CALIFORNIA OAK MORTALITY TASK FORCE REPORT
AUGUST 2005

NURSERIES

The first *P. ramorum*-infected *Taxus media* has been reported from the Plant Protection Services of the Netherlands. This is the third yew to be identified as susceptible to *P. ramorum*. Previously, *Taxus baccata* had been confirmed in the UK and *Taxus brevifolia* (Pacific yew) had been identified in a coastal California forest. Although confirmation of the Boskoop, Holland nursery plant was made by PCR and isolation, Koch's postulates were unable to be performed because the isolate was contaminated and couldn't be preserved. As a Koch's postulates have not been completed, this plant has been added to the USDA APHIS list of *P. ramorum*-regulated associated host plants. For more information on this plant and its symptoms, see Host of the Month.

The Oregon Department of Agriculture (ODA) has identified five additional nurseries in four counties with *P. ramorum*-positive plants. The Multnomah County retail/wholesale nursery was found to have infected *Pieris japonica*. The Deschutes County retail garden center was found to have positive *Magnolia loebneri* (the first *P. ramorum*-positive Magnolia reported in the US), and the Coos County retail nursery was found to have infected rhododendron. One of the Lane County nurseries was confirmed to have *P. ramorum*-positive *Pieris floribunda*, while the other was found to have infected *Rhododendron* sp. 'Gomer Waterer.' Trace-forward/-back investigations are underway and the Confirmed Nursery Protocol (CNP) has been implemented at all sites.

The Washington Department of Agriculture (WSDA) has confirmed two nurseries to be *P. ramorum*-positive. Both the Pierce and Clark County nurseries were found during the National Nursery Survey. The Clark County facility was found to have infected *Rhododendron* Blue Jay, while the Pierce County facility was found with infected *Viburnum* Bewley's variegated, *Rhododendron* Grace Seabrook, *Rhododendron* Reward Too Lavender, *Rhododendron* Yaku Princess, *Pieris* Valley Valentine, and *Pieris* Scarlett O'Hara. Trace-back/-forward investigations are underway. Both facilities had been found with *P. ramorum* during the 2004 year and had completed the CNP.

Two additional retail garden center nurseries have been found infested with *P. ramorum* in Georgia. One nursery in Forsyth County was found with infected *Rhododendron* sp. and *Camellia japonica*, while the other was in Gwinnett County and had infected *Camellia sasanqua*. Trace-back/-forward investigations are underway and the CNP has been implemented at both sites.

As of 8/1/05, the California Department of Food and Agriculture (CDFA) has identified 53 *P. ramorum*-positive nurseries in 2005. Ten of the confirmed nurseries ship interstate, with two of the ten shipping only to Nevada outside of California's borders. Eight of the confirmed nurseries have had recurrent infestations.

***P. ramorum* federal order compliance agreements, trace-forward/-back investigations, the USDA APHIS National Nursery Survey, and other investigations are ongoing.** To date, 76 sites in 6 states have had *P. ramorum* detections. Positive findings by state are: CA(53), GA(4), LA(2), OR(14), TN(1), and WA(2).

The Canadian Food Inspection Agency's (CFIA) Canadian *P. ramorum* survey is underway across Canada. To date, CFIA has detected *P. ramorum* at three British Columbia sites this year. Two of the affected nurseries are retail sites and one is a wholesale nursery. All sites were found positive for the pathogen in 2004. CNP was implemented last year and has been applied upon confirmation this year; trace-forward activities are underway.

National Nursery Surveys are complete in 41 states; 2,433 nurseries were visited and 39,345 samples were collected. To date, 38 positive sites in six states have been identified through the National Nursery Survey, Federal order, and annual cleanliness compliance surveys. The only 7 nurseries found positive outside of the three regulated West Coast states were all found during the National Nursery Survey: GA(4), LA(2), and TN(1).

The US Nursery Perimeter and General Forest Detection Surveys have been competed in 23 states, with 304 nursery perimeter surveys having been conducted so far. The US Forest Service has collected 787 samples; results for 102 samples confirmed to date have all been negative. Additionally, 241 general forest surveys in 21 states have also been conducted, with 529 samples having been collected. Of the 87 confirmed samples so far, all have been negative.

REGULATIONS

USDA APHIS has issued an updated State Plant Regulatory Official (SPRO) Letter, adding eight new associated host plants and two new host plants to the list of plants regulated for *P. ramorum* (all plants have been mentioned in COMTF monthly reports). The addition of these 10 plants brings the list of regulated *P. ramorum* host and associated hosts to 75. Under the 12/05 PPQ Emergency Federal Order, nurseries operating in Washington, Oregon, and California may be affected by the addition of these 10 plants to the Interim rule. To review compliance expectations for these states, go to the APHIS website and refer to the 8/3/05 SPRO at: http://www.aphis.usda.gov/ppq/ispm/pramorum/.

The SPRO also updated the status of six hosts from the associated host list to the host list, with all having completed Koch's postulates and having been reviewed and approved by APHIS. The six newly classified hosts are: *Castanea sativa*, *Fraxinus excelsior*, *Quercus falcata*, *Quercus ilex*, *Syringa vulgaris*, and *Taxus baccata*. Information on reported affected parts of each of these hosts can also be obtained in the SPRO. Additionally, a new chart of each known host and associated host plant, providing applicable references, the affected plant parts, and any other pertinent information is also available in conjunction with the SPRO on the APHIS website.

The USDA Center for Plant Health Science and Technology (CPHST) has completed validation of a Real Time PCR test for detection of *P. ramorum*. The last step in the approval process before implementation is a ring test, whereby several laboratories will use the Real Time PCR on known samples, as well as any additional samples they wish to use. The results of the ring test provide data to help determine the robustness of the assay. As long as no problems are detected during the test, CPHST will release the Standard Operating Procedure soon after its completion. An advantage of the ring test is that some labs have instrumentation other than the Cepheid Smartcycler (used to validate the assay), allowing CPHST researchers to see how the method behaves on different instrumentation platforms. Additionally, labs that are provisionally approved for current molecular diagnostics that have real time capability will need only to pass a proficiency test to be able to perform this assay.

National Plant Board (NPB) members from 10 states met in Raleigh, NC on 7/19 along with USDA *P. ramorum*-program staff and CPHST scientists to discuss the effectiveness of the USDA APHIS Plant Protection and Quarantine (PPQ) December Federal Order that took effect in 1/05. 2005 *P. ramorum* program data were reviewed and show a 55 percent decrease in pathogen detections compared to the same time last year, despite more intensive and focused surveys. To date, the National Nursery Survey only seven sites in three non-West Coast states have been found positive, compared to 61 sites in 17 states in July 2004.

The group reviewed the CNP and the issue of repeat positives at mitigated sites. Based on a CPHST analysis, several recommendations are under review as enhancements to the CNP. CPHST also reported that five laboratories are now provisionally approved to run nested-PCR *P. ramorum* tests (Oregon State University, CDFA, WSDA, University of Tennessee, and the USDA Agricultural Marketing Service Laboratory at Gastonia, NC) for negative confirmation. Sixteen additional labs have been inspected, but have not yet completed the approval process.

