Sudden Oak Death
Phytophthora ramorum

Nursery Management Update

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Presentation outline

- Biology of pathogen
- Sudden Oak Death update
- Management in nurseries
- Research
- Resources

Phytophthora ramorum

Wide host range of ornamentals and natives:

- More than 127 plant groups (genera or species). Many plant families.
- Primarily attacks foliage and woody hosts.

Two genotypes are known:

- A European (A1 mating type primarily) and a North American (A2 mating type). Suggests introduction from a third unknown origin.

Phytophthora ramorum

A water mold

Sporangia

- Aerial infectious sporangia can be spread in streams, irrigation water, and between plants.
- Can produce copious, ephemeral, infectious swimming zoospores.

Sporangia and zoospores

Chlamydospores

- Abundant thick-walled spores produced in adverse conditions in plant debris and soil.
- Capable of surviving many months.

Chlamydospores

Phytophthora ramorum

Favorable environment

- Cool: 68 ^{o}F (optimum)
  36 - 79 ^{o}F. (min.-max.)
- Wet

Sometimes found in unexpected nursery locations.

- Southern CA. , Sacramento Valley

Sudden Oak Death
SOD

Serious canker disease
Coast live oak and other red oaks, tan oak (CA and OR), beech, and larch (UK)

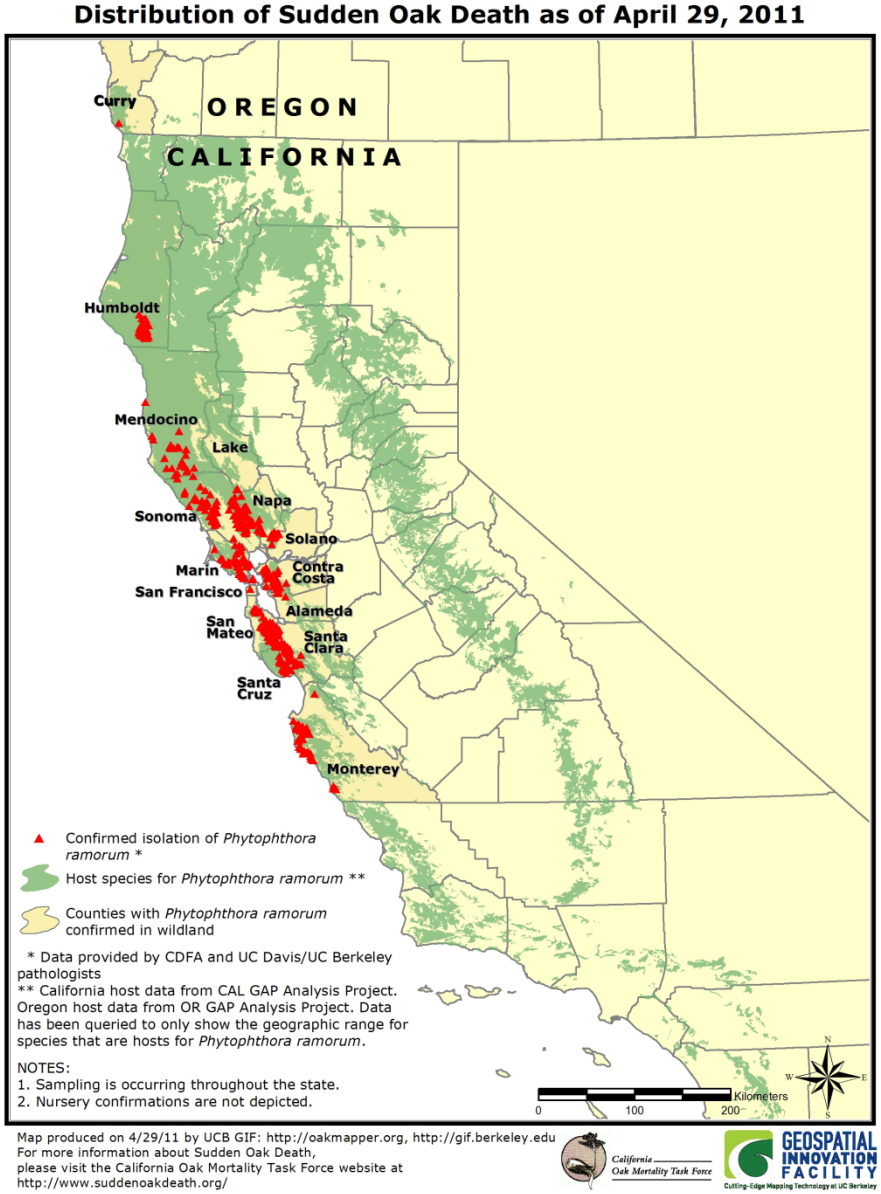
Regulated by state and federal quarantines, and ornamental nurseries are targeted

