CALIFORNIA OAK MORTALITY TASK FORCE REPORT
NOVEMBER 2012

MONITORING

A spike in infection and establishment of *P. ramorum* in Bay Area urban residential areas is one of the findings from the 2012 SOD Blitzes. Urban outbreaks were detected in Santa Cruz County, Carmel Valley Village (Monterey Co.), and in Golden Gate Park (San Francisco Co.) in a southwestern sector near Middle Lake, several miles from the previously infected site in the AIDS Memorial Grove. Most of the Bay Area locations sampled had increased levels of infection, with the East Bay infestation found to have transitioned from a "newly arrived" status (in 2011) to epidemic levels on bay (in 2012), suggesting oak and tanoak infection in those areas are likely to increase. In total, the 2012 SOD Blitz surveyed over 10,000 trees this past spring throughout coastal Northern California, thanks to the help of more than 500 volunteers. Survey results are available at http://nature.berkeley.edu/garbelotto/english/sodblitzresults.php.

NURSERIES

To date this year, *P. ramorum* has been reported in 8 (CA, OR, WA, NC, ME, NY, PA. and IN) states and 33 nurseries, including 17 interstate shipping facilities (CA-2, OR-7, WA-7, NY-1; 10 nurseries did ship material out of state) and 16 non-interstate shipping nurseries (CA-4, OR-4, WA-3, NC-1, ME-1, NY-1, PA-1, IN-1). Forty-seven percent (15) of the finds were first time detections (CA-3, OR-7, WA-2, NY-1, IN-1) and 48 percent (16) were repeat nurseries. In total, 10 trace investigations have been implemented.

Host plants from *P. ramorum*-positive nurseries were shipped to 33 states, with positive finds in 2 (ME, PA traced-back to OR) non-interstate shipping nurseries and four residential locations. Of the four (ME, OR, WA, CA) residential confirmations, two (ME, CA) were traced back to a nursery in OR and two (OR, WA) were traced back to a WA nursery.

MANAGEMENT

***Phytophthora ramorum* management in Redwood Valley is still underway, following** the unexpected 2010 discovery of a Sudden Oak Death outbreak in Redwood Valley. The collaborative project, being led by UC Cooperative Extension, Humboldt County, is the largest landscape-level slow-the-spread attempt to date in California. Redwood Valley's close proximity to critical tanoak forests in Redwood National and State Parks and on Hoopa and Yurok Tribal lands, as well as valuable and productive timber lands and disease-free Del Norte County, has made it an area of high priority for *P. ramorum* management. Over 370 acres have been treated to date in the first phase of the effort. Surveys of the area around the perimeter of the treated zone are underway and have found the pathogen outside of the treated area. An adaptive management strategy for these infected hosts is in development.

RESEARCH

Beh, M.M.; Metz, M.R.; Frangioso, K.M.; and Rizzo, D.M. 2012. The key host for an invasive forest pathogen also facilitates the pathogen's survival of wildfire in California forests. New Phytologist. DOI: 10.1111/j.1469-8137.2012.04352.x.

Summary

- The first wildfires in sudden oak death-impacted forests occurred in 2008 in the Big Sur region of California, creating the rare opportunity to study the interaction between an invasive forest pathogen and a historically recurring disturbance.
- To determine whether and how the sudden oak death pathogen, *Phytophthora ramorum*, survived the wildfires, we completed intensive vegetation-based surveys in forest plots that were known to be infested before the wildfires. We then used 24 plot-based variables as predictors of *P. ramorum* recovery following the wildfires.
- The likelihood of recovering *P. ramorum* from burned plots was lower than in unburned plots both 1 and 2 yr following the fires. Post-fire recovery of *P. ramorum* in burned plots was positively correlated with the number of pre-fire symptomatic California bay laurel (*Umbellularia californica*), the key sporulating host for this pathogen, and negatively correlated with post-fire bay laurel mortality levels.
- Patchy burn patterns that left green, *P. ramorum*-infected bay laurel amidst the charred landscape may have allowed these trees to serve as inoculum reservoirs that could lead to the infection of newly sprouting vegetation, further highlighting the importance of bay laurel in the sudden oak death disease cycle.

Garbelotto, M. and Hayden, K.J. 2012. Sudden Oak Death: Interactions of the Exotic Oomycete *Phytophthora ramorum* with Naïve North American Hosts. Eukaryotic Cell 11(11):1313 -1323. DOI: 10.1128/EC.00195-12. Available online at http://ec.asm.org/content/current.

