Improving Disease Diagnostics and Management Strategies of Recurrent Pathogens in California Greenhouses and Nurseries

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California Nursery Conference

Watsonville, CA

October 15, 2024

Outline

- How to scout for diseases in a nursery
- Update on improvement of diagnostics tools for Phytophthora detection

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- Update on improvement of diagnostics tools for Phytophthora detection

Monitor

Patterns

Look for unusual trends

Are there symptoms?

How are they distributed ?

Symptom distribution

Same symptoms observed along the same area (bench)

Photo credit: Derby canyon Native Nursery
https://derbycanyonnatives.com/2021/a-too-hot-summer-in-the-nursery-welcome-the-fall/

Symptom distribution: biotic vs. abiotic

Symptoms caused by biotic factors

- Foliar symptoms can be the consequence of below ground rots

Environmental and cultural conditions

- Host: Crop age, cultivar
- Season → Temperature, RH
- Cultural practices
  - Irrigation
  - Standing water
  - Direct contact with soil
  - Plant spacing

Gathering “clues”

- Symptom distribution
- Symptoms observed
- Host:
  - Crop age
  - Cultivar
- Environment: temp., RH
- Cultural practices

1. Contact area farm advisor
2. Send diseased samples to a diagnostics lab!

Sample information

Plant _____Variety _____ Date planted _____

Sample came from: ❑ Field/Farm ❑Orchard
❑Nursery ❑Greenhouse ❑Vegetable garden
❑Christmas tree farm ❑Other:

Soil characteristics: ❑sandy ❑clay ❑loam
❑organic ❑hard pan ❑soilless media
❑other:

Symptoms: Root: ❑Rot ❑Lesions
Crown/stem/canopy: ❑Rot ❑Lesions ❑Die back ❑Wilt
❑Vascular discoloration ❑Canopy bleaching
Leaves: ❑Speckled/ spots ❑Marginal necrosis ❑Mottle
❑Chlorosis ❑Deformed ❑Mildew
Flowers: ❑Rot ❑Lesions ❑Color break ❑Deformed
Other symptoms _____

Exposure: ❑full sun ❑partial shade shade
❑full shade ❑windy ❑protected

Irrigation type and frequency: _____
_____
Chemicals applied: _____
_____

Date damage first noticed: _____ **Number of years at present site:** _____
% Affected: _____ **Acreage:** _____
Number of plants affected (for potted plants) _____
Distribution of affected plants: ❑single plant ❑grouped ❑scattered ❑edge of field
Previous crops: _____

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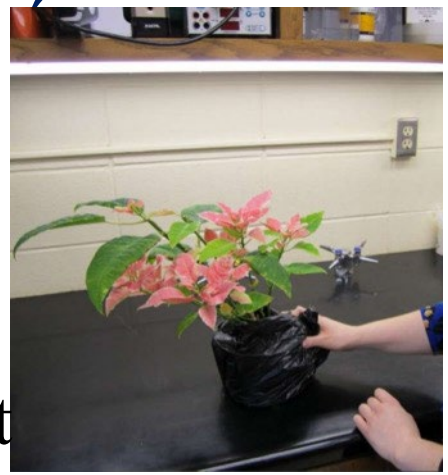
How to submit samples?

- Fresh plant material
  (not entirely dead plants!)



- When possible send the entire plant

- Wrap samples in paper towels
  Do NOT add moisture

- Mail samples in a sturdy container:
  Boxes, not bags

- Include pictures of the disease stages

(images credit: NDSU Plant diagnostic lab)

What is NOT a good diagnostics sample?

- Dead plants

What is NOT a good diagnostics sample?

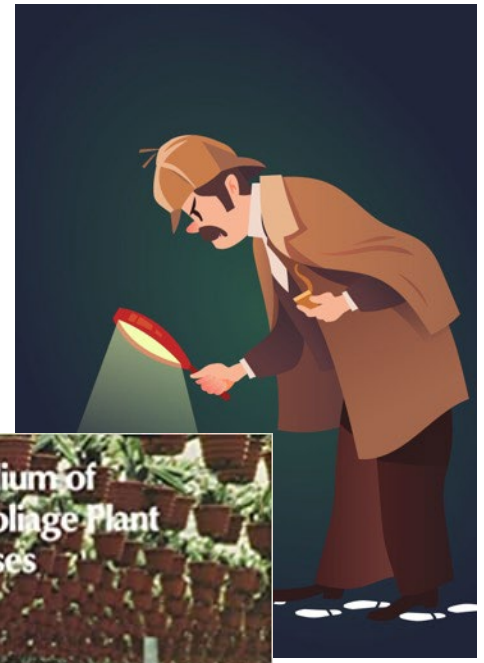
- Parts of the plant instead of the whole plant
- Soil

What is a good diagnostics sample?