Sudden Oak Death Natural Distribution

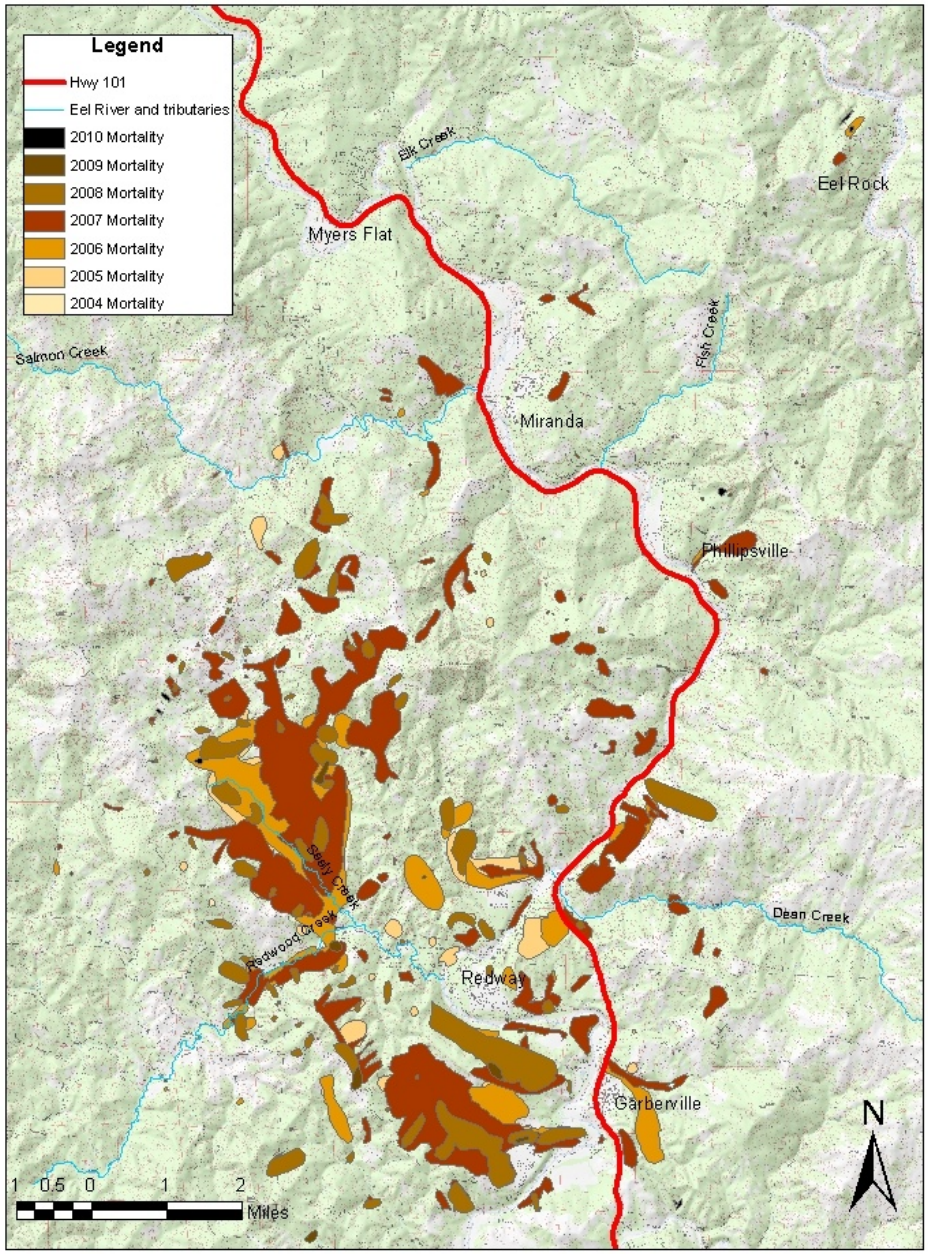
(2011)

14 Counties in California

Curry County in southwestern Oregon



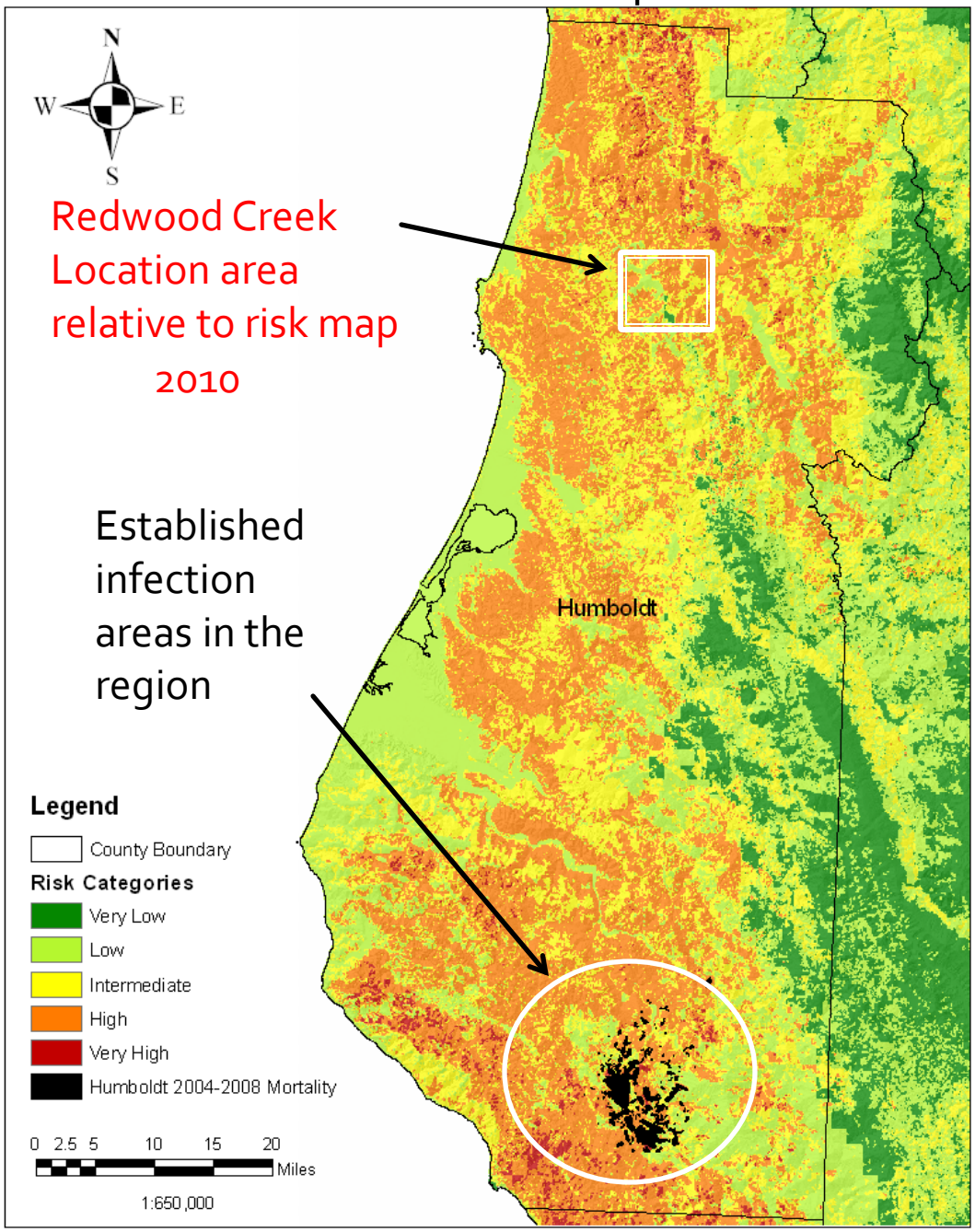
Southern Humboldt Tanoak Mortality 2004-2010