At the meeting, the NPB Board of Directors approved creation of a NPB working group to review, discuss, and assist in resolving *P. ramorum* issues. Additionally, PPQ and NPB representatives reached consensus on an interim protocol for regulating new hosts, which will add newly identified hosts immediately to the

host list. Those host plant nurseries operating under a compliance agreement may continue to ship host and associated host plants, including the new host. Those non-host nurseries that have been inspected and found free from *P. ramorum* may continue to ship plants interstate, except for the new host, which will be withheld from trade until inspected, sampled, and tested. The NPB working group will evaluate this interim protocol.

Action items for the NPB working group include a discussion of the role of high-risk hosts in spreading *P. ramorum*. CPHST is also conducting an analysis of the relative risk of infestation among *P. ramorum* hosts at the cultivar level. The goal is to determine if a few high-risk plants or plant varieties may be responsible for most of the movement of *P. ramorum* in nursery stock. Pending results, PPQ headquarter staff and select State Plant Regulatory Officials will be working together to identify, if possible, appropriate short-term mitigations.

RESEARCH

A wide-ranging systematic experiment is underway to assist APHIS in identifying the next method for detection of *P. ramorum*. The project is a collaborative effort among several US, Canadian, and UK laboratories. Under the leadership of Mike Coffey (UC Riverside) and Frank Martin (Agricultural Research Service, Salinas), the world *Phytophthora* collection is being 'mined,' with approximately 400 identical DNA samples being shared among project partners. The investigations are intended to determine the overall specificity of the varied tests that have been developed for *P. ramorum* identification. Follow-up testing of DNA from selected isolates to determine sensitivity is anticipated. When completed, this study should identify the next appropriate test for validation, which will be based on a genetic locus different than the ITS used by both the current nested PCR and Real Time PCR.

Currently underway are two research efforts focused on obtaining further information on the relative sensitivity and specificity of the tests used for *P. ramorum* identification, including ELISA, culturing, baiting, nested PCR, and Real Time PCR. One study being conducted by USDA's CPHST analyzed a block of heavily infected Camellias from a California nursery. Identical samples were used to test all of the current diagnostic methods on a block of over 300 individuals (a large enough population for a detailed statistical analysis). The results of this study are being analyzed, and preliminary results were presented at the annual American Phytopathological Society meeting in Austin (see abstract below). A second research effort underway at UC Berkeley is designed to obtain similar data, but also investigate the influence of different hosts, environmental conditions, and other factors on the ability to accurately detect and identify the pathogen.

Concerned with the potential threat of the *Phytophthora ramorum* to European forests, gardens, and nurseries, European Union researchers are gathering for a three-day informational meeting on

the pathogen. Susan Frankel, Sudden Oak Death Research Program Manager for the USDA Forest Service, Pacific Southwest Research Station will host the event in San Francisco July 26–28, 2005. During the three days, indoor information-sharing sessions, outlining current *P. ramorum* knowledge, strategies, and challenges will be addressed. A field trip is scheduled to infested Marin and Sonoma County forests, where researchers will have the opportunity to experience the pathogen's impact to CA's natural habitat and talk to researchers conducting field experiments. The group will also tour impacted nurseries, where researchers will meet first-hand with regulators and industry representatives. This meeting will serve as a fact gathering trip to inform the Risk Assessment for *Phytophthora ramorum* project (RAPRA) in the development of a European Pest Risk Analysis for *Phytophthora ramorum*, which will include risk management strategies and EU-applicable pathogen contingencies. For more information on the RAPRA program, go to http://rapra.csl.gov.uk/. The National Park Service, UC Berkeley, and the California Oak Mortality Task Force are also assisting with the meeting.

***In vitro* leaf inoculation studies as an indication of tree foliage susceptibility to *Phytophthora ramorum* in the UK. Denman, S., Kirk, S. A., Brasier, C. M., and Webber, J. F. 2005. *Plant Pathology* 54, 512-521.** http://www.blackwell-synergy.com/doi/abs/10.1111/j.1365-3059.2005.01243.x?cookieSet=1.

Leaves of 11 coniferous and 23 broad-leaved tree species important to UK forestry were tested for their susceptibility to the quarantine pathogen *Phytophthora ramorum* using a detached leaf assay. Two European and two USA isolates were used. Wounded and unwounded leaves were dipped in zoospore suspensions during summer; conifers were also tested in winter. Successful infection of tissue and amount of necrosis were assessed. Highly susceptible broad-leaved hosts included *Aesculus hippocastanum*, *Fraxinus excelsior*, *Quercus ilex*, *Ulmus procera* and, to a lesser extent, *Castanea sativa*, *Q. cerris* and *Q. petraea*, together with *Umbellularia californica* and rhododendrons. *Acer pseudoplatanus*, *Alnus glutinosa*, *Carpinus betulus*, *Corylus avellana*, *Fagus sylvatica*, *Prunus avium*, *Q. robur*, *Q. rubra* and *Q. suber* showed consistently low susceptibility. Conifer species including *Abies procera*, *Picea abies*, *P. sitchensis*, *Pseudotsuga menziesii*, *Sequoia sempervirens* and *Tsuga heterophylla* were also susceptible. *Pseudotsuga menziesii* and *A. procera* were severely affected. *Pinus contorta*, *P. nigra* var. *maritima* and *P. sylvestris* were virtually resistant, while *Taxus baccata* was only slightly affected. Increased necrosis was apparent on leaves that were wounded prior to inoculation. These results extend the known range of trees that *P. ramorum* is able to attack and confirm its relative host-nonspecificity.

Foliar infection of sweet chestnut (*Castanea sativa*) by *Phytophthora ramorum* in the UK. Denman, S., Kirk, S. A., Brasier, C. M., Hughes,

K. J. D., Griffin, R., Hobdon, E., and Webber, J. F. 2005. New Disease Report *Plant Pathology* 54, 581.

The American Phytopathological Society's 2005 Annual Meeting was held 7/30 – 8/3 in Austin Texas. Many different issues were presented at the meeting, including *P. ramorum*-related topics. Highlighted below are abstracts and presentations that are relative to *P. ramorum*. To access the program in its entirety, go to the APS website at: http://meeting.apsnet.org/program/tech_presentations.cfm.

Poster-228: Detection and identification of *Phytophthora* species in streams in the southern Appalachian Mountains. Presenter: J. Hwang, Clemson University, Clemson, SC. Co-Author: S. Jeffers, Clemson University, Clemson, SC.

Water samples from seven forest and two residential streams in Georgia, North Carolina, South Carolina, and Tennessee were collected. Replicate sub-samples (100 ml) were vacuum-filtered with two types of membrane filters with three pore sizes (Durapore 5-micrometer, Nuclepore 1- and 3-micrometer), and filters were placed on selective medium to isolate *Phytophthora* spp. *P. cinnamomi*, *P. citricola*, *P. gonapodyides*, and five morphologically and genetically distinct groups of isolates (*P.* species A to E) were identified from 553 isolates recovered. *P. gonapodyides* (159 isolates) was most widely distributed (present at eight sites). *P.* species B was most prevalent (382 isolates) but only occurred at the two residential sites. Multiple species were detected at five sites. Density of propagules in water samples varied significantly (0.1 to 40.9 colonies/100 ml); densities in the two residential streams (mean = 25.5) were greater than densities in the seven forest streams (mean = 2.1). There were no obvious differences among the three filters for recovery of *Phytophthora* spp. from streams. Filtration was effective for isolating and quantifying *Phytophthora* species in stream water.

