Diagnosis and management of *Phytophthora ramorum* canker in canyon live oak, an atypical bole canker host

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Quercus chrysolepis – canyon live oak
Section Protobalanus - Intermediate oaks
First report of *Phytophthora ramorum* on canyon live oak in California (Plant Disease, March 2003. 87:315).

Shannon Murphy and David Rizzo, UC Davis, reported in August 2002 that *Phytophthora ramorum* was isolated from branches less than 2.0 cm in diameter on a canyon live oak (*Quercus chrysolepis*) in a state park in Marin County, CA. The shrub was a cluster of stems less than 1 m in diameter and 1 m high. Similar cankers were observed on small branches of adjacent canyon live oak.

Larger canyon live oak trees have been observed with bleeding symptoms typical of *Phytophthora ramorum*, but isolation attempts had failed. (from COMTF newsletter April 2003)
Los Trancos Open Space Preserve, San Mateo Co.
2007 (Photos: MROSD)
Feb 2008: cause(s) uncertain

- *P. ramorum* on bay and *Q. agrifolia*
- not detected in *Q. chrysolepis*
- possible root disease?
Survey to compare bay distribution with symptoms in *Q. chrysolepis* - Mar 2009
Increased incidence of symptoms as bay cover near trunk increases, as previously shown for *Q. agrifolia*
Favorable years for SOD

Rainfall yr
Jul-Jun
Mar-Jun
Apr-Jun

Los Trancos Open Space Preserve, San Mateo Co. Mar 2009

P. ramorum positive PCR from 2 trees, no positive isolations

SOD management actions initiated
Log inoculations – Sep 2009
Q. chrysolepis / P. ramorum
4 weeks after inoculation
-Q. chrysolepis had similar canker length but smaller canker area compared with Q. agrifolia
-P. ramorum reisolated from all cankers
Lower plot: natural stand

Upper plot: planted stand

Skyline Open Space Preserve, San Mateo Co.

Field inoculations – July 2010

100 m
Q. chrysolepis / P. ramorum
14 weeks after inoculation
Q. chrysolepis / P. ramorum
14 weeks after inoculation
Shreve oaks

Inoc type
- bleeding

Days after inoculation

Shreve oaks

Canyon live oaks

Upper plot trees

Inoc type
- bleeding

Days after inoculation

6/18 (33%) of *Q. chrysolepis* trees showed bleeding at some point before sampling.

**all inoculated Q. chrysolepis**

% of trees with recent bleeding

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Days after inoculation

**Recent bleeding**

**Active beetle boring**

**A. thouarsianum** sporulation

**Callus development**

**Post-sampling observations**
Q. chrysolepis / P. ramorum
14 weeks after inoculation.
Q. chrysolepis / P. ramorum
14 weeks after inoculation
Isolation efficiency
Canyon live oak: 0 (xylem) - 89%
Shreve oak: 77 - 100%

Lower plot
- 12/16/2010 (14 weeks)
- 4/30/2011 (40 weeks)

Upper plot
- 12/16/2010
- 4/30/2011
Q. chrysolepis / P. ramorum
14 weeks after inoculation.
Q. chrysolepis / P. ramorum
40 weeks after inoculation
Q. chrysolepis / P. ramorum
99 weeks after inoculation
Q. chrysolepis / P. ramorum
99 weeks after inoculation
Q. chrysolepis / P. ramorum
99 weeks after inoculation
Q. chrysolepis natural infection
P. ramorum positive – 8/18/10
Q. chrysolepis natural infection
P. ramorum positive – 7/22/11
Q. chrysolepis natural infection
P. ramorum positive – 12/14/11

Naturally-infected Q. chrysolepis
6/08 through 12/11:
52 (+) trees sampled
3 positive P. ramorum isolations

but...
8/11/08 through 12/11:
3 of 13 sampled trees positive
Management options:
- Bay removal
- Phosphite application
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- Bay removal
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Los Trancos OSP

Control
Local bay removal

Agri-Fos and bay removal

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Sand column spore traps
monitor bay removal effect
Spore trap results show even local bay removal greatly reduces *P. ramorum* inoculum.
2002: first field isolation from twigs
2010: first field isolation from bole canker

- low percent of cankers bleed
- bleeding amount usually miniscule
- isolation efficiency is low under optimal conditions
- first evidence of disease may be secondaries

If SOD or similar disease develops in new areas on hosts with *Q. chrysolepis* - type reaction, it may be very difficult to diagnose!
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