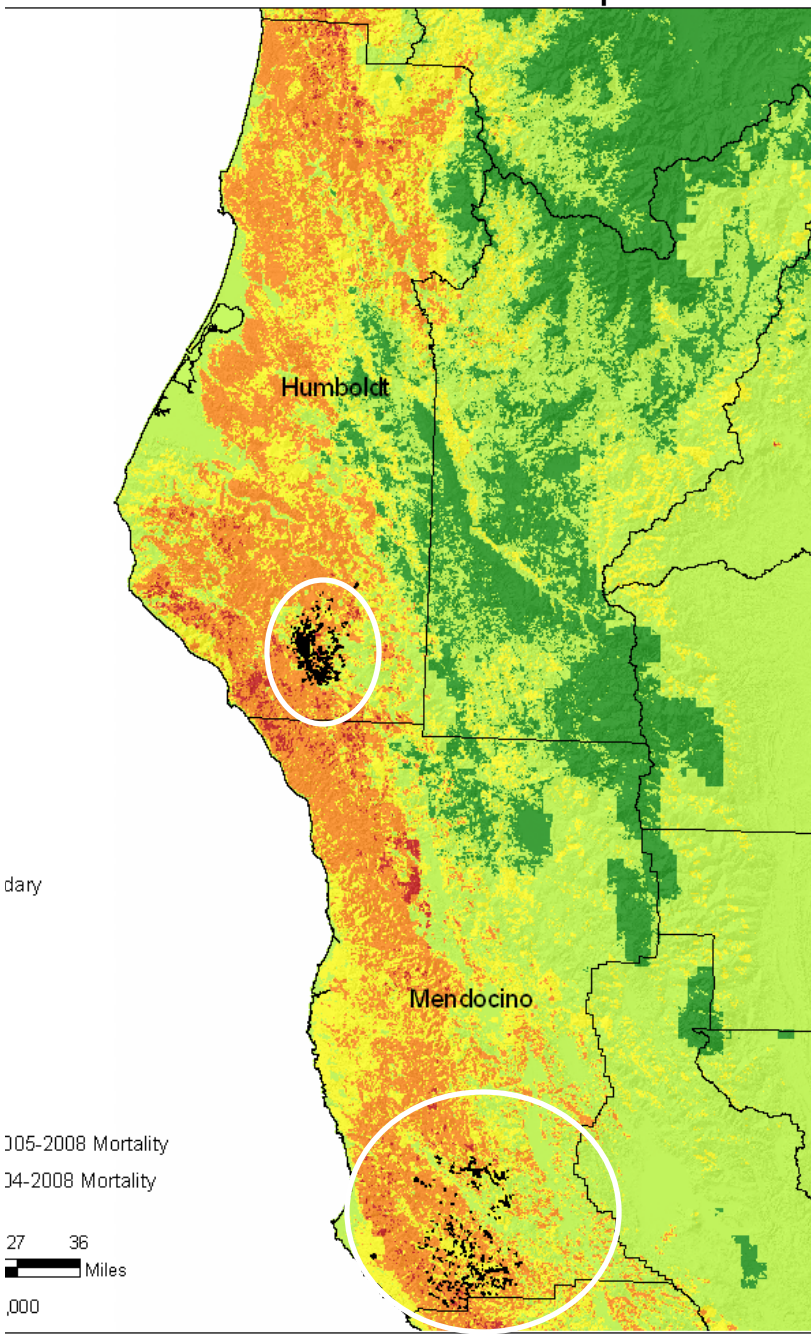
Rate of expansion is ~1500 acres per year for the last 7 years

