CALIFORNIA OAK MORTALITY TASK FORCE REPORT
APRIL 2015

NURSERIES

From January 1 to March 25, 2015, *Phytophthora ramorum* was reported in six nurseries and one commercial business site (not a nursery) throughout the US in non-quarantine areas. *P. ramorum* was detected at the six Oregon nurseries in *Camellia* (1), *Kalmia* (1), *Osmanthus* (1), *Pieris* (1), *Rhododendron* (24), and soil samples (4). Four of the nurseries ship interstate and are in the compliance program (started last spring, Federal Order DA-2014-02). Due to state regulator inspections, very few shipments were made prior to these early detections, allowing for rapid mitigation and response efforts before the busy shipping season. The Confirmed Nursery Protocol is underway in all nurseries and trace investigations are complete for 3 of the 4 interstate shippers with no detections at trace forward sites. Additionally, one *Rhododendron* was found positive at a Louisiana commercial business site; the residential protocol and trace-back investigation are underway.

Washington received *P. ramorum* positive-plant shipments from three out of state nurseries in March. Trace-forward investigations were conducted at the 11 receiving Washington nurseries. Samples were collected from high-risk host and associated host plants (HAP) remaining at seven of the locations. All samples collected were negative for the pathogen. One trace-forward investigation is still underway for high-risk HAP received and planted in landscapes in the Puget Sound area.

FEATURED RESEARCH

How many times has *Phytophthora ramorum* been introduced into Oregon? From where did the introductions originate?

A genetic analysis of *Phytophthora ramorum* detections in Oregon forests from 2001 through 2014 found that the pathogen has been introduced at least twice there. The original introduction occurred in the Joe Hall area, about 3 miles northeast of Brookings (Curry Co.). Over time the pathogen spread primarily to the north, but also to the east and southwest. A second isolated introduction near Cape Sebastian (Hunter Creek), 22 miles north of Brookings, was first detected via aerial survey in fall 2011 and was 12 miles from the nearest known forest infestation (See Figure 1.). Microsatellite genotyping of forest and nursery isolates shows that each introduction originated from nursery populations in California or Oregon.

The complete analysis will appear in Kamvar, Z.N.; Larsen, M.M.; Kanaskie, A.M.; Hansen, E.M.; and Grunwald, N.J. 2015. Spatial and Temporal Analysis of Populations of the Sudden Oak Death Pathogen in Oregon Forests, in the June issue of Phytopathology, part of a focus issue on Emerging and Re-emerging Plant Diseases. This work is a collaboration between the Oregon Department of Forestry, Oregon State University, and the USDA Agricultural Research Service, with support from the USDA Forest Service, Forest Health Monitoring Program and the USDA Animal and Plant Health Inspection Service.

