



CALIFORNIA OAK MORTALITY TASK FORCE REPORT APRIL 2009

MANAGEMENT

The United Kingdom Environment Minister announced on March 3, 2009 that £25 million will be provided over five years to help contain and eradicate *P. ramorum* and *P. kernoviae* in historic gardens, woodlands, heathlands and from nurseries and retailers in England and Wales. The program will focus on disease management, education and awareness, and research and development. Activities will be reviewed after three years to analyze successes and plan future strategies. The work will be managed by the new Food and Environment Research Agency (FERA) who will continue to work closely with other Government and non-Government agencies, including the Forestry Commission, Forest Research and with the agencies responsible for conservation of habitats such as heathlands which have recently been infected. Funding for the program will begin April 1, 2009. For more information on *P. ramorum* in the UK, go to www.defra.gov.uk/planth/pramorun.htm. For more information on *P. kernoviae*, go to <http://www.defra.gov.uk/planth/pkernovii.htm>.

MONITORING

A rhododendron leaf bait deployed in December 2008 in a Gadsden County, FL stream (outside a previously confirmed positive retail nursery) has been found culture positive. The nursery had most recently been confirmed positive in February, 2008 from soil and water samples. A follow-up survey of the nursery and environs was conducted on March 11, 2009. Diagnostic results on vegetation, water, and soil samples collected inside and outside the nursery are pending.

The United Kingdom confirmed the first case of *P. ramorum* on European blueberry (*Vaccinium myrtillus*) in February. The small patch of the infested blueberry was found in a mixed deciduous woodland with *P. ramorum*-infected *Rhododendron ponticum*. Symptoms are the same as those of *P. kernoviae* on European blueberry. The infected rhododendron understory is being managed for disease containment, and the blueberry has either been treated with herbicide or physically removed as part of an on-site scientific study. USDA APHIS is reviewing the findings and anticipates adding this newly identified host to the federally regulated list of *P. ramorum* hosts in the near future.

The COMTF March newsletter reported the first *P. ramorum* find in Serbia. Aleksandra Bulajic and Branka Krstic, University of Belgrade, have since provided a description of the detection. According to Bulajic and Krstic the pathogen was found in a private garden in the locality of Zemun, near Belgrade. The owner reported that the *Rhododendron* plants were planted almost two years before symptom expression. Investigations were not able to trace the source of the infection. Several imported plants were planted at the site during early spring, 2007, most of which were destroyed by the owner because they rapidly declined. It is suspected that the pathogen was introduced via the importing of the rhododendron plants. Zemun is a town in Serbia and one of the 17



municipalities which constitute the City of Belgrade, the country's capital. The Zemun climate is predominately a moderate continental climate, with Mediterranean climate influences.

RESEARCH

The final “Risk Analysis of *Phytophthora ramorum*, a Newly Recognised Pathogen Threat to Europe and the Cause of Sudden Oak Death in the USA” (RAPRA), as well as a summary of the report, have been posted to the RAPRA website. To access the information, go to <http://rapra.csl.gov.uk/>.

Goss, E.M.; Carbone, I.; and Grünwald, N.J. 2009. Ancient isolation and independent evolution of the three clonal lineages of the exotic sudden oak death pathogen *Phytophthora ramorum*. Molecular Ecology 18:1161–1174. DOI: 10.1111/j.1365-294X.2009.04089.x.

Abstract: The genus *Phytophthora* includes some of the most destructive plant pathogens affecting agricultural and native ecosystems and is responsible for a number of recent emerging and re-emerging infectious diseases of plants. Sudden oak death, caused by the exotic pathogen *P. ramorum*, has caused extensive mortality of oaks and tanoaks in Northern California, and has brought economic losses to US and European nurseries as well due to its infection of common ornamental plants. In its known range, *P. ramorum* occurs as three distinct clonal lineages. We inferred the evolutionary history of *P. ramorum* from nuclear sequence data using coalescent-based approaches. We found that the three lineages have been diverging for at least 11% of their history, an evolutionarily significant amount of time estimated to be on the order of 165,000 to 500,000 years. There was also strong evidence for historical recombination between the lineages, indicating that the ancestors of the *P. ramorum* lineages were members of a sexually reproducing population. Due to this recombination, the ages of the lineages varied within and between loci, but coalescent analyses suggested that the European lineage may be older than the North American lineages. The divergence of the three clonal lineages of *P. ramorum* supports a scenario in which the three lineages originated from different geographic locations that were sufficiently isolated from each other to allow independent evolution prior to introduction to North America and Europe. It is thus probable that the emergence of *P. ramorum* in North America and Europe was the result of three independent migration events.