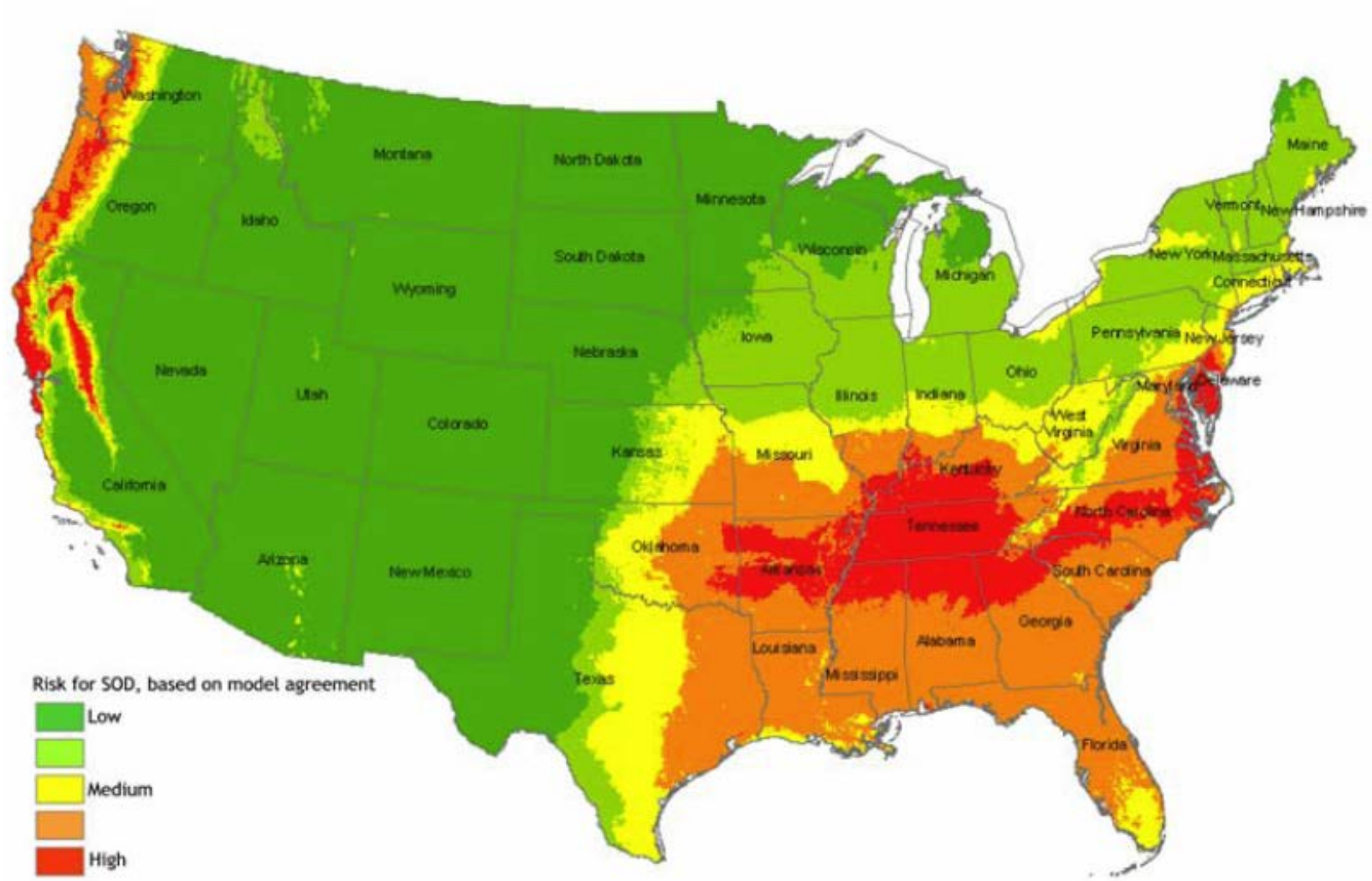
Slide Credit: Yana Valachovic and Chris Lee, UCCE