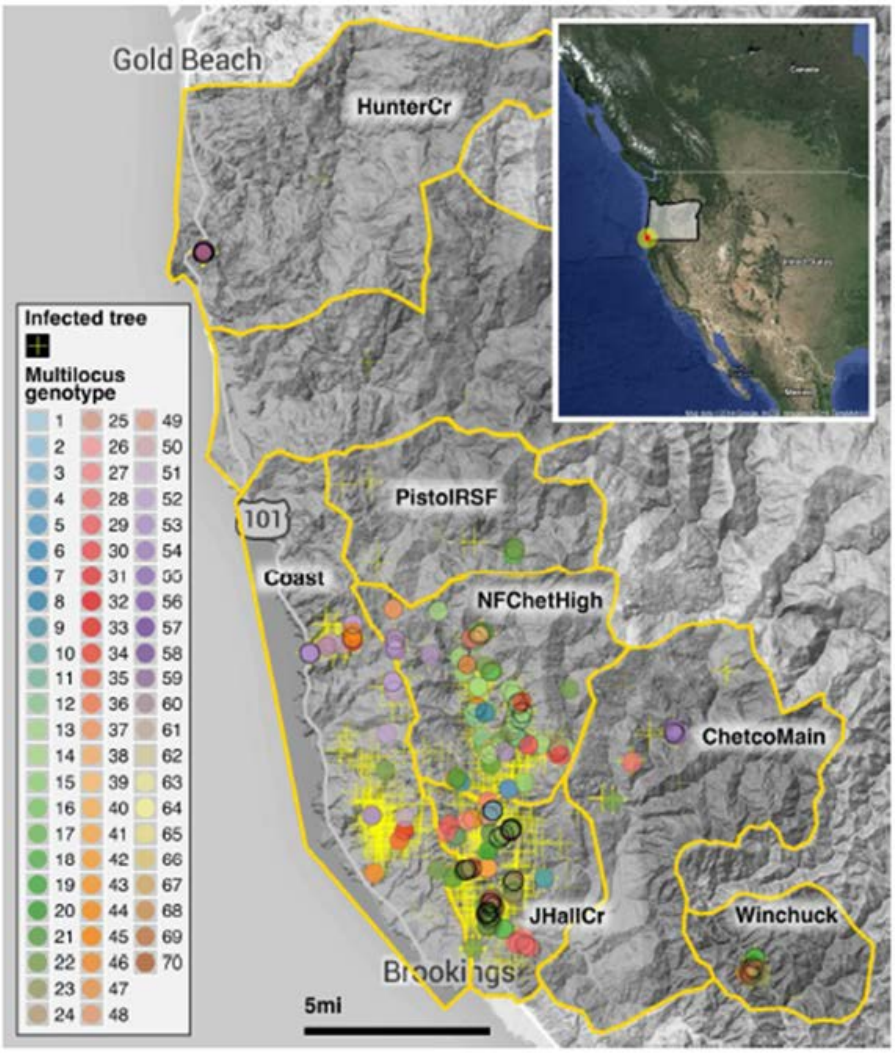

Figure 1. Spatial distribution of SOD and multilocus genotypes of *Phytophthora ramorum* in Curry County, Oregon. Tanoak trees found positive during aerial surveys are marked with yellow crosses. From 2001 – 2014, 70 multilocus genotypes were identified and are color coded in the legend. The inset map represents the location of Curry County in Oregon (red dot). By K. Aram, UC Davis, and others, 2015. Courtesy of N. Grunwald, USDA ARS.

FUNDING

The 2014 Farm Bill awarded roughly $796,717 in *Phytophthora ramorum*-related program funding to 19 states for the 2015 federal fiscal year. California is receiving $109,000 of the available funds for survey efforts, confirming the pathogenicity and host range of the pathogen, and assessing disinfectants for *P. ramorum* control. The National Ornamentals Research Site at Dominican University of California also received funding (separate from *P. ramorum* funding) for $474,303, allowing key *P. ramorum* nursery-

related research to continue. For more information on the Farm Bill 2015 program of work, go to http://content.govdelivery.com/accounts/USDAAPHIS/bulletins/f833cb.

MONITORING

Sudden oak death has been confirmed for the first time in Montgomery Woods State Park, Mendocino County by UC Cooperative Extension, Humboldt and Del Norte County staff on California bay laurel and tanoak. The 1-acre area infestation is off trail and uphill from the main parking lot and included approximately 20 affected trees – four or five small dead tanoak as well as several that were heavily bleeding and a few small bays. The nearest known infestation is approximately 1.3 miles east near Orr Hot Springs.

RESEARCH

Gibson, G. and Gilligan, C.A. 2015. Inference and Prediction with Individual-based Stochastic Models of Epidemics. Biosecurity Surveillance: Quantitative Approaches. 253-264.