Poster-288: *Phytophthora* species on woody plants in Minnesota nurseries and a first report of *P. hedraiandra* in the United States. Presenter: B. Schwingle, University of Minnesota. Co-Authors: J. Smith, R. Blanchette, and B. Blanchette, University of Minnesota; S. Gould, University of Minnesota; J. Pokorny, USDA Forest Service; S. Cohen, USDA APHIS.

Phytophthora ramorum has been found in 22 states and threatens native plants and woody ornamentals in Minnesota. New aggressive *Phytophthora* species and hybrids are being identified worldwide from surveys to detect *P. ramorum*. Surveys in Minnesota nurseries did not identify this organism, but other *Phytophthora* species were found. Diseased plant tissues from *P. ramorum* hosts were plated on *Phytophthora*-selective media (PARP). DNA was extracted from cultures and the rDNA ITS-1 and ITS-2 regions were amplified with the primer pair ITS1/ITS4. DNA was sequenced, and the sequences were searched against GenBank. A unique DNA sequence from one of the cultured isolates suggested it

was a hybrid of *P. cambivora* and an unknown *Phytophthora* species. Seven other cultures isolated from leaf lesions on *Rhododendron* were identified as *P. hedraiandra*, a species that has not previously been reported in the United States. Morphological studies on potato dextrose agar and V8 agar confirmed the identity of those seven isolates. In several other isolates, the ITS-1 and ITS-2 sequences differed from the closest sequence match (*P. citricola*) by several shared nucleotide polymorphisms. Additional studies on those isolates are warranted to ascertain their appropriate taxonomic status.

Poster-297: Detection of *Phytophthora ramorum* in camellia leaves by isolation, ELISA, nested and real-time PCR. Presenter: R. Bulluck, Center for Plant Health Science and Technology, USDA/APHIS/PPQ, Raleigh, NC. Co-Authors: G. Parra, P. Shiel, P. Berger, and D. Kaplan, USDA APHIS PPQ CPHST, Raleigh, NC; W. Li, K. Zeller, and L. Levy, National Plant Germplasm and Biotechnology Laboratory, USDA/APHIS/PPQ, Beltsville, MD; J. Keller and M. Reddy, Monrovia Growers, Azusa, CA; N. Sharma and M. Dennis, California Department of Food and Agriculture, Plant Health & Pest Prevention Services, Van Nuys, CA; J. Stack, J. Pierzynski, and J. Mara, Department of Plant Pathology, Kansas State University, Manhattan, KS; C. Webb, USDA/APHIS/PPQ, Department of Plant Pathology, Kansas State University, Manhattan, KS; M. Palm and J. McKemy, USDA/APHIS/PPQ, National Identification Service, Beltsville, MD.

Phytophthora ramorum (*Pr*) is an invasive pathogen of more than 50 species of ornamental and forest trees and shrubs in USA, Europe, and Canada. Because the pathogen infects nursery stock, quarantine measures are currently used to prevent the spread of *Pr* based on detection using immunological assays such as ELISA, molecular diagnosis using PCR, and isolation onto *Phytophothora*-selective media. To compare the performance of these assays, a block of 300 camellia plants was chosen at a California nursery known to be infested with *Pr*. Disease symptoms, such as foliar lesions and leaf drop were recorded for each plant (as was the presence of moss) prior to foliar and potting medium sampling. Four-seven leaves and 500 ml medium were collected from each plant. Healthy camellia leaves were used as bait to isolate *Pr* from the potting medium of each plant. Leaf discs removed with a sterile paper punch were ground in 1 ml of TE buffer (pH 8.0). Three separate aliquots were taken from the same leaf tissue or leaf bait extracts and were either plated on PARP-V8, tested using ELISA, or subjected to nested and real-time PCR analysis. Diagnostic sensitivity and specificity of the assays were determined to compare the performance of each method for diagnosis of *Phytophthora* spp. or *Phytophthora ramorum* in camellia tissues and associated potting medium.

Poster-320: Real-time PCR detection of *P. ramorum* and the effect of DN extraction protocols on the sensitivity of detection. Presenter: P. Uribe, USDA ARS, Salinas CA.

Phytophthora ramorum, the causal agent of Sudden Oak Death (SOD) has a broad host range that includes forest and ornamental plant species. Quarantine restrictions limit the interstate movement of host nursery stock and related articles from infested areas in California, Oregon, and Washington. Therefore, an accurate detection system is needed to track the movement of the pathogen. A conventional PCR marker system based on the spacer region between the mitochondrially encoded genes *COX1* and *COX2* has been developed for detection of *Phytophthora* species associated with tree decline in areas known to have SOD. We have adapted this system for real-time PCR detection using both SYBR green and TaqMan technologies and are expanding it to include other species such as *P. pseudosyringae* and *P. nemorosa*, species commonly isolated from *P. ramorum* infested areas. Current data indicate that PCR inhibitors contribute to a lack of sensitivity with some PCR based detection systems. To clarify this we are comparing the efficiency of PCR amplification using DNA isolated with different high throughput extraction protocols and from plant species known to possess PCR inhibitors. This work will provide knowledge to enhance the reliability and sensitivity of molecular diagnostic methods for this pathogen and potentially numerous others.

Poster-322: Searching for *Phytophthora ramorum*: Surveys of New York State and Northeastern nurseries for the sudden oak death pathogen. Presenter: K. Snover-Clift, Cornell University, Ithaca, NY. Co-Authors: M. McKellar and P. Clement, Cornell University, Ithaca, NY.

In March 2004, the discovery of *Phytophthora ramorum* on Camellia in a large production nursery in Los Angeles County, Azuza, California, prompted trace forward and national survey sampling and testing of containerized ornamental plant material shipped to nurseries across the country. The Plant Disease Diagnostic Clinic (PDDC) at Cornell University conducted the testing of plant material from the National Plant Diagnostic Network's trace forward surveys, the New York State Department of Agriculture and Markets National Survey, and a Northeast nursery perimeter survey conducted by the United States Forest Service. The PDDC processed a total of 1548 samples comprised of 255 trace forward samples, 1131 National Survey samples, and 162 U.S. Forestry nursery perimeter samples. Testing methods included isolation attempts, the use of a commercial Enzyme-Linked ImmunoSorbant Assay (ELISA) test kit, DNA extractions performed on samples testing positive with ELISA, and double nested Polymerase Chain Reaction (PCR). 269 of the 1548 samples tested positive for a Phytophthora species with the ELISA test kits. DNA extractions were performed and shipped to the APHIS-PPQ-CHPST laboratory for PCR testing. No positives for *Phytophthora ramorum* resulted from the double nested PCR testing.