- PLANTS CANNOT BE DEAD
- More than one plant (n= 3) plants
  - Foliar symptoms critical
- Capture range of symptoms
  - Minor, moderate, severe

Pathogen diagnostics

- Hypothesis based diagnostics:
  - Gathering clues: symptoms, host, environmental and cultural conditions
  - Disease compendiums, literature
- Tentative diagnostics (Hypothesis)
- Pathogen detection



Case study: Phytophthora detection

- Phytophthora spp. recovered from 20 of 26 surveyed nurseries:
  - P. tentaculata (27%)
  - P. cactorum (22%)
  - P. cryptogea-complex (13%)
- Hosts:
  - Toyon (26%)
  - Coffeeberry (17%)
  - Pacific madrone (8%)
  - California wild rose (8%)

Phytophthora in native habitats working group

An Accreditation Program to Produce Native Plant Nursery Stock Free of *Phytophthora* for Use in Habitat Restoration

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Phytophthora species appear to have wide host ranges, capable of causing disease on plants

- Implement Best Management Practices (BMPs) to produce native plant nursery stock free of Phytophthora for use in habitat restoration
  - Systematic approach to disease prevention that is integrated with nursery production practices

Photo by Janell Hillman, Santa Clara Valley Water District

Preventing hazards in the nursery

1. Propagation source : Clean seed collection or shoot tip cuttings
2. Contaminated ground : Use of raised (75 cm) benches and gravel
3. Contaminated irrigation water: Use of well or city water
4. Used containers : Steam sterilization of containers
5. Contaminated potted media: Steam sterilization of media

Accreditation to Improve Restoration (AIR)

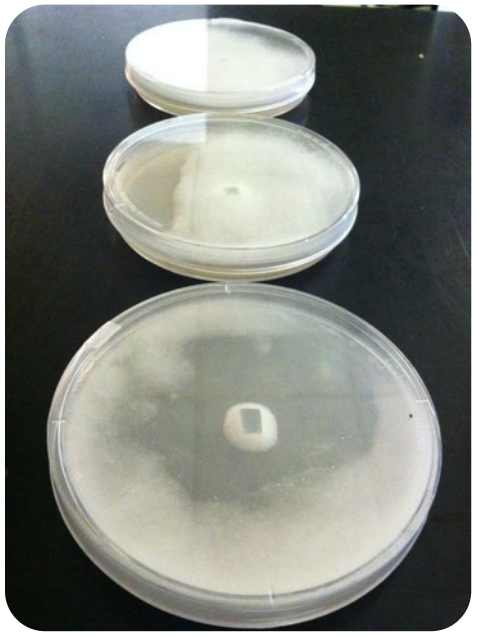
AIR

What is the most effective method for Phytophthora detection?

- Leachate method (sampling water)
- Sample from roots (SM isolation)
- Immunostrips

(Serdani, 2011)