Martin, F.N.; Coffey, M.D.; Zeller, K.; Hamelin, R.C.; Tooley, P.; Garbelotto, M.; Hughes, K.J.D.; Kubisiak, T.; Bilodeau, G.J.; Levy, L.; Blomquist, C.; and Berger, P.H. 2009. Evaluation of molecular markers for *Phytophthora ramorum* detection and identification: Testing for specificity using a standardized library of isolates. Phytopathology 99:390-403.

Abstract: Given the importance of *Phytophthora ramorum* from a regulatory standpoint, it is imperative that molecular markers for pathogen detection are fully tested to evaluate their specificity in detection of the pathogen. In an effort to evaluate 11 reported



diagnostic techniques, we assembled a standardized DNA library using accessions from the World Phytophthora Genetic Resource Collection for 315 isolates representing 60 described *Phytophthora* spp. as well as 11 taxonomically unclassified isolates. These were sent blind to collaborators in seven laboratories to evaluate published diagnostic procedures using conventional (based on internal transcribed spacer [ITS] and cytochrome oxidase gene [*cox*]1 and 2 spacer regions) and real-time polymerase chain reaction (based on ITS and *cox*1 and 2 spacer regions as well as β -tubulin and elicitor genes). Single-strand conformation polymorphism (SSCP) analysis using an automated sequencer for data collection was also evaluated for identification of all species tested. In general, the procedures worked well, with varying levels of specificity observed among the different techniques. With few exceptions, all assays correctly identified all isolates of *P. ramorum* and low levels of false positives were observed for the mitochondrial *cox* spacer markers and most of the real-time assays based on nuclear markers (diagnostic specificity between 96.9 and 100%). The highest level of false positives was obtained with the conventional nested ITS procedure; however, this technique is not stand-alone and is used in conjunction with two other assays for diagnostic purposes. The results indicated that using multiple assays improved the accuracy of the results compared with looking at a single assay alone, in particular when the markers represented different genetic loci. The SSCP procedure accurately identified *P. ramorum* and was helpful in classification of a number of isolates to a species level. With one exception, all procedures accurately identified *P. ramorum* in blind evaluations of 60 field samples that included examples of plant infection by 11 other *Phytophthora* spp. The SSCP analysis identified eight of these species, with three identified to a species group.

Moralejo, E.; García-Muñoz, J.A.; and Descals, E. 2009. Susceptibility of Iberian trees to *Phytophthora ramorum* and *P. cinnamomi*. Plant Pathology 58:271–283. DOI: 10.1111/j.1365-3059.2008.01956.x.

Abstract: The capacity of *Phytophthora ramorum* to colonize the inner bark of 18 native and two exotic tree species from the Iberian Peninsula was tested. Living logs were wound-inoculated in a growth chamber with three isolates belonging to the EU1 and two to the NA1 clonal lineages of *P. ramorum*. Most of the *Quercus* species ranked as highly susceptible in experiments carried out in summer, with mean lesion areas over 100 cm² in *Q. pubescens*, *Q. pyrenaica*, *Q. faginea*, and *Q. suber* and as large as 273 cm² in *Q. canariensis*, ca. 40 days after inoculation. *Quercus ilex* ranked as moderately susceptible to *P. ramorum*, forming lesions up to 133 cm² (average 17.2 cm²). *Pinus halepensis* and *P. pinea* were highly susceptible, exhibiting long, narrow lesions; but three other pine species, *P. pinaster*, *P. nigra*, and *P. sylvestris*, were resistant to slightly susceptible. No significant difference in aggressiveness was found between the isolates of *P. ramorum*. In addition, there was evidence of genetic variation in susceptibility within host populations, and of significant seasonal variation in host susceptibility in some *Quercus* species. The results suggest a high risk of some Iberian oaks to *P. ramorum*, especially in forest ecosystems in southwestern Spain, where relict populations of *Q. canariensis* grow amongst susceptible understory species such as *Rhododendron ponticum* and *Viburnum*



tinus. One isolate of *P. cinnamomi* used as positive control in all the inoculations was also highly aggressive to Iberian oaks and *Eucalyptus dalrympleana*.