Poster-387: Isolation of a new lineage of *Phytophthora ramorum* from asymptomatic stems and roots of a commercial lot of rhododendron in California. Presenter: J. Bienapfl, University of California, Davis. Co-Authors: J. Zanzot

and S. Murphy, University of California, Davis, CA; M. Garbelotto, University of California, Berkeley, CA; D. Rizzo, University of California, Davis, CA.

In early January 2005, 44 asymptomatic rhododendron plants (cv. Colonel Coen) in one gallon pots were purchased from a wholesale nursery in Sacramento, CA. The nursery had been previously inspected for *Phytophthora ramorum* as part of recent quarantine efforts. Plants were stored in a lathehouse in Davis, CA. In mid-February, foliar and stem symptoms typical of *P. ramorum* infection were observed on 40 of 44 plants. Isolations from necrotic tissues confirmed the presence of *P. ramorum* on all 40 symptomatic plants. Isolations were also made from asymptomatic portions of roots, stems and leaves of all plants. *P. ramorum* was isolated from asymptomatic stem tissues up to 6.5 cm from the nearest stem lesion in 37 plants. *P. ramorum* was also isolated from asymptomatic roots on 6 plants. Roots ranged in size from 0.5 to 6 mm diameter. No root rot associated with *P. ramorum* was observed. This finding confirms previous laboratory inoculation studies that indicated *P. ramorum* was capable of infecting roots. RFLP analysis of the isolates indicated that they were the A2 mating type. Microsatellite analysis indicated that all isolates were of a genotype that differed from the typical North American and European genotypes. This unique lineage of *P. ramorum* has previously only been reported from Washington state nurseries.

Poster-390: Recovery of *Phytophthora ramorum* from soilless mixes around container-grown ornamental plants. Presenter: S. Jeffers, Clemson University, Clemson, SC.

Between Feb 2003 and Feb 2004, container-grown ornamental plants, primarily camellias, from a wholesale nursery in California where *Phytophthora ramorum* occurred were shipped to 27 retail nurseries in South Carolina. In spring 2004, trace-forward efforts identified plants that still were present at these nurseries. A composite sample of container mix (CM) was collected from the pots of each group of similar plants at each nursery. CM samples were stored at 4 to 10°C until tested with a baiting bioassay using camellia and rhododendron leaf pieces. Baits were submerged in PARPH-V8 selective medium, and isolation plates were placed at 20°C to recover *Phytophthora* spp. Between May and Jul 2004, 69 CM samples were collected from 19 locations, and samples were assayed 2 to 4 wk after collection. *P. ramorum* was recovered from three CM samples (4%), all collected from around camellias shipped in Jan or Feb 2004; *Phytophthora* spp. were recovered from 52 (75%) of the CM samples. *P. ramorum* was recovered from one CM sample after storage for 6, 8, and 12 wk at 4°C but was not recovered from another CM sample stored for 10 wk at room temperature. *P. ramorum* also was baited from the CM around a camellia planted in a landscape and from two other CM samples collected from quarantined camellias.

Poster-392: Resistance to *Phytophthora ramorum* in a range of species and cultivars of the genus *Viburnum*. Presenter: N. Grunwald, USDA ARS, Corvallis,

OR. Co-Authors: S. Scheuerell, Oregon State University, Corvallis, OR; A. Davis and R. Linderman, USDA ARS, Corvallis, OR.

Currently *Viburnum* species are considered to be highly susceptible to *P. ramorum*. It is not known whether all cultivars in this genus are equally susceptible. The objective of our research was to evaluate 23 cultivars in 9 species of field-grown *Viburnum* including *V. burkwoodii*, *V. dentatum*, *V. lantana*, *V. opulus*, *V. plicatum*, *V. lentago*, *V. nudum*, *V. sargentii*, and *V. trilobium* for resistance in detached leaf tests. Detached leaves were wound-inoculated with 6 mm agar plugs of 1-week old colonies of *P. ramorum* using strains 4123 and 03-74-D12A grown on dilute V-8 agar. While two mycelial agar plugs were used to inoculate one side of a leaf, a control plug of the same medium was inoculated on the other side of the leaf. Leaves were incubated in moist chambers at 20°C for 8 days before measurements were taken. Lesion area was determined as the percentage of infected leaf area of the total leaf area using the Assess program. We obtained significant differences for levels of resistance based on percentages of leaf areas affected ($P < 0.001$) and no significant differences for isolates and interactions between isolates and cultivars. Our data indicate that there is a considerable range of resistance phenotypes in this genus ranging from high susceptibility to resistance.

Poster-393: Surveying for *Phytophthora ramorum* in ornamental nurseries, home landscapes, and forests in Georgia. Presenter: J. Williams-Woodward, University of Georgia, Athens, GA.

Six ornamental production nurseries in Georgia were surveyed for *Phytophthora ramorum* in 2003. No *P. ramorum* was detected in 946 plant samples (508 nursery and 438 nursery perimeter/forest). Other *Phytophthora* species, mostly *P. cinnamomi*, *P. nicotianae*, and *P. citricola*, were recovered from Rhododendron and Pieris leaves from 50 nursery and 2 perimeter samples. Trace forward surveys in 2004 identified 14 retail nurseries that received *P. ramorum*-infected camellia plants from Monrovia Nurseries, Azusa, CA. Adjacent plants, as well as the forested nursery perimeters were surveyed and no *P. ramorum* was detected. From January 2003 to March 2004, Georgia received 28,000 plants from Monrovia Nurseries in Azusa. A collaborative effort to recover purchased potentially infected plants was initiated by the Georgia Department of Agriculture, Georgia Forestry Commission, and The University of Georgia Cooperative Extension Service. Three camellias were confirmed positive out of 221 home landscape samples. All known infected plants were removed and no *P. ramorum* was detected in a survey of landscape plants, soils, or forested environ away from the infected plant. There is no evidence that *P. ramorum* has spread or become established in Georgia, however, additional environ surveys are being conducted.

Poster-394: Survivability and pathogenicity of *Phytophthora ramorum* chlamydospores in soil. Presenter: G. Colburn, USDA ARS. Co-Authors: K. Sechler and N. Shishkoff, USDA ARS.

Chlamydospores are produced by most *Phytophthora* spp. and are important long term survival propagules in the soil. *Phytophthora ramorum* produces abundant chlamydospores but their purpose in the disease cycle of Sudden Oak Death is unknown. Chlamydospores of A1 and A2 isolates of *P. ramorum* were produced to infest soils at 100 spores/cm ^{3} soil in sand, potting soil mix, and natural biologically active forest soil. Direct plating was used to quantify the viable chlamydospore population. The soils were maintained in bags at 22°C and 4°C and in plastic pots under normal greenhouse conditions. After 4 months, there was no decline in the population of chlamydospores held at 4 C in any of the soil types. The decline was gradual for chlamydospores held at 22°C, but was much more rapid for soils kept in the greenhouse. Survival of chlamydospores was lowest in the forest soil under greenhouse conditions. Real Time PCR will also be used to detect *P. ramorum* in the soil. To examine chlamydospore pathogenicity, *Rhododendron* 'Cunningham's White' plants were inoculated with soils infested with 40 chlamydospores/cm^3. After 4 weeks, the rhododendron plants had healthy root systems, but *P. ramorum* could be isolated from the roots indicating infection had occurred.