Abstract. Ten years after a threatening and previously unknown disease of oaks and tanoaks appeared in coastal California, a significant amount of progress has been made toward the understanding of its causal agent *Phytophthora ramorum* and of the novel pathosystems associated with this exotic organism. However, a complete understanding of the ecology and epidemiology of this species still eludes us. In part, our inability to fully understand this organism is due to its phylogenetic, phylogeographic, phenotypic, and epidemiological complexities, all reviewed in this paper. Most lines of evidence suggest that the high degree of disease severity reported in California is not simply due to a generalized lack of resistance or tolerance in naïve hosts but also to an innate ability of the pathogen to survive in unfavorable climatic conditions and to reproduce rapidly when conditions become once again favorable.

Jiang, R.H.Y. and Tyler, B.M. 2012. Mechanisms and Evolution of Virulence in Oomycetes. Annual Review of Phytopathology 50:295–318. DOI: 10.1146/annurev-phyto-081211-172912.

Abstract. Many destructive diseases of plants and animals are caused by oomycetes, a group of eukaryotic pathogens important to agricultural, ornamental, and natural ecosystems. Understanding the mechanisms underlying oomycete virulence and the genomic processes by which those mechanisms rapidly evolve is essential to developing effective long-term control measures for oomycete diseases. Several common mechanisms underlying oomycete virulence, including protein toxins and cell-entering effectors, have emerged from comparing oomycetes with different genome characteristics, parasitic lifestyles, and host ranges. Oomycete genomes display a strongly bipartite organization in which conserved housekeeping genes are concentrated in syntenic gene-rich blocks, whereas virulence genes are dispersed into highly dynamic, repeat-rich regions. There is also evidence that key virulence genes have been acquired by horizontal transfer from other eukaryotic and prokaryotic species.

Metz, M.R.; Frangioso, K.M.; Wickland, A.C.; Meentemeyer, R.K.; and Rizzo, D.M. 2012. An emergent disease causes directional changes in forest species composition in coastal California. Ecosphere 3(10):86. http://dx.doi.org/10.1890/ES12-00107.1.

Abstract. Non-native forest pathogens can cause dramatic and long-lasting changes to the composition of forests, and these changes may have cascading impacts on community interactions and ecosystem functioning. *Phytophthora ramorum*, the causal agent of the emergent forest disease sudden oak death (SOD), has a wide host range, but mortality is concentrated in a few dominant tree species of coastal forests in California and Oregon. We examined interactions between *P. ramorum* and its hosts in redwood and mixed evergreen forest types over an 80,000 ha area in the Big Sur ecoregion of central California, an area that constitutes the southernmost range of the pathogen and includes forest stands on the advancing front of pathogen invasion. We established a network of 280 long-term forest monitoring plots to understand how host composition and forest structure facilitated pathogen invasion, and whether selective mortality from SOD has led to shifts in community composition. Infested and uninfested sites differed significantly in host composition due to both historical trends and disease impacts. A reconstruction of pre-disease forest composition showed that stands that eventually became infested with the pathogen tended to be more mature with larger stems than stands that remained pathogen-free, supporting the hypothesis of aerial dispersal by the pathogen across the landscape followed by local understory spread. The change in species composition in uninfested areas was minimal over the study period, while infested stands had large changes in composition, correlated with the loss of tanoak (*Notholithocarpus densiflorus*), signaling the potential for SOD to dramatically change coastal forests through selective removal of a dominant host. Forest diversity plays an important role in pathogen establishment and spread, and is in turn changed by pathogen impacts. Asymmetric competency among host species means that impacts of *P. ramorum* on forest diversity are shaped by the combination and dominance of hosts present in a stand.