Humboldt Risk Map



Humboldt - Mendocino Risk Map

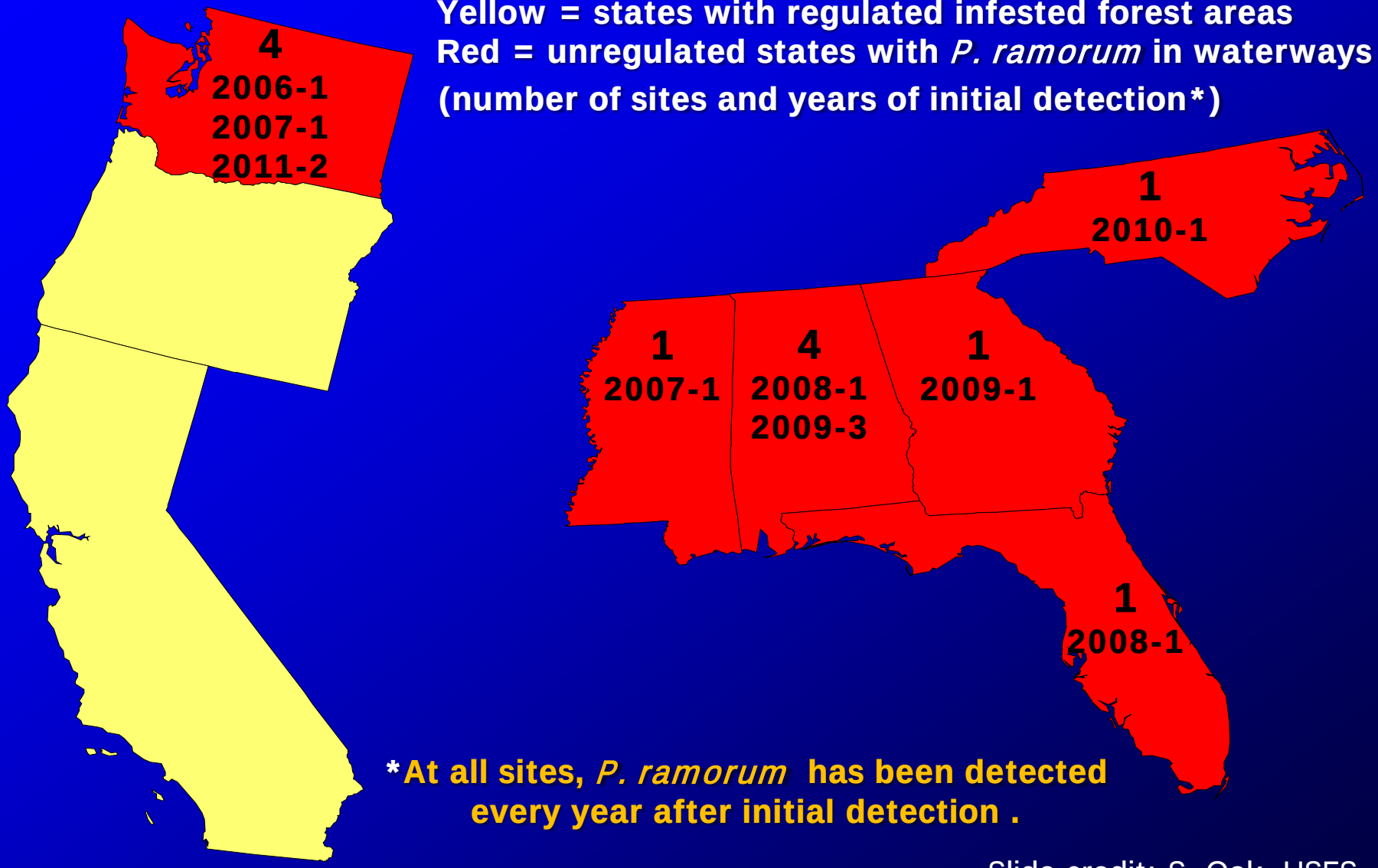




Spatial Modeling of Sudden Oak Death Risk (Kelly, Shaari, Guo & Liu, 2005)

P. ramorum Early Detection Survey of Forests

Stream Baiting National Results 2006-July 2011



Yellow = states with regulated infested forest areas
Red = unregulated states with *P. ramorum* in waterways
(number of sites and years of initial detection*)

***At all sites, *P. ramorum* has been detected every year after initial detection .**

Slide credit: S. Oak, USFS

Eastern Forests at Risk

Slide credit: S. Oak, USFS

Infested Nurseries Associated with Stream and Runoff Detections

Slide credit: S. Oak, USFS

Infected maturing larch commonly 20-25m tall

2010
[UK Forest Research Photos]

Young larch (5-8 yr) probably infected from the mature larch

Management in Nursery

Preventing Introduction and Persistence

1. Inspection of plant introductions and nursery scouting
2. Cultural practices to prevent movement and persistence within nursery
3. Chemical treatments to prevent establishment and persistence

Management in Nursery
Preventing Introduction and Persistence

1. Inspection of plant introductions and nursery scouting

- Know hosts and host symptoms
- Know the source
  - CDFA lists nurseries approved to ship product interstate
  - Operator integrity, history of cleanliness.

Ornamental hosts

- *Rhododendron, Camellia, Pieris, Viburnum, Kalmia latifolia* (USA)
- Genera listed above and *Syringa*, *Leucothoe fontanesiana*, *Arbutus unedo*, *Pittosporum undulatum, Magnolia, Photinia,* and others (EU)
- *Rhododendron, Euonymus, Gaultheria, Osmanthus, and Prunus*. (Canada)
- Native species used in ornamental landscape (redwood, madrone, manzanita, etc.) (CA., OR.)
- Christmas tree farms (*Pseudotsuga menziesii*, *Abies concolor, Abies grandis*) (CA)

http://www.aphis.usda.gov/plant_health/plant_pest_info/pram/

Know where to look:
Plant diseases associated with *P. ramorum*

Shoot tip dieback

Leaf lesions and defoliation

Stem cankers

Roots

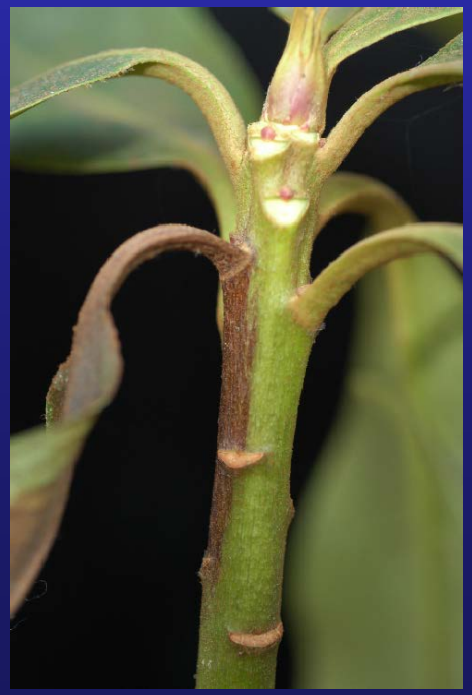
Slide by C. Blomquist

Host Symptom Examples

Rhododendron

Camellia

Pieris



Viburnum

Regular systematic scouting

Phytophthora Field Detection Kits

Uses Leaf or root lesions

- Phytophthora species
  - ELISA (e.g. Agdia ImmunoStrips®)
- Phytophthora ramorum
  - DNA or RNA (e.g. Agdia Amplify RP)

Management in Nursery
Preventing Introduction and Persistence

2. Cultural practices to prevent movement and persistence within nursery

- Air
- Soil and Plant Debris
- Water

Phytophthora ramorum persists in soil (and leaf debris in the soil)

Phytophthora ramorum moves in water

Movement in water within a nursery and/or recycled water ?