Poster-395: Survival of *Phytophthora ramorum* in potting mix components or soil and eradication with aerated steam treatment. Presenter: R. Linderman, USDA ARS. Co-Author: E. Davis, USDA ARS.

Phytophthora ramorum, while thought to be primarily a foliage pathogen, could be introduced into soilless media in nursery containers as sporangia or chlamydospores and remain undetected while disseminated geographically. Pathogen inoculum of A1 and A2 mating types was used to infest potting media components or soil, using either sporangia, chlamydospores produced in vermiculite culture, or dry infected rhododendron leaf pieces. Monthly baiting or direct plating on selective medium indicated that *P. ramorum* survived in most media components or soil for up to 6 months, whether introduced as sporangia or chlamydospores. However, it was not detected at all from infected rhododendron leaf pieces by either detection method. Experiments were also conducted to determine the lethal temperature needed to eradicate *P. ramorum* from infested potting medium (chlamydospores in vermiculite) or contaminated plastic containers using aerated steam treatments over a range of 45-70°C for 30 min. Assays indicated that it was killed by temperature treatments of 50°C or greater. These results show that *P. ramorum* can survive in potting media if introduced as sporangia or chlamydospores, and that infested media or contaminated containers can be sanitized by aerated steam treatment without melting the plastic.

Poster-440: Variation in susceptibility of tanoak to sudden oak death at the population and species levels. Presenter: K. Hayden, University of California, Berkeley, CA. Co-Author: M. Garbelotto, University of California, Berkeley, CA.

Sudden oak death, caused by the oomycete *Phytophthora ramorum*, is particularly devastating to stands of tanoak (*Lithocarpus densiflora*), in which up to 70% of trees may be infected, with correspondingly high mortality. Infection and mortality patterns are patchy, however, and there are anecdotal reports of lone trees remaining healthy for years in the midst of heavily infested stands. This, combined with a common-garden study of resistance within a single population of tanoak, suggests that variable resistance to the pathogen may play a role in tanoak infection dynamics. We report on a preliminary study of resistance to infection by *P. ramorum* across populations. We analyze variability in resistance within and across populations of tanoak as measured by a detached-leaf assay on thirty trees from each of five populations across the tree's geographic range. Lesion expansion rate in detached leaves is correlated with lesion expansion in stems, and is therefore an appropriate measure of host resistance to the girdling lesions associated with sudden oak death mortality.

Poster-445: Fungi associated with leaves of California bay laurel. Presenter: J. Andrews, University of Wisconsin, Madison, WI. Co-Authors: L. Douhan, G, Douhan, and D. Rizzo, University of California, Davis, CA.

California bay laurel (myrtlewood; *Umbellularia californica*) is a linchpin host for *Phytophthora ramorum* in the epidemiology of Sudden Oak Death. To determine the possible role of endophytic or epiphytic fungi in mediating the prevalence of *P. ramorum* in bay laurel, symptomatic and asymptomatic leaves were collected in June 2004 and January 2005 from a redwood/tanoak forest in Jack London State Park, Sonoma Co. The identity of phyllosphere fungi was determined either by isolation onto growth media followed by conventional taxonomy, or inferred by molecular phylogenetics of cultured isolates. Additionally, the ITS, 5.8S, and partial large subunit regions of the rDNA were directly amplified and sequenced from adhesive tape strips of the leaf epidermis and from surface-disinfested, macerated leaves. Preliminary evidence points to a leaf microbiota that is relatively diverse and composed of numerous species of yeasts, coelomycetes, and hyphomycetes. Controlled environment assays of *P. ramorum* foliar infection in bay seedlings treated or untreated with selected fungal isolates are in progress.

Poster-470: Monitoring *Phytophthora ramorum* distribution in streams within California watersheds. Presenter: S. Murphy, University of California, Davis, CA. Co-Authors: D. Rizzo and J. Bienapfl, University of California, Davis, CA; Y. Valachovic and C. Lee, University of California Cooperative Extension, Eureka, CA; W. Mark and A. Jirka, Cal Poly State University, San Luis Obispo, CA; T. Smith, California Department of Forestry and Fire Protection, Davis, CA; D.

Owen and D. Adams, California Department of Forestry and Fire Protection, Redding, CA.

Eighty locations were established in perennial watercourses in 2004 and 2005 to monitor for the presence of *Phytophthora ramorum* (*Pr*), causal agent of Sudden Oak Death, throughout coastal central and northern California as well as portions of the Sierra Nevada mountains. Most of the monitored areas have limited or no *Pr* at this time, but are near the epidemic range of *Pr* and considered high-risk for invasion by *Pr*. Two currently infested sites in Sonoma County were included as a baseline for successful recovery of *Pr*. Rhododendron leaves were placed in mesh bags and secured in watercourses for 1 to 3 week intervals year-round to bait for *Phytophthora* species. Recovered symptomatic leaves were plated on *Phytophthora*-selective media. *Pr* was recovered at all sites with a prior knowledge of *Pr* forest infestation. We recovered *Pr* at three sites downstream of known forest infestations. One site was along the South Fork Eel River, approximately 8 km downstream of known infestation near Redway, CA. Additionally, *Pr* was recovered at two sites without prior knowledge of forest infestation in Briones East Bay Regional Park. Stream monitoring provides a useful method of early detection for *Pr* infestation. Future research will address spread and survival of this pathogen in watercourses.

Poster-480: Susceptibility to *Phytophthora ramorum* of roots and shoots of common container weeds. Presenter: N. Shishkoff, USDA ARS. Co-Author: A. Senesac, Cornell University, Riverhead, NY.

Phytophthora ramorum is known to infect a number of ornamental plants grown in containerized culture. However, pots may also contain weeds, so it was useful to test eleven common container weeds for susceptibility to *P. ramorum*. These included *Senecio vulgaris, Cardamine hirsuta, Chamaesyce maculata, Sagina procumbens, Epilobium ciliatum, Stellaria media, Oxalis stricta* and *Pteris*, sp. Foliage was inoculated with water suspensions of approx. 3000 sporangia/mL and placed in a dew chamber for 3-4 days prior to evaluation. Roots were inoculated by pouring suspensions as 10 mL aliquots into pots and waiting at least 25 days before plating (washed or surface-sterilized for 5 min in 0.025% sodium hypochlorite). Of weeds tested, only *Epilobium* and *Pteris* showed foliar symptoms. The pathogen could also be isolated from the roots of *Epilobium*, whether washed or surface-sterilized, suggesting that roots were internally colonized. *P. ramorum* could be re-isolated in low numbers from the washed roots of various weeds, but not from surface-sterilized ones, suggesting superficial colonization of the rhizosphere.

Poster-483: The effect of temperature and moisture period on infection of *Rhododendron* 'Cunningham's White' by *Phytophthora ramorum*. Presenter: P.

Tooley, USDA ARS, Fort Detrick, MD. Co-Authors: K. Kyde, University of Rhode Island, Kingston, RI; M. Browning, USDA ARS, Fort Detrick, MD.