Chapter Abstract: Stochastic models for the spread of epidemics in space and time are increasingly being used as predictive tools to help in the control of emergent pests and pathogens and as tools for the interpretation of observations of epidemics as they occur. This chapter provides an introduction to a particular class of stochastic model – the individual-based, spatio-temporal compartment model – that is frequently applied in this context. An overview of the techniques used to implement these models and to fit them to observations is provided. The main implications of different model formulations for biosecurity and the design of control strategies are given. The chapter aims to provide the reader, who already has some knowledge of mathematical and statistical approaches to modelling infectious diseases, with a technical overview of the Bayesian computational approach.

King, K.M.; Harris, A.R.; and Webber, J.F. 2015. *In planta* Detection Used to Define the Distribution of the European Lineages of *Phytophthora ramorum* on Larch (*Larix*) in the UK. Plant Pathology. DOI: 10.1111/ppa.12345.

Abstract: Two genetically distinct evolutionary lineages of the oomycete pathogen *Phytophthora ramorum* are responsible for the major epidemic on larch (*Larix* spp.) in the UK: EU1 (historically widespread) and the recently identified EU2 (reported only from Northern Ireland and a small area in southwest Scotland). Methods for lineage discrimination have required pure cultures of *P. ramorum* but, as the pathogen is challenging to isolate from infected larch tissue, only limited data have been available on the distribution of EU2. In this study a protocol was developed to determine the lineage of *P. ramorum* in infected larch tissue without the need for isolation. The protocol was applied to 134 UK samples collected during 2013–14. In addition, lineage testing was applied to over 300 *P. ramorum* isolates cultured from a wide range of hosts between 2002 and 2012. Combined data confirmed that EU2 is restricted to Northern Ireland and a small area of southwest Scotland where it is the dominant lineage. There was no evidence of EU2 spread into England and Wales where only EU1 was found. However, EU2 was

more widely distributed in southern and eastern parts of Scotland than previously reported. Furthermore, EU1 and EU2 were detected <10 km apart in larch plantations. This study provides the first reports of natural EU2 infection on European larch (*Larix decidua*), hybrid larch (*Larix* × *eurolepis*), beech (*Fagus sylvatica*), noble fir (*Abies procera*) and western hemlock (*Tsuga heterophylla*).

König, S.; Schwenkbier, L.; Pollok, S.; Riedel, M.; Wagner, S.; Popp, J.; Weber, K.; and Werres, S. 2015. Potential of *Ypt1* and ITS Gene Regions for the Detection of *Phytophthora* Species in a Lab-on-a-Chip DNA Hybridization Array. Plant Pathology. DOI: 10.1111/ppa.12357.

A novel DNA-chip hybridization assay that uses the *ras*-related GTP-binding protein 1 gene (*Ypt1*) was developed for the identification of several devastating *Phytophthora* species. The hybridization was conducted in a portable microfluidic lab-on-a-chip device for fast and accurate detection of 40 *Phytophthora*, two *Pythium* and one *Phytopythium* species. Moreover, the functionality of the *Ypt1* region was examined in comparison to an array for the internal transcribed spacer (ITS) region by *in silico* modelling. The difference in species-specific capture probe sequences was lower for the ITS than for the *Ypt1* region. While ITS-probes of *Phytophthora ramorum*, *Phytophthora fragariae* and *Phytophthora lateralis* cross-reacted with up to 11 non-target species, *Ypt1*-probes were specific except for *P. fragariae*/*Phytophthora rubi*. First analyses of artificially inoculated *Rhododendron* leaves successfully demonstrated the usability of the respective capture probes for the *Ypt1* and the *ras*-related plant protein *Rab1a* gene region. The on-chip hybridization enabled the detection of up to 1 pg μL^{-1} target DNA depending on the species examined. Due to the complementarity of ITS and *Ypt1* genetic features, the use of multiple loci is recommended to identify targets of different taxonomic rank.

Willoughby, I.H.; Seier, M.K.; Stokes, V.J.; Thomas, S.E.; and Varia, S. 2015. Synthetic Herbicides Were More Effective than a Bioherbicide Based on *Chondrostereum purpureum* in Reducing Resprouting of *Rhododendron ponticum*, a Host of *Phytophthora ramorum* in the UK. Forestry. DOI: 10.1093/forestry/cpv004.