Environmental Factors for Sporulation

(2008- 2010)

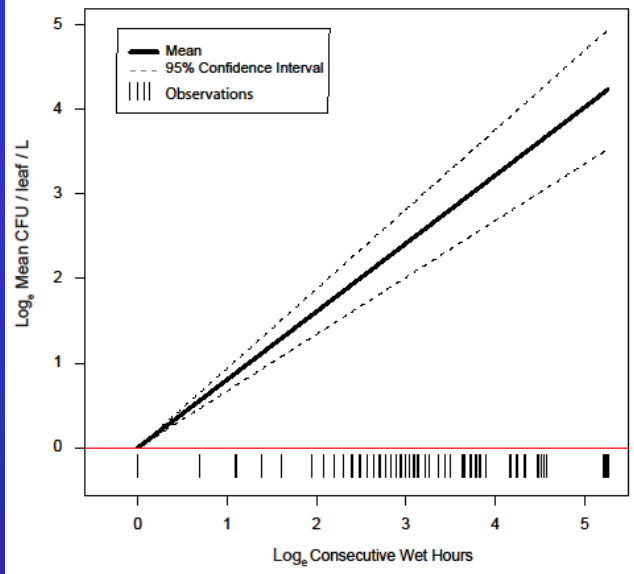
Research supported by USDA APHIS and CANGC

California Bay

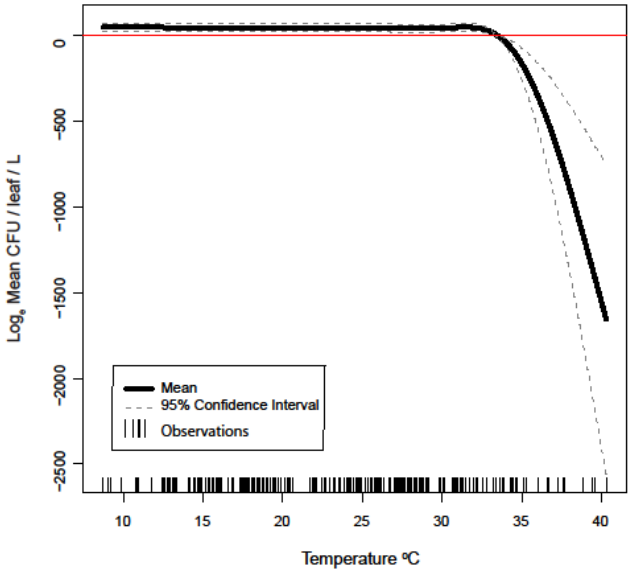
Rhododendron

Camellia

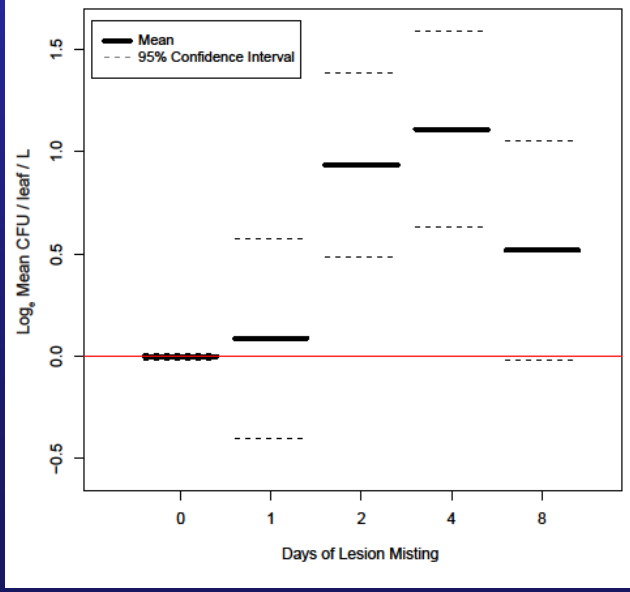
Leaf wetness hours



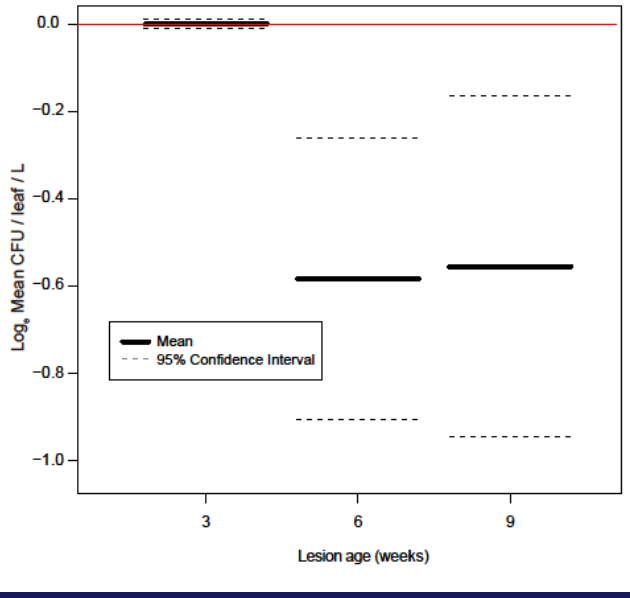
Temperature



Days of Lesion Misting



Lesion age



Management in Nursery

Preventing Introduction and Persistence

3. Chemical treatments to prevent establishment and persistence

- Keep in mind resistance management too.

Disease management in nursery
Prevent introduction and establishment

Oomycete fungicides applied at high risk nurseries before and during high risk environmental conditions

Fungicides for P. ramorum

Rhododendron, Camellia, Pieris, and Viburnum

Tjosvold , Koike, and Chambers (2003-2005)

