

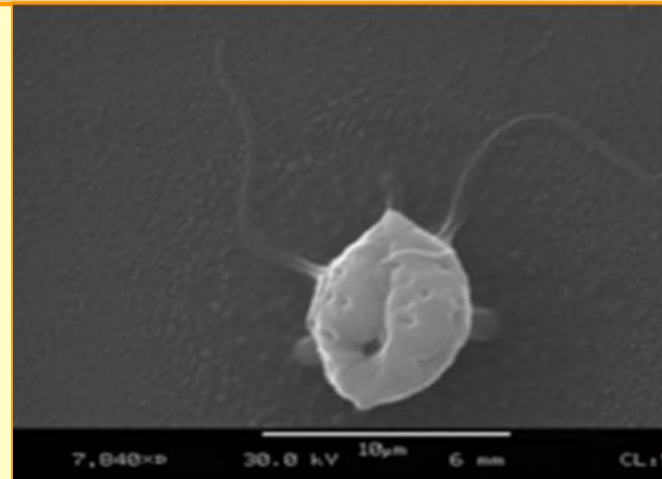
Exotic Root-rotting *Phytophthora* Species in Restoration Plantings and Nursery Stock



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What are Phytophthoras?

Greek for 'plant destroyer'



- **Genus in the water-mold class.**
- **Related to brown algae**
- **Morphologically similar to fungi, but more closely related to plants than animals**
- **Over 100 described, thought to be as many as 500 more species**
- **Mostly pathogens of dicots**
- **Many are host specific**



Phytophthoras can thrive in native plant nurseries



Photos: USDA- APHIS; Tjosvold, UCCE; CDFA, courtesy of Latham

Angeles National Forest Case Study



- 40 restoration sites in Mojave woodland, desert transition chaparral, mixed chaparral, mixed conifer, oak woodland, and coastal sage scrub vegetation ranging from 1,000 to 8,000 ft. elevation
- 150,000 container plants of native species growing in 5 nurseries
- Scheduled for outplanting over ~100 acres of disturbed utility corridors (pipeline, transmission line).



- Involving 4 major utility companies
- Some sites already planted with first/second phase



**Which set
is
infested?**



Nursery Testing Design: green pear effluent baiting



The Good, The Bad

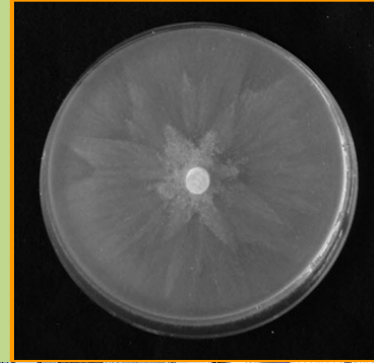


and The Ugly



Isolation on Media and DNA Sequencing Results for Nurseries

- Pieces of lesions on pears removed and placed on agar
- Cultures sent to lab for DNA sequencing to determine species
- 25 native plant species tested, including 6 rare species
- 8 different *Phytophthora* species detected, on 18 host species (1 found on rare species of manzanita)



Nursery #1 = 3 species

Nursery #2 = 3 species

Nursery #3 = 5 species

Nursery #4 = 1 species

Phytophthoras detected	Nursery of origin	Host species
<i>Phytophthora cactorum</i>	1	<i>Cercocarpus betuloides</i> , <i>Heteromeles arbutifolia</i> , <i>Salvia mellifera</i>
<i>Phytophthora cactorum</i>	2	<i>Quercus agrifolia</i>
<i>Phytophthora cambivora</i>	3	<i>Quercus chrysolepis</i>
<i>Phytophthora citrophthora/colocasiae</i>	3	<i>Adenostoma fasciculatum</i>
<i>Phytophthora cryptogea complex</i>	2	<i>Eriogonum fasciculatum</i> , <i>Salvia mellifera</i>
<i>Phytophthora hedraiandra</i>	3	<i>Cercocarpus betuloides</i>
<i>Phytophthora nicotianae</i>	4	<i>Acmispon glaber</i> , <i>Arctostaphylos glandulosa gabrielensis</i> , <i>Artemisia californica</i> , <i>Eriodictyon crassifolia</i> , <i>Eriogonum elongatum</i> <i>Quercus agrifolia</i> , <i>Salvia mellifera</i>
<i>Phytophthora nicotianae</i>	1	<i>Baccharis salicifolia</i> , <i>Populus fremontii</i> , <i>Salix lasiolepis</i>
<i>Phytophthora nicotianae</i>	3	<i>Quercus john-tuckeri</i> , <i>Q. wislezenii</i> , <i>Rhamnus illicifolia</i>
<i>Phytophthora nicotianae</i>	2	<i>Salvia mellifera</i>
<i>Phytophthora niederhauserii</i>	1	<i>Eriogonum fasciculatum</i> , <i>Heteromeles arbutifolia</i> , <i>Salvia mellifera</i>
<i>Phytophthora pini</i>	3	<i>Cercocarpus betuloides</i>

Are Phytophthoras surviving in restoration sites?

- Tested 71 samples at 15 sites, scattered over various veg types
- Sites planted 6 months to 6 years previously
- Took control samples
- Live and dead containers
- Sampled 14 different species



Restoration Site Sampling Design



Testing Results for Restoration Sites

- 6 *Phytophthora* species detected, 5 previously found in nurseries, 3 matching nursery results
- One *Phytophthora* species detected in control sample, but same species found in nursery stock planted at site
- Not seeing any obvious impacts to surrounding natives at any site

Phytophthoras Detected	Container Plant Nursery of Origin	Host Species
<i>Phytophthora cactorum</i>	3	<i>Quercus agrifolia</i> , <i>Q. john-tuckeri</i>
<i>Phytophthora cactorum</i>	5	<i>Pinus coulterii</i> , <i>Pseudotsuga macrocarpa</i>
<i>Phytophthora citrophthora</i> / <i>colocasiae</i>	3	<i>Eriodictyon crassifolia</i>
<i>Phytophthora cryptogea complex</i>	None	<i>Salvia mellifera</i>
<i>Phytophthora nicotianae</i>	1	<i>Artemisia californica</i> , <i>Chrysothamnus nauseosus</i> , <i>Encelia californica</i>
<i>Phytophthora nicotianae</i>	3	<i>Adenostoma fasciculatum</i> , <i>Eriodictyon crassifolia</i> , <i>Malacothamnus fasciculatus</i> , <i>Quercus john-tuckeri</i> , <i>Salvia mellifera</i>
<i>Phytophthora niederhauserii</i>	3	<i>Quercus agrifolia</i>
<i>Phytophthora parvispora</i>	3	<i>Quercus agrifolia</i>

Management Decisions for Container Stock and Restoration Site Plantings



Outcomes

- Region-wide USFS briefing paper on *Phytophthora* concerns for restoration activities
- New contract specifications and requirements to utilize *Phytophthora* free container stock
- Phytosanitary Best Management Practices
- Increased coordination with nurseries and project proponents
- Stronger reliance on seeding methods and weeding

Future Needs

- Additional nursery and restoration site tests for presence
- Monitoring restoration sites for potential spread and impacts



Key Best Management Practices



Resource: Working Group for Phytophthoras in Native Habitats

Thank you!