Whole plants of *Rhododendron* 'Cunningham's White' were dip-inoculated with 5000 sporangia/ml of *P. ramorum* (California) isolate Pr-52 in replicated experiments and placed in dew chambers in darkness at 10, 13, 16, 19, 22, 25, 28, and 31°C. The numbers of leaves infected by *P. ramorum* and resulting lesion areas were quantified following 5 days incubation. The highest percentages of infected leaves per plant were obtained in the range of 16-25°C, ranging from 76% at 19°C to 92% at 22°C. The lowest percentages were obtained at the extremes, 10°C and 31°C, which showed 18% and 16% infection, respectively. The results indicate that *P. ramorum* has the capacity to infect some hosts over a wide range of temperatures. Studies to determine the minimum period of 100% relative humidity required for infection by *P. ramorum* are in progress.

Poster-654: Chemical control of *Phytophthora ramorum* on rhododendron and lilac. Presenter: R. Linderman, USDA ARS. Co-Author: E. Davis, USDA ARS.

Ramorum blight, caused by *Phytophthora ramorum*, affects many nursery crops and management strategies are needed to control it and other Phytophthora diseases in nurseries. We evaluated several chemical agents that target Oomycete pathogens for their capacity to inhibit infection of rhododendron or lilac leaves by *P. ramorum* (both A1 and A2 mating types). We used mycelium plugs to inoculate wounded leaves from plants previously treated with various chemicals that were (a) removed and inoculated, or (b) inoculated on intact plants, maintained in high humidity. Inoculation of leaves on chemically-treated intact plants with *P. ramorum* yielded results similar to those from inoculation of leaves detached from treated plants. Most of the chemicals tested reduced *P. ramorum* infection to varying degrees, but Subdue MAXX and an unregistered compound SA 110201 (Sipcam Agro USA, Inc.) were the most effective, even 6 weeks after application. All chemicals were fungistatic, not fungicidal. Dipping detached leaves in chemicals 24 hr prior to inoculation resulted in the same activity profile as applying chemicals to intact plants or detached leaves. These results indicate that inoculating leaves detached from chemically treated plants is an effective means of evaluating fungicides.

Poster-659: Control of *Phytophthora* in nursery recycled and fresh inlet irrigation water by Agrifos systemic fungicide treatment. Presenter: B. Stringfellow, Fluence/Agrichem, Louisburg, KS. Co-Author: M. Bhaskara Reddy, Fluence/Agrichem, Louisburg, KS.

Phytophthora is one of the common pathogen causing root rots and foliar blights on several hosts in commercial nurseries and several steps are taken to control this pathogen. In California some nurseries recycle their irrigation water and there is a danger of spreading *Phytophthora* from infected hosts to other host

species in this process. Cholorinaton of recycled water is a common practice and proved effective in controlling water borne Phytophthoras. In addition to chlorination other methods include UV treatment and ozonation. Currently *Phytophthora ramorum* emerged as one of the important plant pathogen causing foliar blights of ornamental plants resulting in imposing quarantine regulations affecting the business in commercial nurseries. Since Agrifos treatment proved effective in controlling foliar Phytophthora blight, a trial was conducted to see the efficacy of Agrifos in controlling water borne Phytophthora propagules. Both recycled water as well as fresh inlet water from the river an irrigation source for the nursery were baited with Camellia leaf discs to detect *Phytophthora* sp. Measured amount of such water was treated with Agriofos and Subdue Maxx and baited with Camellia leaf discs to detect *Phytophthora* species. Treatments were repeated for six weeks collecting the water every week and plating the baited camellia leaf discs on PARP medium. Three replicates were maintained for each treatment. Untreated fresh as well as recycled water recorded up to 36.6% *Phytophthora* compared to 0 to 6.6% in Agrifos and Subdue Maxx treatments. For all the six weeks the efficacy of Agrifos was comparable to standard fungicide treatment such as Subdue Maxx. The results of this trial proved that Agrifos treatment effectively controlled water borne propagules of *Phytophthora* spp. and could be an option of injecting the product in to the irrigation system for disease control.

Poster-684: The effects of a surfactant on *Phytophthora ramorum*. Presenter: L. Yakabe, University of California. Co-Author: J. MacDonald, University of California, Davis, CA.

Phytophthora ramorum has been detected in a number of California nurseries producing container-grown ornamental plants. *Phytophthora* species can be spread throughout nurseries using untreated, recycled irrigation water. The practice of managing Phytophthora disease risks by prophylactic applications of suppressive fungicides is not acceptable for *P. ramorum*, a stringently regulated pathogen. Growers are seeking water treatment technologies that can be adapted to this task without prohibitive infrastructural costs. We have tested a surfactant (1st Enviro Safety ECCO Commercial All-Purpose Cleaner ®) derived from plant extracts against the A2 strain of *P. ramorum* and found it to be lethal to mycelium and all forms of propagules. On average, zoospores were the most sensitive (lethal dosage = 1.2 mg/ml) while mycelium was the least sensitive (lethal dosage = 16 mg/ml). Sporangiogenesis, zoosporogenesis, and zoospore motility were also inhibited. There were some differences in sensitivity noted between isolates of *P. ramorum*, but all isolates were more sensitive than *P.capsici* and *Fusarium oxysporum*. Surfactant levels lethal to fungal propagules were found not to be toxic to mung bean seedlings. This study indicates that surfactants may be an effective means of controlling *P. ramorum* in recycled irrigation water.

Presentation-O-009: The effect of systemic fungicides on detection by culturing of *Phytophthora ramorum*. Presenter: Nina Shishkoff, USDA ARS FDWSRU.

Rhododendrons with infections on expanding shoots caused by *Phytophthora ramorum* were sprayed with fosetyl-Al (3 g/L), mefonoxam (0.08-0.15 mL/L), propanocarb (1.5 mL/L) or water alone to determine if systemic fungicides can "mask" the presence of the pathogen. Immediately after spraying and weekly thereafter, leaf disks taken from the edges of lesions were plated on selective media. The organism could be recovered from control, fosetyl-Al and propanocarb-treated lesions at high frequencies (64-100 percent) immediately after treatment, and recovery of the pathogen declined thereafter. The pathogen could not be recovered from mefonoxam-treated lesions until 3-5 weeks after treatment, when low frequencies (3-13 percent) were found. In no case were symptoms suppressed; lesions were easily visible in all treatments. At the end of each experiment (3-8 weeks after spraying), remaining leaves on the plant, fallen leaves and samples of stem, bud, and root tissue were plated; the organism could sometimes be isolated from buds, fallen leaves and roots but the tissue with the highest recovery was stem tissue.

Presentation-O-046: Seasonal survival of *Phytophthora ramorum* in soils. Presenter: E. Fichtner, University of California, Davis, CA. Co-Authors: S. Lynch and D. Rizzo, University of California, Davis, CA.