Tjosvold, S.A.; Chambers, D.L.; Fichtner, E.J.; Koike, S.T.; and Mori, S.R. 2009. Disease risk of potting media infested with *Phytophthora ramorum* under nursery conditions. *Plant Disease* 93:371-376.

Abstract: *Phytophthora ramorum* has been found in potting media of containerized plants; however, the role of infested media on disease development under nursery conditions is unknown. This study assesses pathogen survival, sporulation, and infectivity to rhododendron plants in nursery pots with infected leaf litter that were maintained under greenhouse and field conditions. The influence of environmental conditions and irrigation method on disease incidence was also assessed. Infected leaf disks were buried below the soil surface of potted rhododendrons and retrieved at approximately 10-week intervals for up to 66 weeks. Pathogen survival was assessed by either isolation or induction of sporulation in water over three experimental periods. *P. ramorum* was recovered from infected leaf disks incubated in planted pots for longer than 1 year. Chlamydospores and sporangia formed on hydrated leaf disks but relative production of each spore type varied with the duration of incubation in soil. Root infections were detected after 40 weeks in infested soil. Foliar infections developed on lower leaves but only after spring rain events. Sprinkler irrigation promoted the development of foliar infections; no disease incidence was observed in drip-irrigated plants unless foliage was in direct contact with infested soil. Management implications are discussed.

The program, abstracts, and presentations from the 3rd International *Phytophthora*, *Pythium*, and Related Genera Workshop are now available. To access the information, go to: http://www.aphis.usda.gov/plant_health/identification/phytophthora/index.shtml.

NURSERIES

A Sacramento County, California nursery was found *P. ramorum*-positive in March while undergoing Confirmed Nursery Protocol (CNP) inspections as a result of a positive find for the pathogen in the fall of 2008. Several plants were found *P. ramorum* positive during the inspections, including *Cinnamomum camphora* (camphor tree). This is the first time this host has been detected in the United States. The nursery is now undergoing the CNP.

The nursery owner has expressed an interest in working with the California Department of Food and Agriculture to identify 'critical control points' that can foster disease introduction or spread within the nursery, and to implement best management practices to help reduce or eliminate the pathogen.

As of March 25, 2009, the Oregon Department of Agriculture has tested 1,745 samples from 44 grower sites in 2009. Of the sites tested, *P. ramorum* was confirmed at one wholesale nursery in Washington County on March 19, 2009 infecting two plants of *Pieris japonica* 'Purity.' The USDA Confirmed Nursery Protocol has been enacted at the



nursery. Delimitation samples were collected March 23rd and are being tested for *P. ramorum* according to the USDA-validated protocols. This is the first time *P. ramorum* has been detected at the nursery. Other *Phytophthora* species have been detected at another 18 nurseries, infecting 5% of the samples submitted.

RELATED TOPICS

Garbelotto, M. 2008. Molecular analysis to study invasions by forest pathogens: examples from Mediterranean ecosystems. *Phytopathologia Mediterranea* 47:183–203.

Summary: Biological invasions by plants and animals have been the subject of several review papers, but invasions by plant pathogens have only occasionally been described and reviewed. The present paper discusses exotic plant diseases whose epidemiology has been clarified using molecular analysis. Because the list of all exotic plant diseases is quite large, this review focuses on forest diseases caused by exotic microbes in Mediterranean ecosystems. In particular, the contribution of molecular studies on exotic forest diseases in favor of or against general invasion biology theory is highlighted. The review follows different phases of the invasion process, giving examples of particular diseases/pathogens for which characteristics have been analyzed.