Phytophthora identification



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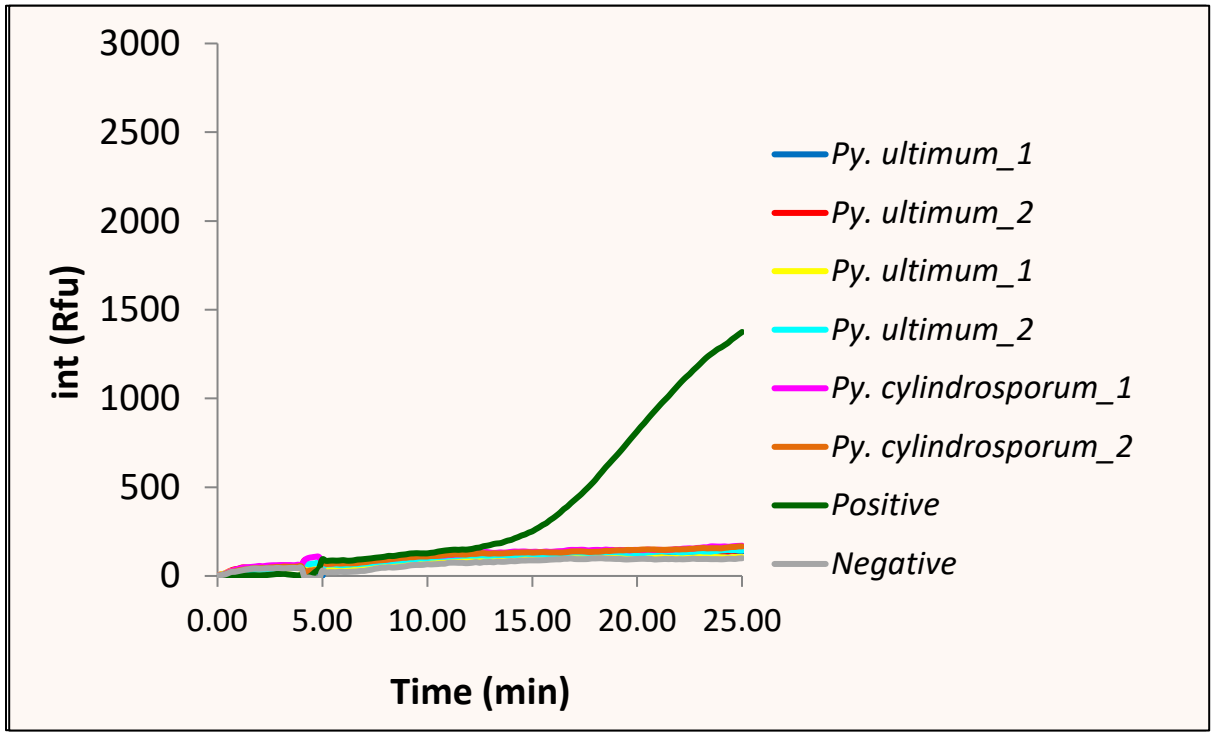
Days for sample processing and final diagnostics

Are there rapid and more robust tools to detect Phytophthora ?

Recombinase Polymerase Amplification (RPA)



