the BLAST search showed 100% homology with *P. citricola*, type II (2). To our knowledge, this is the first report of *P. citricola* on *C. mas* in Bulgaria, thus confirming its ability to attack *Cornus* spp. (3). Taking the lethal results of the disease and the polyphagous nature of the causal agent into consideration, this report is a serious warning for nurserymen and consumers.

Jung, T. 2009. Beech decline in Central Europe driven by the interaction between *Phytophthora* infections and climatic extremes. *Forest Pathology* 39:73–94. DOI: 10.1111/j.1439-0329.2008.00566.x.

Summary: During the past decade, and in particular after the wet year 2002 and the dry year 2003, an increasing number of trees and stands of European beech (*Fagus sylvatica* L.) in Bavaria were showing symptoms typical for *Phytophthora* diseases: increased transparency and crown dieback, small-sized and often yellowish foliage, root and collar rot and aerial bleeding cankers up to stem heights of >20 m. Between 2003 and 2007 134 mature beech stands on a broad range of geological substrates were surveyed, and collar rot and aerial bleeding cankers were found in 116 (86.6%) stands. In most stands the majority of beech trees were declining and scattered or clustered mortality occurred. Bark and soil samples were taken from 314 trees in 112 stands, and 11 *Phytophthora* species were recovered from 253 trees (80.6%) in 104 stands (92.9%). The most frequent species were *P. citricola*, *P. cambivora* and *P. cactorum*. Primary *Phytophthora* lesions were soon infected by a series of secondary bark pathogens, including *Nectria coccinea*, and wood decay fungi. In addition, infected trees were often attacked by several bark and wood boring insects leading to rapid mortality. Bark necroses were examined for their probable age in order to determine whether the onset of the current *Phytophthora* epidemic was correlated to rainfall rates recorded at 22 Bavarian forest ecosystem monitoring stations. A small-scale survey in nine Bavarian nurseries demonstrated regular infestations of all beech fields with the same range of *Phytophthora* species. The results indicate that (1) *Phytophthora* species are regularly associated with beech decline and may also be involved in the complex of ‘Beech Bark Disease,’ (2) excessive rainfalls and droughts are triggering the disease, and (3) widespread *Phytophthora* infestations of nursery stock might endanger current and future silvicultural projects aiming on the replacement of non-natural conifer stands by beech dominated mixed stands.

Jung, T. and Burgess, T.I. 2009. Re-evaluation of *Phytophthora citricola* isolates from multiple woody hosts in Europe and North America reveals a new species, *Phytophthora plurivora* sp. nov. *Persoonia* 22:95–110. DOI:10.3767/003158509X442612.

Abstract: During large-scale surveys for soilborne *Phytophthora* species in forests and semi-natural stands and nurseries in Europe during the last decade, homothallic



Phytophthora isolates with paragynous antheridia, semipapillate persistent sporangia and a growth optimum around 25 °C which did not form catenulate hyphal swellings, were recovered from 39 host species in 16 families. Based on their morphological and physiological characters and the similarity of their ITS DNA sequences with *P. citricola* as designated on GenBank, these isolates were routinely identified as *P. citricola*. In this study DNA sequence data from the internal transcribed spacer regions (ITS1 and ITS2) and 5.8S gene of the rRNA operon, the mitochondrial *cox1* and β -tubulin genes were used in combination with morphological and physiological characteristics to characterise these isolates and compare them to the ex-type and the authentic type isolates of *P. citricola*, and two other taxa of the *P. citricola* complex, *P. citricola* I and the recently described *P. multivora*. Due to their unique combination of morphological, physiological and molecular characters these semipapillate homothallic isolates are described here as a new species, *P. plurivora* sp. nov.

Rooney-Latham, S.; Blomquist, C.L.; Pastalka, T.; and Costello, L. 2009. Collar rot on Italian alder trees in California caused by *Phytophthora siskiyouensis*. Online. Plant Health Progress. DOI: 10.1094/PHP-2009-0413-01-RS.

Abstract: In November 2006, trees of Italian alder (*Alnus cordata*) were observed declining in association with bleeding trunk cankers in a commercial landscape in Foster City, CA. A species of *Phytophthora* was isolated on PARP selective medium from the leading edge of the cankers. The *Phytophthora* species was homothallic with primarily paragynous antheridia and had oospores that were mostly globose and aplerotic. Sporangia were produced from mycelia on plugs of carrot piece agar in soil extraction solution and were semi-papillate and ovoid to ellipsoid in shape. The intergenic transcribed spacer region of rDNA from an alder isolate matched with 100% identity to isolates in GenBank of *Phytophthora siskiyouensis*, a recently described species associated with tanoak and found in the soil and waterways of coastal Oregon. Pathogenicity was tested on young alder trees growing in pots. Pathogenicity was confirmed on Italian alder trees and potential pathogenicity was demonstrated on red and white alder trees.

NURSERIES

A California production nursery in Contra Costa County was found infested with *P. ramorum* on April 22nd. The infected *Leucothoe fontanesiana* were detected during an annual nursery certification inspection. The nursery was also found positive in 2004 as part of a trace-forward inspection from another California production nursery. This nursery ships interstate. Trace-forward and -back investigations are under way.

