Phytophthora spp: risks they pose to our restoration goals and how to thwart them

Diana Benner

Cal-IPC Nov. 3rd, 2016
Who am I?

- Not a plant pathologist
- Co-owner of restoration nursery in Richmond, Ca.
- Started our business in 2001 because we saw need for more diverse site-specific plant material for restoration projects
- Business grew from basketball court to football field size, worked with many Bay Area organizations on projects
- Generally having a great time

- But then....
Who are they?

- In December of 2013 I heard from a client that the agency they were working for had received material from a restoration nursery infected with a pathogen.
- Phytophthora species, related to the one that caused Sudden Oak Death, only documented once before in California, and on APHIS list of top 5 rated Phytophthora spp to keep out of U.S.
- ***Phytophthora*** (from Greek φυτόν (phytón), “plant” and φθορά (phθorá), “destruction”; “the plant-destroyer”) is a **genus** of plant-damaging ***Oomycetes*** (water molds), whose member species are capable of causing enormous economic losses on crops worldwide, as well as environmental damage in natural ecosystems. The genus was first described by Heinrich Anton de Bary in 1875.
Why do I care?

- Chestnut blight (actually a fungus), 1\textsuperscript{st} half of 20\textsuperscript{th} century killed 4 billion trees
- Late/Potato blight (\textit{P. infestans}), in Ireland between 1845-1857 \textit{P. infestans} related to over one million people starving to death and 2 million others to emigrate
- \textit{P. ramorum} in California, since 1990's has
  - Has killed millions of tanoak trees and several Species of oaks
- Basically doing the business to try to do good
- Met with California Native Nursery Network (CNNN), organized Symposium in Dec. 2014, participant in the organizing member of the Working Group for Phytophthora in Native Habitats, current organizer and participant in the nursery and restoration subcommittees, current organizing member of the CNNN
What do we know? Life Cycle

- Oospores: sexual reproductive spores enable long-term survival in plant tissue or soil
- Chlamydospores: another type of thick-walled, long-term survival spore, but produced asexually
- Both spore types can produce sporangia in presence of water
- Sporangia release short-lived, one-celled, flagellated zoospores that can swim
- When zoospore arrive at suitable infection site they develop a cell wall and become a cyst (a short-lived resting structure)
- Cysts germinate to form microscopic, filamentous hyphae which infect and grow within the plant cells.
- Once plant infected Phytophthora sp. Produces more spores, sporangia and repeats.

Forest Phytophthoras of the World.org
What do we know, cont

- How many are there? ~Over 100 described species. Number increasing as technology to detect improves
  - Some historically described as one species now being identified as several separate species. Puts our understanding of ecology back to close to zero
  - Being found in plant species and habitats previously thought to be not at risk from this type of organism
- How dangerous are they?
  - *P. cactorum* almost causing lone manzanita to go extinct
  - “Phytophthora species are among the most destructive pathogens of agricultural crops and forest in the world” Forest Phytophthoras of the World
- Can we predict impact (ie. Invasiveness)?
  - Method of dispersal- plants, soil, water
  - Habitat of infection
  - Effect of species? Who and when? => Precautionary Principle
So what can we do?

- Some countries ahead of us

Foot bath along popular footpath through Moor House Nation Nature Reserve in North East England.
California Oak Mortality Task Force- Sudden Oak Death P. ramorum-research, outreach, education, partial closures, highly regulated in horticultural trade (inspections, quarantines).

The Working Group for Phytophthoras in Native Habitats group of pathologists, regulators, agencies, nurseries, restoration contractors, environmental consultants working together to develop strategies to address the issue

Developed website with background, education, resources, updates (Calphytos.org)

Released Best Management Practices (BMPS) for nursery growers

Developing BMPS for restoration contractors

Meeting with regulators to discuss permitting requirements and performance criteria

Many nurseries, restoration contractors, land managers, agencies have already made huge changes to their infrastructures, practices, policies
How hard is it?

- Initial expense for retrofitting infrastructure, purchasing equipment, associated labor
- Our nursery currently close to additional full time position for heat-treating soil, maintenance of sanitizing chemicals across site, and routine testing
- Most difficult aspect retraining habits
  - Kitchen conduct
Restoration Contractors:

Agency/regulatory folks
What to require
How meet goals
FIGURE 1. FLOWCHART FOR DETERMINING VULNERABILITY TO DAMAGE BY PHYTOPHTHORA CINNAMOMI, DELINEATION OF ‘PROTECTABLE AREAS’ AND THEIR PRIORITY FOR MANAGEMENT

DRAFT ONLY

1. An unirrigated area, located so as to be amenable to protection from infestation through control of human access and hygienic entry and is of a size and shape that will not be completely overrun in a timeframe of 1-3 decades. May include unirrigatable areas.

2. Other areas may retain high conservation, cultural or landscape values that require management action.

VULNERABILITY TO PHYTOPHTHORA CINNAMOMI

- If the area is unirrigated by any human source or methodologies?
  - Yes
  - If the area is already protected from Phytophthora Cinnamomii?
    - Yes
      - No further action
    - No
      - No further action
  - No
    - No further action

PROTECTABLE AREAS

- If the area is vulnerable to Phytophthora Cinnamomii?
  - Yes
    - No further action
  - No
    - No further action

PRIORITY FOR MANAGEMENT ACTION

- If the area is already protected by other means?
  - Yes
    - No further action
  - No
    - No further action

- If the area is high priority for management?
  - Yes
    - Implement Preventative Action
  - No
    - No further action
So why do it?

- Difficult at first, easier with time
- Real impacts of efforts being documented
- Consequences of not doing it potentially disastrous and completely contrary to all our goals

Bottom line- Cal-IPC folks some of the best in regards to experience and knowledge to comprehend the risks and challenges of this situation and as individuals and an industry we have, through implementing phytosanitary BMPs, the opportunity to do what we do better than we ever have before.
Thank you! Questions?

California Department of Food and Agriculture

UC Davis

California Native Nursery Network

UC Berkeley

UCCE

UC Berkeley

Working Group for Phytophthoras in Native Habitats