Santini, A.; Ghelardini, L.; De Pace, C.; Desprez-Loustau, M.L.; Capretti, P.; Chandelier, A.; Cech, T.; Chira, D.; Diamandis, S.; Gaitniekis, T.; Hantula, J.; Holdenrieder, O.; Jankovsky, L.; Jung, T.; Jurc, D.; Kirisits, T.; Kunca, A.; Lygis, V.; Malecka, M.; Marcais, B.; Schmitz, S.; Schumacher, J.; Solheim, H.; Solla, A.; Szabò, I.; Tsopelas, P.; Vannini, A.; Vettraino, A.M.; Webber, J.; Woodward, S.; and Stenlid, J. 2012. Biogeographical patterns and determinants of invasion by forest pathogens in Europe. New Phytologist. DOI: 10.1111/j.1469-8137.2012.04364.x

Summary

- A large database of invasive forest pathogens (IFPs) was developed to investigate the patterns and determinants of invasion in Europe.
- Detailed taxonomic and biological information on the invasive species was combined with country-specific data on land use, climate, and the time since invasion to identify the determinants of invasiveness, and to differentiate the class of environments which share territorial and climate features associated with a susceptibility to invasion.
- IFPs increased exponentially in the last four decades. Until 1919, IFPs already present moved across Europe. Then, new IFPs were introduced mainly from North America, and recently from Asia. Hybrid pathogens also appeared. Countries with a wider range of environments, higher human impact or international trade hosted more IFPs. Rainfall influenced the diffusion rates. Environmental conditions of the new and original ranges and systematic and ecological attributes affected invasiveness.
- Further spread of established IFPs is expected in countries that have experienced commercial isolation in the recent past. Densely populated countries with high environmental diversity may be the weakest links in attempts to prevent new arrivals. Tight coordination of actions against new arrivals is needed. Eradication seems impossible, and prevention seems the only reliable measure, although this will be difficult in the face of global mobility.

Widmer, T.L.; Shishkoff, N.; and Dodge, S.C. 2012. Infectivity and Inoculum Production of *Phytophthora ramorum* on Roots of Eastern United States Oak Species. Plant Disease 96(11):1675-1682.

Abstract. Little is known about colonization of roots of trees by *Phytophthora ramorum*. We examined zoospore concentration and exposure time needed to infect six *Quercus* (oak) species and the inoculum produced from their roots. Sprouted acorns, exposed to zoospores (3,000/ml) for different times and transplanted to potting soil, were susceptible to infection within 1 h of exposure but root weights were not impacted after 4 weeks (P = 0.952). Roots of *Quercus prinus* seedlings, inoculated with sporangia, had 0.6 to 3.2% colonization of the total root mass after 5 months. Neither root lesions nor obvious root sloughing were observed. Inoculum threshold levels were tested by exposing radicles to varying zoospore concentrations for 24 h. Results showed that radicle infection occurred even at 1 zoospore/ml. To test inoculum production, roots were inoculated with sporangia and transplanted into pots. Periodically, samples of runoff were collected and plated on selective medium. Afterward, root segments were plated to calculate percent colonization. After 16 and 35 days, root colonization and inoculum production from oak

was lower than that of *Viburnum tinus*, a positive control. This study shows that *P. ramorum* is able to infect sprouted oak acorns and produce secondary inoculum, which may be important epidemiologically.

RELATED RESEARCH

Eggers, J.E.; Balci, Y.; and MacDonald, W.L. 2012. Variation Among *Phytophthora cinnamomi* Isolates from Oak Forest Soils in the Eastern United States. Plant Disease 96(11):1608-1614.

Goheen, D.J.; Mallams, K.; Betlejewski, F.; and Hansen, E. 2012. Effectiveness of Vehicle Washing and Roadside Sanitation in Decreasing Spread Potential of Port-Orford-Cedar Root Disease. Western Journal of Applied Forestry 27(4):170-175.

Judelson H.S. 2012. Dynamics and Innovations within Oomycete Genomes: Insights into Biology, Pathology, and Evolution Eukaryotic Cell 11:1304-1312. DOI:10.1128/EC.00155-12. Available online at http://ec.asm.org/content/current.

RELATED ISSUES

New potential threat? – There have been some Coast live oak, Engelmann oak, and other native trees in Southern California found declining as a result of a new disease/beetle complex, a new *Fusarium* species vectored by an exotic polyphagous shot hole borer (*Euwallacea* sp.). A survey of the Huntington Botanical Garden and Los Angeles Arboretum, conducted by Richard Stouthamer and Akif Eskalen (UC Riverside), found more than 100 infected host tree species, including many native trees, coast live oak, Engelmann oak, box elder, and sycamore. The new ambrosia beetle is closely related to the tea shot hole borer (*Euwallacea fornicates*), and the complex is causing serious damage on avocado in Israel. The problem was first noticed on several residential avocado trees and in a commercial avocado grove in Los Angeles County in spring 2012. The fungus attacks the vascular system of infested trees, disrupting the transport of food and water, and ultimately causing branch dieback and tree death. For more information, go to http://www.avocadosource.com/.