A Lane County Oregon production nursery was confirmed to have *P. ramorum*-positive *Camellia* sp. on April 23rd. The confirmation was the result of Oregon's annual compliance and certification program. The nursery was also found *P. ramorum* positive in 2006.

**WORKSHOPS AND EVENTS**

The agenda for the 4th Sudden Oak Death Science Symposium is now available on the Symposium website at <http://nature.berkeley.edu/comtf/sodsymposium4/>. Online registration is available at <http://nature.berkeley.edu/comtf/sodsymposium4/registration.php>. Hotel reservations are available at a discounted rate, pending availability, through May 16th, at http://nature.berkeley.edu/comtf/sodsymposium4/hotel_travel.htm.

A “Science for Managing the Big Sur Ecosystem” seminar will take place Wednesday, May 27, 2009 at the Big Sur Lodge Conference Room. Intended to support land managers working in the Big Sur area, this seminar will present research relevant to natural resource issues in Big Sur. Presentations from leading researchers will include the Big Sur ecosystem, the role of fire in Big Sur and coastal areas, coastal grasslands and invasive species, and Sudden Oak Death status and management. There will also be a land manager panel discussion, and an interdisciplinary dialogue addressing key management issues.

There is no fee to attend; however, you must register ahead of time with Kerri Frangioso at kfrangioso@ucdavis.edu. Drinks and light refreshments will be provided, but lunch will not. For government attendees traveling from out-of-town, the Big Sur Lodge will offer their government rate for the seminar through Saturday, May 30. For additional information, go to the Calendar of Events below.

The last *P. ramorum* Preventative Treatment Training session for this spring will be offered in May at UC Berkeley. The two-hour outdoor session covers basic Sudden Oak Death information, integrated pest management approaches, selection of candidate trees for treatment, and proper preventative treatment application. DPR, ISA, SAF, and California Urban Forestry Council credits are available. For more information, see the “Calendar of Events” below.

The last two Sudden Oak Death (SOD) Blitzes for this spring are being held in May in the counties of Santa Clara and Alameda. The intention of the Blitzes is to engage people in SOD as it relates to their local areas, and to assist communities in identifying locations where the pathogen is present. Participants will be given a two-hour training on identifying SOD symptoms, correctly sampling symptomatic plants, and documenting sample locations. For Blitz dates, see the “Calendar of Events” below. For more information on the Blitzes, go to <http://nature.berkeley.edu/garbelotto/english/sodblitz.php>.

RESOURCES

The World Wildlife Fund-Australia report “Arresting *Phytophthora Dieback* – the Biological Bulldozer” is available online. This document discusses the biology and epidemiology of *Phytophthora cinnamomi*, and its effects on Australia’s native plants and animals. It is a call to the community to increase the awareness of the pathogen and its impacts, and to work together to invest in the research and management necessary to help



put a stop to its devastating impacts. To access the report, go to:
http://wwf.org.au/publications/dieback_report/.

CALENDAR OF EVENTS

- 5/6 - SOD Treatment Workshop; meet at oak outside of Tolman Hall, UC**
Berkeley Campus; 1 – 3 p.m.; Pre-registration is required. This class is free and will be held rain or shine. 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, go to <http://nature.berkeley.edu/garbelotto/english/sodtreatmenttraining.php> or contact Katie Palmieri at (510) 847-5482 or palmieri@nature.berkeley.edu.
- 5/9 – 5/10 – Los Altos Hills SOD Blitz; Mandatory training and organizational meeting** will be 5/9 from 10:30 a.m. – 12 p.m. at the Los Altos Hills Town Hall (26379 Fremont Road, Los Altos Hills). This event is free. Pre-registration is encouraged. To register, call 650-815-8286 or email sodblitz09@earthlink.net. For more information, go to <http://nature.berkeley.edu/garbelotto/english/sodblitz.php>.
- 5/16 – 5/17 - East Bay SOD Blitz; Mandatory training and organizational meeting** will be 5/16 from 10 a.m. – 12 p.m. at the Regional Parks Botanic Garden Visitor Center (Wildcat Canyon Road at S. Park Drive, Tilden Regional Park, Berkeley). This event is free. For more information, go to <http://nature.berkeley.edu/garbelotto/english/sodblitz.php>.
- 5/27 – Science for Managing the Big Sur Ecosystem: A workshop for land managers** in the Big Sur area; Big Sur Lodge Conference Room; 9:00 a.m. - 2:30 p.m.; Registration is free; however, pre-registration is required. To register, email Kerri Frangioso at kfrangioso@ucdavis.edu. For more information, contact Janice Alexander at jalexander@ucdavis.edu.
- 6/15 – 6/18 – Fourth Sudden Oak Death Science Symposium; Hilton, Scotts Valley** (near Santa Cruz). For Symposium registration information, go to <http://nature.berkeley.edu/comtf/sodsymposium4/> or contact Janice Alexander at JAlexander@ucdavis.edu. For submission of abstracts, conference logistics, and facilities information, contact Katie Palmieri at Palmieri@nature.berkeley.edu. For hotel room reservations, go to <http://www.hilton.com/en/hi/groups/personalized/SJCSVHF-SODS-20090612/index.jhtml>.
- 3/7/10 – 3/12/10 - 5th IUFRO *Phytophthora* in Forest Trees and Natural Ecosystems** Conference; Rotorua, New Zealand; For more information, contact Pam Taylor at pam.taylor@scionresearch.com.