Pre-infection (preventative) foliar fungicide application

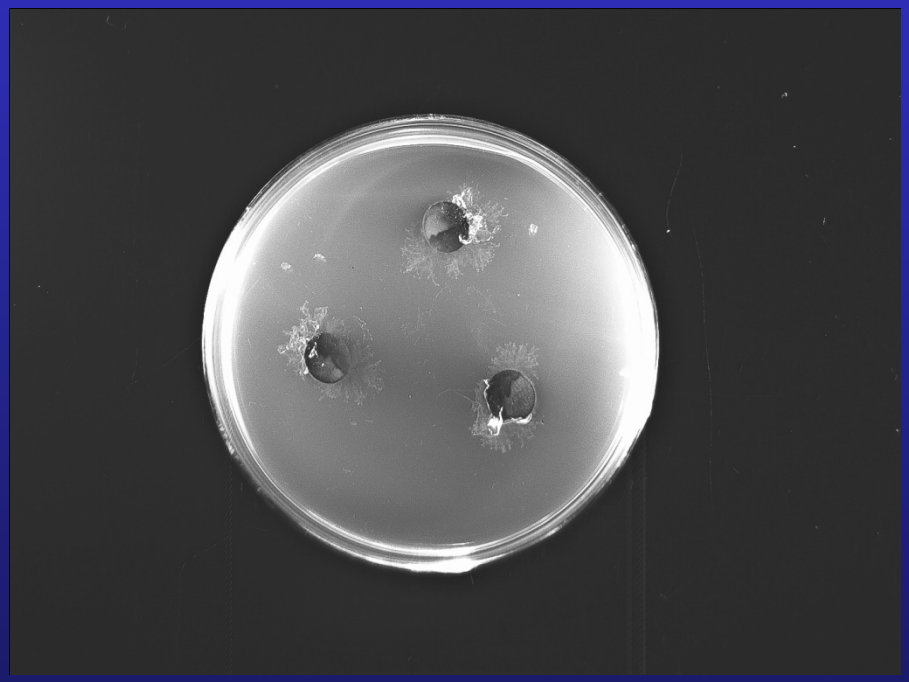
- mefenoxam (Subdue Maxx, Syngenta)
- dimethomorph (Stature DM, BASF)
- pyraclostrobin (Insignia, BASF)
- fenamidone (Fenstar, Olympic)
- cyazofamind (Segway; FMC,)

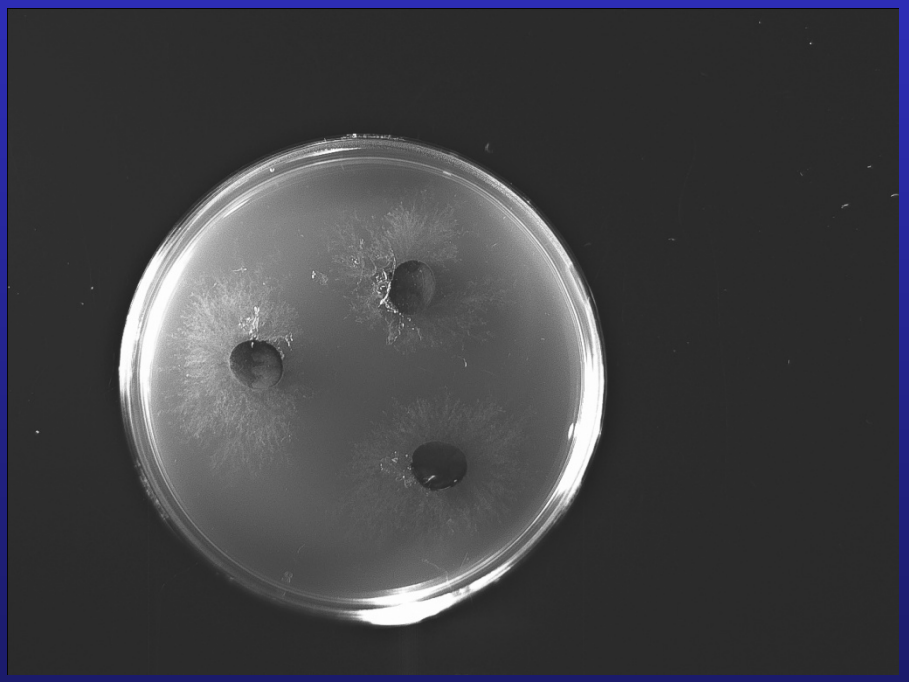
Control for at least 2– 4 weeks, depending on host

Post-infection (curative) fungicide application

- No reduction in lesion growth for at least 6 weeks after fungicide application.
- High rate of recovery of pathogen with all fungicides.

Colony characteristics





leaf sampled 20 DAT

Segway (cyazofamid)

Untreated

Effect of Fungicides and Biocontrol Agents on Sporulation and Persistence of *Phytophthora ramorum* on Nursery Hosts