Abstract: A UK field trial compared the efficacy of a range of synthetic herbicides and the fungal biocontrol agent *Chondrostereum purpureum* (Pers.) Pouzar at preventing resprouting of *Rhododendron ponticum* L. following cutting, and hence countering infection with *Phytophthora ramorum* Werres or *P. kernoviae* Brasier. Treatments were applied to cut rhododendron stumps in the summer and winter, and regrowth was evaluated 25 months after application. All chemical herbicide treatments significantly reduced regrowth, and would therefore help to lower reinfection by *P. ramorum* or *P. kernoviae*. Timing of applications (summer or winter) did not affect efficacy. Picloram was the least effective of the chemical herbicide treatments. A 20 percent solution of Roundup Pro Biactive® (360 g l^{-1} glyphosate; Monsanto) applied to stumps immediately after cutting was an effective, low-toxicity and inexpensive means of preventing regrowth, although some follow-up treatment was necessary. If approvals for glyphosate formulations were lost in the future, products based on triclopyr or picloram could be

potential substitutes. Use of the wood-rotting basidiomycete *C. purpureum* as a biocontrol agent did not have a statistically significant effect in this study, although the possibility of a synergistic effect with glyphosate has not been ruled out. It is possible that any impact of the biological agent becomes apparent only over a longer time frame and thus extended assessment periods would be required. Refinement of the application technique and/or the formulation method as well as a more comprehensive strain selection might result in improved efficacy of the biocontrol treatment.

MANAGEMENT

T. Swiecki collects SOD-related fuels data in redwood-tanoak forest, Jack London State Historic Park. Photo by Liz Bernhardt, Phytosphere Research

SOD-related fuels evaluated at Jack London State Historic Park **–** California State Parks (CSP) staff used resource values and other considerations to identify priority areas to treat SOD-related fuels at Jack London State Historic Park. Surveys by Phytosphere Research plant pathologists showed that the highest priority zone, a mixed oak woodland, had relatively low SOD-related mortality to date, but a high potential for future impacts to coast live and California black oaks due to intermixed California bay laurel. The goal for the area was to minimize SOD-related tree mortality by removing understory bay near oaks, helping to minimize the likelihood of new infections as well as reduce live surface and ladder fuels. About 33 acres were treated in August and September in 2014 under the direction of CSP staff.

The survey also revealed an area of extensive Pacific madrone mortality and bay laurel decline in the priority area. Two introduced soil-borne *Phytophthora* species (*P. cinnamomi* and *P. cambivora*) were baited from the soil. The presence of these additional exotic pathogens has implications for forest structure and health. Best management practices were put in place to prevent further spread of infested soil during fuel management activities in and around the affected area.

Within the second priority zone (redwood/tanoak forest), plot data from the UC Davis Rizzo lab, in addition to updated plot evaluations, were used to estimate the contribution of SOD-related fuels to total fuel loading in the area. Background fine woody fuel loadings (about 2 tons/acre) were increased by about 65% when considering SOD-associated fine woody debris. SOD-

Oak woodland after bay manipulation and ladder fuel reduction, Jack London State Historic Park, 2014. Photo by Cyndy Shafer, CA State Parks

related fuels were discontinuous and decayed to varying degrees. Output from two fire models showed that these discontinuous SOD-related fuels had little effect on predicted fire behavior across the landscape. However, localized areas of fire intensification could occur within mixed fuelbeds associated with recent tanoak mortality. Recommended treatments of SOD-related fuels in this 156 acre area are directed at recent snags and debris piles located where fire intensification could increase scorch height and lead to redwood mortality.