Phytophthora ramorum has been recovered from soils throughout the sudden oak death affected regions of California. This ongoing study assesses seasonal pathogen survival in infected leaf tissue at the soil surface in a redwood-tanoak forest ecosystem. Colonized rhododendron leaf disks were placed in mesh sachets before transfer to the field in April 2004 and January 2005 to assess both winter and summer survival. The sachets were dispersed under 10 trees each of *Lithocarpus densiflorus, Umbellularia californica,* and *Sequoia sempervirens*, and at three vertical locations: i) leaf litter surface, ii) litter/soil interface, and iii) below the soil surface, and were retrieved at four points throughout each season. After 24 wk incubation in summer soil conditions over 60% recovery was observed in leaf disks retrieved from soil, whereas no recovery was observed at the surface and the litter/soil interface. Hydration of *P. r.*-negative leaf disks for three weeks enhanced recovery of the pathogen up to 10% in some treatments, and hydration-stimulated recovery was associated with high populations of chlamydospores. After 8 weeks in winter soil conditions, pathogen recovery was over 80% at the surface and approximately 99% in both subsurface treatments. The heightened survival of buried inoculum suggests that soil may serve as an inoculum reservoir in the disease cycle.

Presentation-O-047: The discovery and characterization of a unique group of isolates of *Phytophthora ramorum* from U.S. nurseries. Presenter: N. Rosenzweig, University of California, Berkeley, CA. Co-Authors: D. Hüberli,

University of California, Berkeley, CA; K. Ivors, North Carolina State University, Fletcher, NC; R. Olarte, University of California, Berkeley, CA; D. Rizzo, University of California, Davis, CA; M. Garbelotto, University of California, Berkeley, CA

Sudden oak death (SOD) caused by *Phytophthora ramorum*, has recently become a major concern in western U.S. coastal forest ecosystems and European nurseries and private estates. During 2004 and 2005, isolates of *P. ramorum* were recovered from symptomatic ornamental plants in California and Washington that were phenotypically unique in morphology compared to other U.S and European isolates also collected from these plants. As part of a continued effort to monitor genotypes in new nursery infestations, these isolates were characterized using microsatellite analysis, growth rate, pathogenicity and mating studies. Microsatellite variation in repeat regions and sequence of flanking regions for 14 loci revealed that these isolates showed fixed polymorphisms compared to U.S. and European isolate genotypes collected thus far. Growth rate and pathogenicity studies showed a broad range of variation among isolates of *P. ramorum*. The implications of these phenotypic and genotypic variations may be important for the future design and implementation of effective management strategies for the control of SOD in nurseries.

Presentation-O-048: AFLP analysis of *Phytophthora nemorosa* and *P. pseudosyringae* genetic structure in North America and Europe. Presenter: R. Linzer, University of California, Berkeley, CA. Co-Authors: D. Rizzo, University of California, Davis, CA; S. O. Cacciola, University of Palermo, Palermo, Sicily, Italy; Matteo Garbelotto, University of California, Berkeley, CA.

In California and Oregon forests, *Phytophthora ramorum*, causal agent of sudden oak death, overlaps in host and geographic range with two recently described *Phytophthoras*, *P. nemorosa* and *P. pseudosyringae*. The two species can affect forest tree hosts similarly to *P. ramorum*, even resulting in some host mortality, but unlike *P. ramorum*, are hypothesized to be native in this area. Because they may share a niche, the newly described *Phytophthoras* may affect the *P. ramorum* epidemic. In order to study patterns of genetic variability within *P. nemorosa* and *P. pseudosyringae* and to specifically address the hypothesis of indigency, we use amplified fragment length polymorphism (AFLP) analysis to genotype *P. nemorosa* and *P. pseudosyringae* isolates from the western U.S. and *P. pseudosyringae* isolates from Europe. Utilizing isolates from a broad sample of their host and geographic ranges, we generate AFLP fingerprints for each species and calculate Jaccard coefficients of similarity and neighbor-joining trees. We compare inter- and intracontinental patterns with expected genetic structure of equivalent native species to evaluate the idea of North American indigency and implications for *P. ramorum*-caused diseases.

Presentation-O-108: Control of foliar *Phytophthora* infection on *Camellia japonica* Kumasaka by Agrifos systemic fungicide treatment in a nursery

environment. Presenter: B. Stringfellow, Fluence/Agrichem, Louisburg, KS. Co-Author: M. Bhaskara Reddy, Fluence/Agrichem, Louisburg, KS.

Agrifos is one of the Phosphorus derivatives basically an essential macronutrient to plants proved effective against *Phytophthora* root rots of plants. *Phytophthora ramorum* has become one of the important quarantine diseases on ornamental plants affecting the quality and shipment of plants by commercial nurseries in North America. A trial was conducted to see the efficacy of Agrifos in controlling foliar *Phytophthora* on *Camellia*. Camellia plants variety *Camellia japonica* 'Kumasaka' of one gallon size with new flush of growth were inoculated by keeping the plants near the inoculum source. Agrifos applied as spray alone, drench alone and spray+drench at monthly intervals. The number of infected leaves and plant height were measured at intervals and compared with standard fungicide applications such as Subdue Maxx and Stature DM treatments. All Agrifos treatments significantly reduced the incidence of foliar Phytophthora blight on Camellias. Agrifos spray and spray+ drench treatments proved better but significantly not different form Agrifos drench alone or alternate spray and drench applications. The efficacy of Agrifos treatments was comparable to Subdue Maxx or Stature DM treatments. Furthermore, Agrifos treatments not only controlled foliar Phytophthora blight on Camellia but also improved plant growth. The results of this trial proved that Agrifos could be successfully used for the control of foliar Phytophthora including *Phytophthora ramorum* to arrest its spread and infection of ornamental plant hosts including *Camellia* spp. in a nursery environment.

RESOURCES

The USDA APHIS PPQ Risk Analysis for *P. ramorum* is now available on the APHIS website at: **http://www.aphis.usda.gov/ppq/ispm/pramorum/pramorumpra05-05-05.pdf**. Topics in the 82-page document include general pest information, organism risk assessment, pathway assessments, and mitigation measures.

To assist researchers and other affected parties in complying with various landowner and government permit requirements, the COMTF has posted general permit guidelines and contact information to its website. Permits are required when plant collecting as well as transporting *P. ramorum*-cultures and infested material. To access this information, go to www.suddenoakdeath.org under "Research" to "Permit Information."

The publication "Diversity and Management of *Phytophthora* in Southeast Asia" is available online in a three-part series at: http://www.aciar.gov.au/web.nsf/doc/ACIA-67E8HU. It focuses on *Phytophthoras* found in Southeast Asia. Topics addressed include hosts, biology, and economics as well as integrated management of *Phytophthora* diseases.

LOOK ALIKE DISEASE - COMMON IN CALIFORNIA

California black oak (*Quercus kelloggii*) and blue oak *(Q. douglasii*) in the Sierra Nevada and Coast Ranges are being reported as having premature leaf edge curling, browning, and abscission. In some cases, entire hillsides now have oak forests with few, if any, leaves. While both of these deciduous species do lose all of their foliage in the fall, in mid-summer they are normally green and leafy.

Many of the landowners reporting these symptoms are concerned that symptomatic oaks may be infected with *Phytophthora ramorum*. However, it is important to note that blue oak is not a known host of *P. ramorum* and in CA black oak, Sudden Oak Death symptoms begin as stem cankers. The more likely culprits of the leaf spotting and dropping are fungal organisms, including Septoria leaf blight (*Septoria quercicola*) and oak anthracnose (*Apiognomonia errabuna*). During previous similar outbreaks, both of these pathogens have been identified as principal causes.