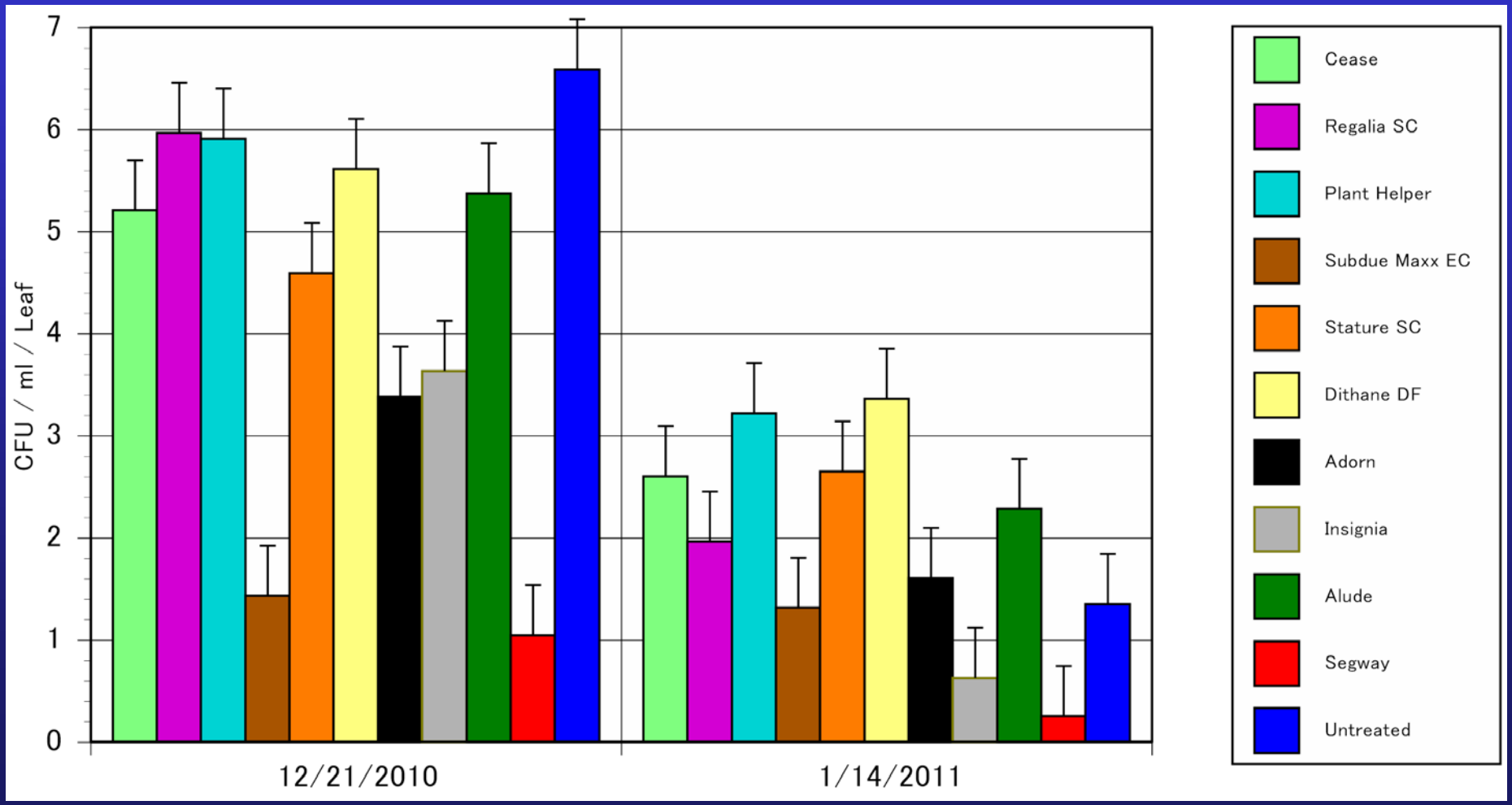
Research 2010-2012

- Evaluate fungicides for sporulation inhibition and reduction of pathogen persistence in foliar lesions.
- Effective fungicides may inhibit spread and establishment in the environment or nursery.

Research supported by USDA APHIS and CANGC

Sporulation in Field

Rhododendron and Camellia



9 DAT

38 DAT

Management in Nursery

Preventing Introduction and Persistence

1. Inspection of plant introductions and nursery scouting
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Nursery Industry
BEST MANAGEMENT PRACTICES
for *Phytophthora ramorum*

- to prevent the introduction or establishment in California nursery operations

Version 1.0

ENDORSEMENTS

CA Association of Nurseries and Garden Centers
Nursery Growers Association
CA Farm Bureau
San Diego Flower and Plant Association
Garden Rose Council
CA Oak Mortality Task Force
California Center for Urban Horticulture, UC Davis
Horticultural Research Institute

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CHERYL BLOMQUIST, CA Department of Food and Ag

COVER PHOTO

Brigga Nursery in Bonsall, CA. ERIC LARSON, photographer

PUBLICATION 8156

Nursery Guide for Diseases Caused by *Phytophthora ramorum* on Ornamentals: Diagnosis and Management

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INTRODUCTION

Phytophthora ramorum, a newly discovered plant pathogen, has caused widespread mortality in native oaks and tanoaks in many coastal areas of central and northern California and in southwestern Oregon. On oaks, the disease is commonly called sudden oak death because trees typically appear to die rapidly (fig. 1) In infested wildlands (forests and woodlands), the pathogen has been detected on several other trees, shrubs, vines, and herbaceous native plants, where it causes less-destructive leaf blights, stem cankers, and tip dieback.

Camellias, rhododendrons, and other popular ornamental plants are susceptible to *P. ramorum* infection, and the pathogen can be moved long distances through shipments of infected nursery stock. By the end of 2004, the pathogen has been detected on nursery stock and some outplantings in 21 U.S. states and British Columbia. Federal and state quarantines are in effect that require nursery inspections, and if the pathogen is found, affected nursery stock must be destroyed as a means of eradication.

Figure 1. Coast live oak mortality, Santa Cruz County, CA, 1999. Photo: S. Tjosvold.

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Grower-oriented Publications

CALIFORNIA
OAK MORTALITY TASK FORCE

About California Oak Mortality Task Force

The California Oak Mortality Task Force (COMTF) is a non-profit group working to manage Sudden Oak Death in California. COMTF was formed in August 2000 by merging the efforts of two separate state organizations: The California Forest Pest Council (CFPC) and the California Department of Forestry and Fire Protection (CDF). The resulting Task Force is a consensus-driven coalition of research/educational institutions, public agencies, non-profit organizations, and private interests. Its primary purpose is to coordinate research, management, monitoring, education, and public policy efforts addressing elevated levels of oak mortality in California resulting from Sudden Oak Death (SOD). As we learn more about *P. ramorum*, our concern has broadened to include the other diseases it causes.
The Task Force goals are to:

- Minimize the impact and spread of Phytophthora ramorum on natural, agricultural, and human communities.
- Coordinate an integrated response by all interested parties to address Phytophthora ramorum.
- Serve as liaison to local, state, national, and international groups.

Contact List

Browse all contacts below by area of responsibility.

Coordinating Staff | COMTF Chair & Special Advisors | COMTF Committees

California Oak Mortality Task Force
www.suddenoakdeath.org

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