NURSERIES

The Systems Approach to Nursery Certification (SANC) program continues to make progress, with a national pilot project underway that includes eight grower operations throughout the US working in cooperation with the NPB, AmericanHort, the Society of American Florists, and USDA APHIS Plant Protection and Quarantine (PPQ). The first two facilities, Conard Pyle Company (greenhouse grower in West Grove, PA) and Forrest Keeling Nursery (Elsberry, MO), have nearly completed their risk assessments and will next work on site-specific facility manuals. Three other production facilities - Lucas Greenhouses, NJ; Southeast Growers, GA; and Walla Walla Nursery, WA - are just beginning the pilot risk assessment process.

As part of the pilot, state regulatory staff, in coordination with an industry-supported team, provide assistance in conducting facility risk assessments, suggesting best management practices and reviewing facility manual drafts. Early reactions to the pilot from industry have been enthusiastic and encouraging, with recognition of improved facility organization and pest management leading to lower pest risk and better quality stock. State certifying agencies will conduct regular audits to insure that agreed upon commitments for pest exclusion and management are being carried out at each of the eight sites, providing oversight and credibility to SANC certification. It is anticipated that the pilot project will take about 3 years to complete. SANC is a cooperative effort of the National Plant Board, industry, and USDA APHIS Plant Protection and Quarantine. For more information, go to www.sanc.nationalplantboard.org.

REGULATIONS

Australia has issued a "Draft review of policy: importation of *Phytophthora ramorum* host propagative material into Australia" following a request from the Australian nursery industry to revise importation conditions for nursery stock from countries where *P. ramorum* is known to occur. As *P. kernoviae*, *P. nemorosa*, and *P. pseudosyringae* have similar hosts and geographic ranges and cause symptoms indistinguishable from *P. ramorum*, the review also addresses those pathogens.

Several changes to the existing policy are proposed, including updating the *P. ramorum* host list and adding additional hosts of *P. kernoviae*, *P. nemorosa*, and *P. pseudosyringae*; reducing the post-entry quarantine (PEQ) growth period for dormant cuttings and budwood, with visual screening, culturing, and active testing for all four *Phytophthora* species; and allowing the importation of 1-year-old, bare-rooted plants without foliage. On arrival, bare rooted plants will be subject to inspection, fumigation,

Phytophthora screening, and sodium hypochlorite treatment as well as a PEQ. Stakeholder comments are due by April 29th. For more information, or to access the review, go to http://www.agriculture.gov.au/biosecurity/risk-analysis/memos/ba2015-03.

RELATED RESEARCH

Eschen, R.; Rigaux, L.; Sukovata, L.; Vettraino, A.M.; Marzano, M.; and Grégoire, J.-C. 2015. Phytosanitary Inspection of Woody Plants for Planting at European Union Entry Points: A Practical Enquiry. Biological Invasions. DOI: 10.1007/s10530-015-0883-6.

Jarrad, F.; Low-Choy, S.; and Mengersen, K. 2015. Biosecurity Surveillance: Quantitative Approaches. Oxfordshire, UK: CABI Invasive Series; No. 6. 386 pgs.

Navarro, S.; Sims, L.; and Hansen, E. 2015. Pathogenicity to Alder of *Phytophthora* Species from Riparian Ecosystems in Western Oregon. Forest Pathology. DOI: 10.1111/efp.12175.

CALENDAR

4/10 – Santa Cruz SOD Blitz Training; UC Santa Cruz Botanic Garden; 6:00 – 7:00 p.m.; For more information, contact Brett Hall at brett@ucsc.edu.

4/11 – East Bay (Orinda) SOD Blitz Training; Orinda Library Garden Room; 26 Orinda Way, Orinda; 10:00 – 11:00 a.m.; For more information, contact Bill Hudson at wllhh@ymail.com.

4/11 – East Bay (Berkeley) SOD Blitz Training; UC Berkeley campus; 159 Mulford Hall, Berkeley; 1:30 p.m. – 2:30 p.m.; To register, go to http://sodblitz2015.eventzilla.net/web/event?eventid=2139075836.