While these foliage diseases are fairly common and may be found on many oaks in normal rainfall years, they are much more prevalent and widespread during years with unusually wet, late-spring conditions. Cool wet weather in mid-spring slows leaf development and extends the period in which the leaves remain succulent and most susceptible to fungal pathogens. Since wet weather this year continued as temperatures increased, it provided an ideal environment for infection. With unusual weather patterns necessary for these spikes in leaf diseases, such outbreaks are typically limited to one growing season. While the immediate effects may be startling, there should be little long-term impact on tree health.

During the coming months, affected trees may continue to lose their leaves. Additionally, many trees will grow new leaves before the fall, especially trees that lost their leaves relatively early in the season. Tree vigor also helps determine the amount of refoliation, since trees with more energy reserves are better able to refoliate than weakened trees. Trees with pre-existing stress, or trees that lose their foliage relatively late in the season, may not refoliate as fully. The leaf loss resulting from these diseases does reduce the tree's ability to manufacture food through photosynthesis and, over time, repeated defoliations could weaken trees. But, because these events are often widely spaced, long-term tree health is usually not seriously impacted.

For contact information on experts working with oaks, as well as additional oak information in general, go to the UC Integrated Hardwood Range Management Program website at: http://danr.ucop.edu/ihrmp/.

MANAGEMENT

"The Utilization of Sudden Oak Death-Diseased Woody Material," by John Shelly, University of California Cooperative Extension Advisor, Forest Products and Woody Biomass Advisor

Early in the study of *P. ramorum*, many people voiced the concern that large amounts of infested plant material would be removed from the landscape with little understanding of the risk transporting this material would have on the spread of the pathogen. In addition, if the early predictions of the magnitude of the infestation were correct, it was likely that the existing infrastructure for green waste removal, reuse, and disposal could be quickly overwhelmed. Out of these discussions, the Biomass Utilization Committee of the California Oak Mortality Task Force, in cooperation with the University of California Forest Products Laboratory, designed a project to coordinate the collection, disposal, and potential utilization of *P. ramorum*-infested material. This project, funded by the USDA Forest Service, Pacific Southwest Region, and the California Department of Forestry and Fire Protection, ended June 30, 2005.

During the course of the project, two collection yards were set up and operated in California to provide central collection points for *P. ramorum*-diseased wood and plant material. The project also provided opportunities to monitor pathogen levels during transportation and processing activities, find potential uses for infested material, and develop recommendations for handling and processing diseased material. The first collection yard was set up in Marin County at the Marin Resource and Recovery Center in San Rafael in May 2003 and the second yard was set up in Santa Cruz County at the county waste transfer station in Ben Lomond in November 2003. During the past two years of operation, the two yards collectively received and processed approximately 1,300 green tons of *P. ramorum*-diseased wood and plant material, mostly from the removal of dead, hazardous trees. Twenty-five tree service companies participated in the project. Most of the material collected (about 1,000 tons or 82%) was processed into fuel for biomass power plants. While this was an acceptable use for woody biomass, the value of the material delivered to the power plant barely covered the cost of transportation to the plant. The search for higher value uses included conversion to firewood (about 220 tons or 17%) and lumber (15 tons or 1%). In addition, a test run of 2 tons was processed into a feedstock for compressed firelogs. Acceptable products were produced in each of these tests. Positive cultures of *P. ramorum* were obtained before and during processing, but with the exception of partially air-dried firewood, the finished products did not yield any positive cultures. The temperatures reached in the kiln drying of the lumber and during the extrusion of the fire logs were high enough to destroy *P. ramorum* that may have survived the initial processing of these products. Preliminary results with the firewood indicated that *P. ramorum* may survive in firewood for many months. A follow-up study is underway to better understand this observation (refer to June 2005 COMTF newsletter).

Positive *P. ramorum* cultures were obtained from the following:

- 16 of 112 freshly split firewood specimens
- 1 of 110 firewood specimens air-dried for at least 6 months
- 2 of 152 air-borne dust samples collected in the collection yards
- 8 of 49 dust samples collected adjacent to grinding and sawing equipment
- 7 of 16 rain water runoff samples collected in the collection yards

During this project the levels of *P. ramorum* symptoms in the host vegetation surrounding the collection yards were also monitored. Although active *P. ramorum* was cultured from the material collected at the yards and during the processing activities, along with the sharp increases in bark beetle activity that were correlated with the collection of diseased material, no evidence was found to support the hypotheses that the collection and processing activities influenced the background *P. ramorum* levels at the two sites.

For more information on the SODBusters program, as well as a list of individuals that were instrumental in the program's success, go to: http://groups.ucanr.org/SODBusters/.

Kudos to the Elkhorn Slough National Estuarine Research Reserve in Watsonville, CA where approximately 50,000 visitors annually are asked to clean their shoes before walking on the trails to prevent the introduction and spread of Sudden Oak Death. The shoe-cleaning station, comprised of boot scrapes and pans with Lysol® solution, is outside of the Visitor Center so that Reserve personnel can easily refer to it as they explain the procedure and so they can insure visitor compliance. Each visitor is required to obtain a day use pass, show a hunting/fishing license, or show their annual pass. During this admittance process, they are instructed or reminded about the foot wash. Additionally, before a school group can visit the Reserve, teachers must go through a Teacher Training Workshop, which includes instructions on the shoe wash. Upon arrival, each school group is given an orientation to the Reserve and then guided through the shoe cleaning process. The public is not allowed off-trail, and researchers either have dedicated Elkhorn Slough shoes or they use the Lysol® spray or bleach on their shoes. For more information on the Elkhorn Slough National Estuarine Research Reserve, go to: www.elkhornslough.org.

HOST OF THE MONTH

***Taxus media* (a yew) – is a hybrid cross between *T. baccata* and *T. cuspidata* that was developed in the early 1900s.** It can be found in a wide range of sizes and with great variation in growth characteristics depending on the cultivar. While it is most often found as an evergreen medium-sized tree or large hybrid shrub, its size ranges from two to 20 ft. It is a slow-growing plant with needle-like two-ranked leaves and blunt bud scales. Its foliage is dark-green on the upper side and light to medium green on the underside. While the leaf

apex is always pointed, needles can either be straight or curved. The dioecious flowers of the yew bloom in March and April and form on the previous years' wood. The poisonous yew fruit is a slightly compressed olive-brown seed that is covered by a red aril and is mildly attractive. The bark is scaly and flaky brown, and is usually covered by foliage. *T. media* is often used as foundation plantings in groupings, as a hedge or screen.

The one confirmed positive *T. media* found at a Boskoop, Holland nursery was observed in November 2003. No other host plants at the nursery were found to be *P. ramorum*-positive. Symptoms included *P. ramorum* stem-base rot and root rot caused by *P. cinnamomi*. The plants in the lot were two to three years old. (NOTE: *Taxus baccata* was formerly identified as a host in the UK from a container plant.)

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- Personal email communication
  Jonathan Jones
  National *P. ramorum* Program Manager USDA APHIS PPQ