The first Southern California detection of *Phytophthora siskiyouensis* was found by Drs. Michael Coffey and Deborah Mathews (UC Riverside) during an investigation into the cause of declining alder trees. The positive white alder (*Alnus rhombifolia*) was found in a grassy landscape strip along a city street sidewalk in front of a commercial building complex in Costa Mesa, Orange County. Symptoms included upper canopy dieback, tree mortality, and trunk bark exhibiting dark brown, moist spots. Isolations from a trunk lesion on one of the several sampled trees yielded *P. siskiyouensis*. Since that isolation, at least two of the approximately eight trees there have died and are flagged for removal. Alders with similar symptoms have been found at several landscape sites, including commercial complexes and residential landscapes. The trees at the *P. siskiyouensis* site were approximately 25 years old and 30-40 ft tall; however, they may have been planted at a relatively mature stage. Investigations into the alder die-off in southern CA are ongoing. Another *P. siskiyouensis*-positive alder was found recently at a residential development in Lake Forest, CA. In 2006, Suzanne Rooney-Latham and Cheryl Blomquist, CA Department of Food and Agriculture, reported similar symptoms and dieback on alders in Foster City caused by *P. siskiyouensis*. For more information contact Deborah Mathews at dmathews@ucr.edu.

UK AGENCY REORGANIZATION

The United Kingdom's Department for Environment, Food, and Rural Affairs has been reorganized. The newly restructured Food and Environment Research Agency (FERA) is a merging of the Central Science Laboratory, Plant Health Division/Plant Health & Seeds Inspectorate, the Plant Varieties and Seeds Division, and the Government Decontamination Service. The formal vesting date for FERA was April 1, 2009. Information on FERA, including their Statement of Purpose, key facts, Agency organization, and FAQs, can be found at <http://services.csl.gov.uk/fera/>.

**WORKSHOPS AND EVENTS**

The agenda for the 4th Sudden Oak Death Science Symposium is now posted to the Symposium website at <http://nature.berkeley.edu/comtf/sodsymposium4/>. The Symposium will be held June 15 – 18, 2009, and will include a ½-day field trip, a welcome reception, 2 ½ days of presentations, and an evening poster session. Online registration is available at <http://nature.berkeley.edu/comtf/sodsymposium4/registration.php>. Hotel reservations can be made at http://nature.berkeley.edu/comtf/sodsymposium4/hotel_travel.htm. The discounted Symposium hotel room rate is available through May 16th.

Two *P. ramorum* Preventative Treatment Training sessions are still available this spring on the UC Berkeley campus. Each 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.

Sudden Oak Death (SOD) Blitzes will be held in the counties of San Mateo, Sonoma, Monterey, Santa Clara, and Alameda this spring. 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>.

CALENDAR OF EVENTS

- 4/17 – 4/19 Woodside and Portola Valley SOD Blitz; Mandatory training and** organizational meeting will be 4/17 from 7 – 9 p.m. at the Community Hall in Portola Valley Town Center (765 Portola Road; Portola Valley); This event is free. For more information, go to <http://nature.berkeley.edu/garbelotto/english/sodblitz.php>.
- 4/18 - Northern Big Sur/Carmel SOD Blitz; Mandatory training and organizational** meeting; 3 – 4 p.m.; Carmel Valley Middle School (4380 Carmel Valley Road; Carmel, CA 93923). This event is free. Registration is strongly recommended. To register, contact Cheryl McCormick at cmccormick@slconservancy.org. For more information, go to <http://nature.berkeley.edu/garbelotto/english/sodblitz.php>.
- 4/22 - 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.



- 4/24 – 4/26 Pepperwood Preserve SOD Blitz; Mandatory training and organizational meeting** will be 4/24 from 6 – 7:30 p.m. at the Pepperwood Preserve Bechtel House (3450 Franz Valley Road, Santa Rosa); This event is free; however, registration is required. To register, contact Beth Sabo at bsabo@pepperwoodpreserve.org. For more information, go to <http://nature.berkeley.edu/garbelotto/english/sodblitz.php>.
- 5/2 - Northern Big Sur/Carmel SOD Blitz; Sampling Day; Sampling locations will** be determined at the mandatory training and organizational meeting on 4/18. For more information, see 4/18 listing above.
- 5/6 - SOD Treatment Workshop; meet at oak outside of Tolman Hall, UC** Berkeley Campus; 1 – 3 p.m.; Pre-registration is required. For more information, see the 4/22 listing above.
- 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 – 5/28 – Science for Managing the Big Sur Ecosystem, Big Sur Lodge; A** workshop for land managers in the Big Sur area, from 9 a.m. - 2:30 p.m., with presentations on fire, Sudden Oak Death, and other issues important to the forests and ecosystems of the Central Coast; contact Janice Alexander at jalexander@ucdavis.edu for more information.
- 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>.