4/18 – Napa SOD Blitz Training; UC Cooperative Extension Office Meeting Room; 1710 Soscol Avenue, Napa; 10:00 a.m. – 11:00 noon; For more information, contact Bill Pramuk at info@billpramuk.com.

4/23 – Annual North Coast Sudden Oak Death Coordination Meeting; Fortuna River Lodge; 1800 Riverwalk Dr., Fortuna; Pre-registration is required by April 20th. A $15 registration fee covers lunch and materials. To register, go to http://ucanr.edu/northcoastsodmeeting. For more information, contact Dan Stark at (707) 445-7351.

4/25 – Montalvo SOD Blitz Training; Montalvo Art Center, The Art Commons; 15400 Montalvo Rd., Saratoga; 10:00 – 11:00 a.m.; For more information, contact Ann Northrup at annnorthrup@sbcglobal.net.

4/25 – South Skyline SOD Blitz Training; Cal Fire Saratoga Summit Fire Station 21; 12900 Skyline Blvd, Los Gatos; 1:00 – 2:00 p.m. For more information, contact Jane Manning at skyline_sod@yahoo.com.

5/2 – Burlingame SOD Blitz Training; Burlingame Hills; 120 Tiptoe Lane (off Canyon Rd.), Burlingame; 10:00 – 11:00 a.m.; For more information, contact Steve Epstein at steve@burlingamehills.org.

5/2 – Los Altos Hills SOD Blitz Training; Los Altos Hills Town Hall Council Chambers; 26379 Fremont Rd, Los Altos Hills; 1:00 – 2:00 p.m.; For more

information, contact Sue Welch at sodblitz09@earthlink.net.

5/8 – North Coast SOD Blitz Training (Fort Bragg); Location to be determined; 6:00 – 7:00 p.m. For more information, contact Nancy Ruth Morin at Nancy.Morin@nau.edu.

5/9 – North Coast SOD Blitz Training (Point Arena); Location to be determined; 10:00 – 11:00 a.m.; For more information, contact Nancy Ruth Morin at Nancy.Morin@nau.edu.

5/15 – San Luis Obispo SOD Blitz Training; San Luis Obispo UC Cooperative Extension classroom; 2156 Sierra Way, San Luis Obispo; 6:00 – 7:00 p.m.; For more information, contact Lauren Brown at lbrown805@charter.net.

5/16 – Woodside, **Portola Valley, Atherton, Emerald Hills, and Belmon**t **SOD Blitz** Training; Woodside Town Hall; 2955 Woodside Rd.; Woodside; 10:00 – 11:00 a.m.; For more information, contact Debbie Mendelson at naturemend@sbcglobal.net.

5/23 – Carmel Valley SOD Blitz Training; Carmel Valley Garland Ranch Regional Park Museum Hall; 700 West Carmel Valley Road, Carmel; 10:00 – 11:00 a.m.; For more information, contact Kerri Frangioso at kfrangioso@ucdavis.edu.

5/30 – Marin SOD Blitz Training; Dominican University of California; Joseph R Fink Science Center, Rm 103, San Rafael; 10:00 – 11:00 a.m.; For more information, contact Wolfgang Schweigkofler at wolfgang.schweigkofler@dominican.edu.

5/30 – Sonoma SOD Blitz Training; 10:00 – 11:00 a.m.; 3 locations from which to choose:
Graton Community Club, Main & N. Edison, (8996 Graton Rd.) Graton
Spring Lake Park, Environmental Discovery Center, 393 Violetti Road, Santa Rosa
Cloverdale Historical Society, 215 North Cloverdale Blvd., Cloverdale
For more information on a Sonoma SOD Blitz training, contact Lisa Bell at lkbell@ucanr.edu.

8/23 – 8/28 - 5th International Workshop on the Genetics of Tree-Parasite Interactions; Orléans, France; For more information, or to register, go to https://colloque.inra.fr/tree-parasite-interactions2015.