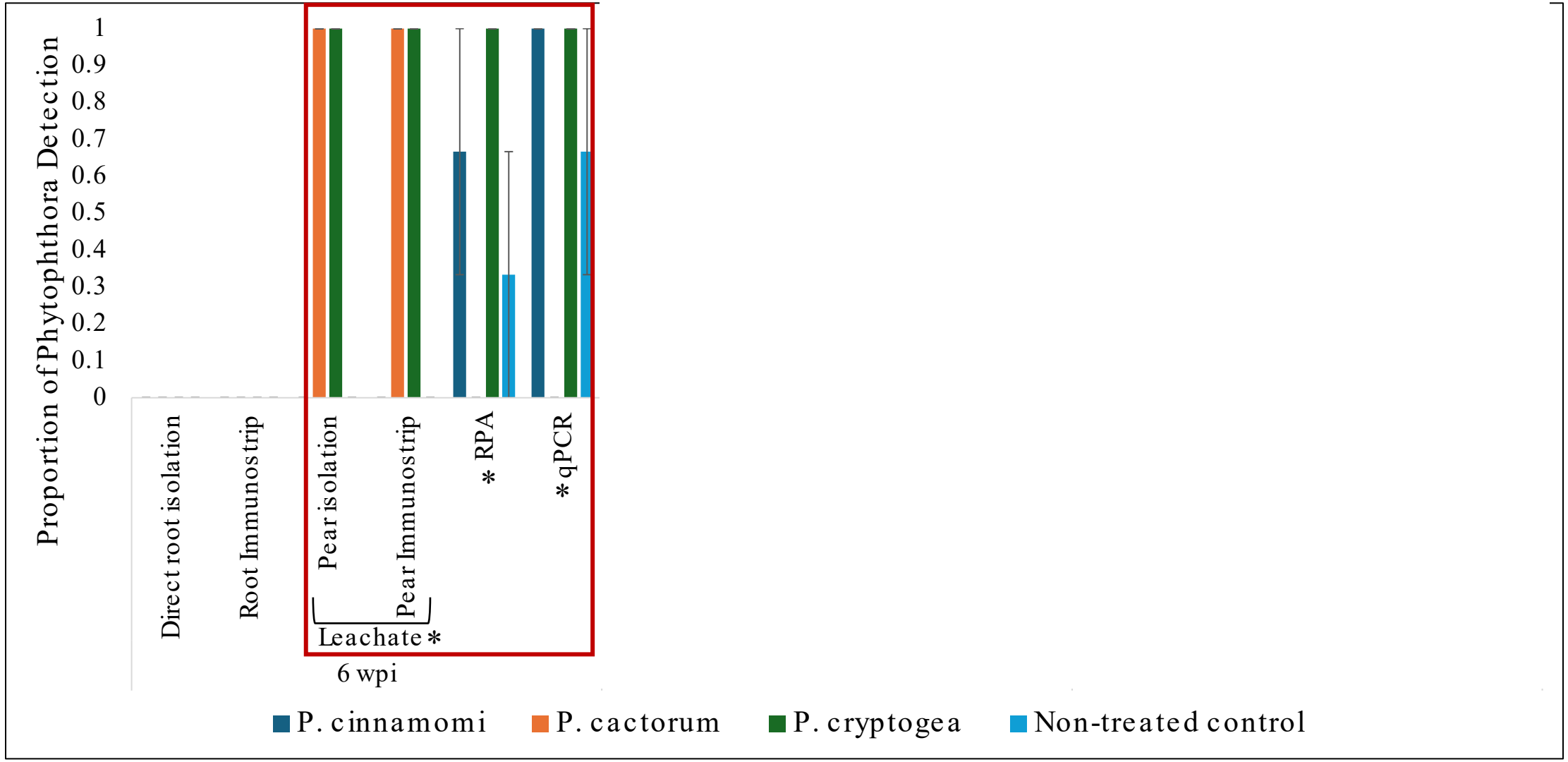
Dr. Frank Martin and Dr. Tim Miles

What is the most effective method for Phytophthora detection?

Randomized complete block design experiment

- 2 Plants
  - Coffeeberry and Toyon
- 4 Pathogen treatments
  - *P. cinnamomi, P. cactorum, P. cryptogea, NTC*
- 3 Sampling time points
  - 6 weeks post inoculation (wpi), 12 wpi. and 18 wpi.

Proportion of Phytophthora detected in inoculated coffeeberry using different detection methods (P <0.0001)



What is the most effective method for Phytophthora detection?

RPA, qPCR, and leachate baiting assay (pear isolations and pear immunostrips) had significantly greater detection rate than direct root isolation and root Immunostrips

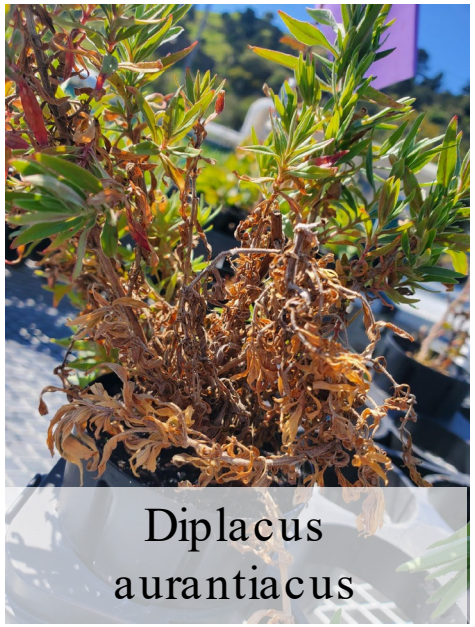
How will the systems work for natural plant infestations?

Symptomatic plants sampled from 3 commercial and 2 native plant nurseries across California