RESOURCES

Cram, M.; Frank, M.; and Mallams, K., tech cords. 2012. Forest Nursery Pests, Agriculture Handbook No. 680. U.S. Department of Agriculture, Forest Service. 202 p.

The Handbook (2012) was prepared by a team of research scientist and pest management specialists who are experts in the field of identifying and controlling the pests of forest tree nurseries. This document is a revision of "Forest Nursery Pests, Agriculture Handbook No. 680," that was issued in December 1989. Gary Chastagner and colleagues prepared the *Phytophthora ramorum* information.

Three videos on *P. ramor*um in the UK are now available from the UK Forestry Commission. The videos address "Helicopter Surveillance of Tree Diseases," "Spotting *Phytophthora ramorum* Symptoms in Larch Trees," and "Identification of *Phytophthora*

ramorum in the Lab." To access the videos, go to http://www.youtube.com/watch?v=LzG0Pq0Wy9s.

"Trees, Pests, & People," a video on the impacts to walnut, avocado, and ash from invasive species, is available online at http://www.dontmovefirewood.org/films/trees-pests-people/watch-the-film/watch-online.html. Developed by The Nature Conservancy, USDA, and other partners, it addresses how relevant forest pests affect people's lives and how we can all help to protect our trees and forests.

CALENDAR OF EVENTS

11/7- 8 - Annual Meeting of the California Forest Pest Council, Wildland Fire Training and Conference Center; 3237 Peacekeeper Way; McClellan; For more information, go to http://caforestpestcouncil.org/ or contact Katie Palmieri at kpalmieri@berkeley.edu.

11/9 - Napa SOD Blitz 2012 Results Meeting; UCCE Office; 1710 Soscol Avenue; Napa; 6 – 8 p.m.; For more information, contact Bill Pramuk at info@billpramuk.com.

11/10 - Santa Cruz SOD Blitz 2012 Results Meeting; Cal-Fire Training Room on Gushee Street (behind the forestry office at 6059 Highway 9); Felton; 10 a.m. – 12 p.m.; For more information, contact Nadia Hamey at nadiah@big-creek.com.

11/13 - The Eighth Meeting of the Continental Dialogue on Non-Native Forest Insects and Diseases; Sacramento Convention Center; Sacramento; 8:00 a.m. – 4:30 p.m.; For more information about the meeting agenda, contact Debbie Lee (dlee@resolv.org; 202-965-6381) or Beth Weaver (bweaver@resolv.org; 202-965-6211). For information regarding registration, go to www.arborday.org/pcf. For registration questions, contact Jen Svendsen (jsvendsen@arborday.org; 888-448-7337 Ext. 297).

11/14 - 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, or for questions, email kpalmieri@berkeley.edu, and provide your name, phone number, affiliation, and license number (if applicable), and the date for which you are registering. For more information, go to http://nature.berkeley.edu/garbelotto/english/sodtreatmenttraining.php.

11/15 - San Francisco SOD Blitz 2012 Results Meeting; Golden Gate Park Presidio and Golden Gate Park; Recreation Room, SF County Fair Building; Golden Gate Park near 9th Ave. and Lincoln Way; San Francisco; 10 a.m. – 12 p.m.; For more information, contact Christa Conforti at CConforti@presidiotrust.gov.

11/15 - Muir Heritage Land Trust (MHLT) Community Meeting: Managing for Sudden Oak Death; McMahon-Telfer Building; 604 Ferry Street, Martinez; 6 – 7:30 p.m. For more information, contact MHLT at (925) 228-5460 or Glen Lewis at glen@muirheritagelandtrust.org.

11/16 - Marin County SOD Blitz 2012 Results Meeting; Dominican University; Joseph R. Fink Science Center, Room 103; San Rafael; 6 – 8 p.m., For more information, contact Sibdas Ghosh at sibdas.ghosh@dominican.edu.

11/17 - West Marin SOD Field Meeting; Marin French Cheese Company; 7500 Red Hill Rd; Petaluma; 10 a.m. – 12 p.m.; For more information, contact Janice Alexander at JAlexander@marincounty.org.

11/17 - Marin/Mt. Tamalpais SOD Field Meeting; Sky Oaks Ranger Station; 49 Sky Oaks Rd.; Fairfax; 2 - 4 p.m.; For more information, contact Andrea Williams at awilliams@marinwater.org.