On-site irrigation leachate testing was conducted in native plant nurseries

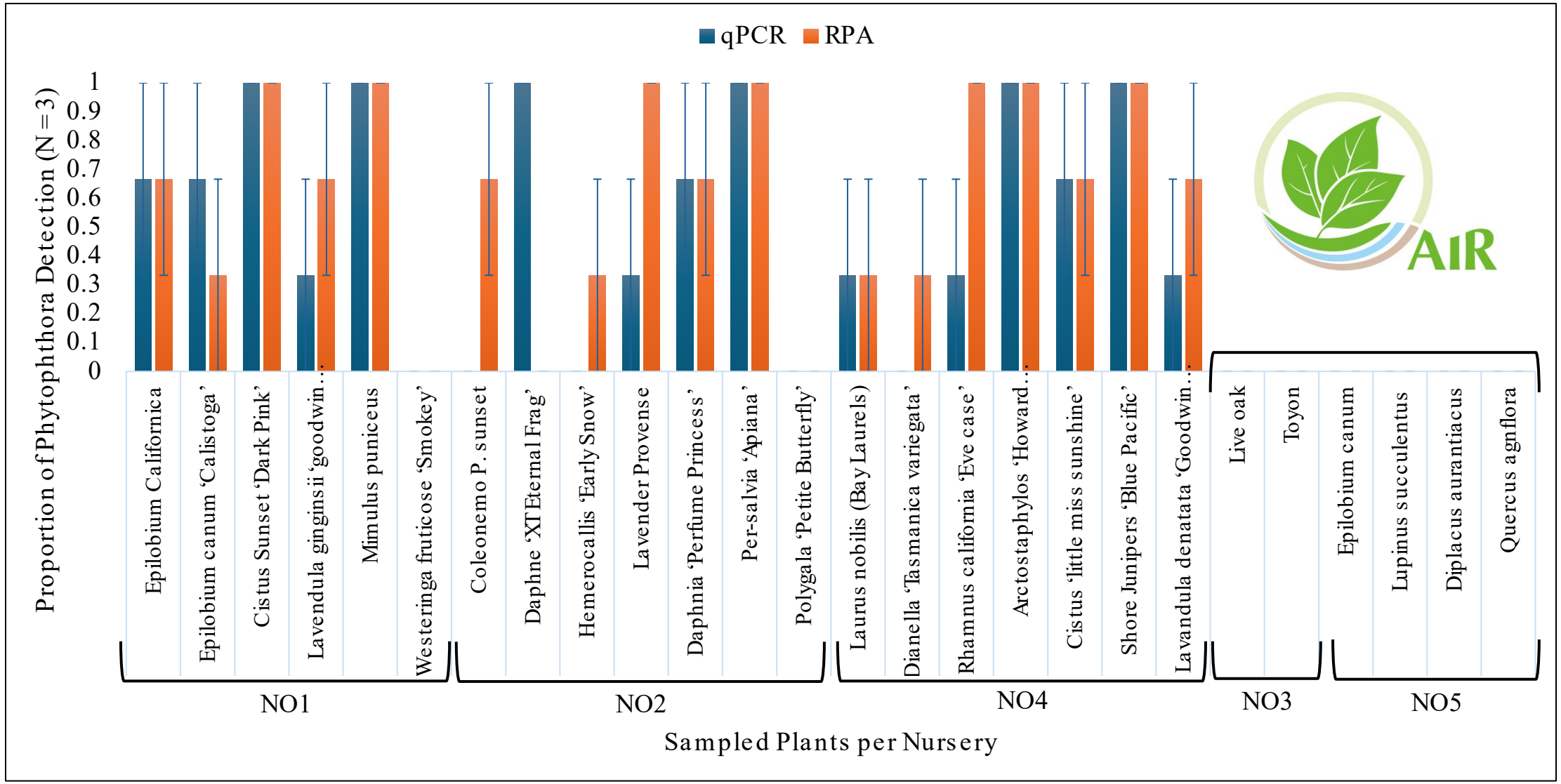
Arctostaphylos ‘Howard Mcminn’

Cistus ‘Little Miss Sunshine’



Diplacus aurantiacus

Proportion of *Phytophthora* detected in naturally infested plants showing crown and root rot symptoms sampled from five different nurseries, using RPA and qPCR assay methods



Conclusions

- RPA, qPCR, and irrigation leachate pear baiting had significantly higher Phytophthora spp. detection irrespective of host, pathogen species, and sampling time

- The RPA assay could be a robust on-site Phytophthora detection tool, and qPCR could be a robust lab-based assay for confirmatory detection of Phytophthora

Strict Best Management Practices along with timely diagnosis can help prevent Phytophthora spread into native ecosystems and landscapes

Acknowledgements

Susan Frankel
Ted Swiecki
Diana Benner
Rizzo Lab
Dr. Dave Rizzo
Dr. Frank Martin
Dr. Tim Miles

Thank you!
Questions ?

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