

Phytophthora Root & Crown Rot on Lavender: A National Problem

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- Undergraduate student lab assistants
 - too many to name



Presentation Outline

- The problem: What we have learned in 7 years
 - PRCR distribution in the US
 - *Phytophthora* species as plant pathogens
 - *Phytophthora* species attacking lavender in the US
 - lavender species affected by PRCR
- Disease management studies
 - chemical fungicides
 - biofungicides
- Solutions for the future
 - early detection of & sampling for *Phytophthora* spp.
 - innovative soil treatments



Distribution of PRCR on Lavender: 2015-2022

- based on samples sent to Clemson University
- 28 states
- multiple locations in some states
- 500+ isolates collected and examined



PRCR on Lavender in the USA: A National Problem

- Primary source of inoculum is coming from nurseries
 - because nursery-grown plants often are contaminated
- **Most** lavender field sites do **not** have native populations of *Phytophthora* species
- Therefore, fields are becoming contaminated by planting dirty plants
- Contaminated fields can affect lavender production for many years
 - depending on geographic location and local environmental conditions

A Case in Point from South Carolina...

Feb 2018



Jan 2020



Phytophthora species as Plant Pathogens

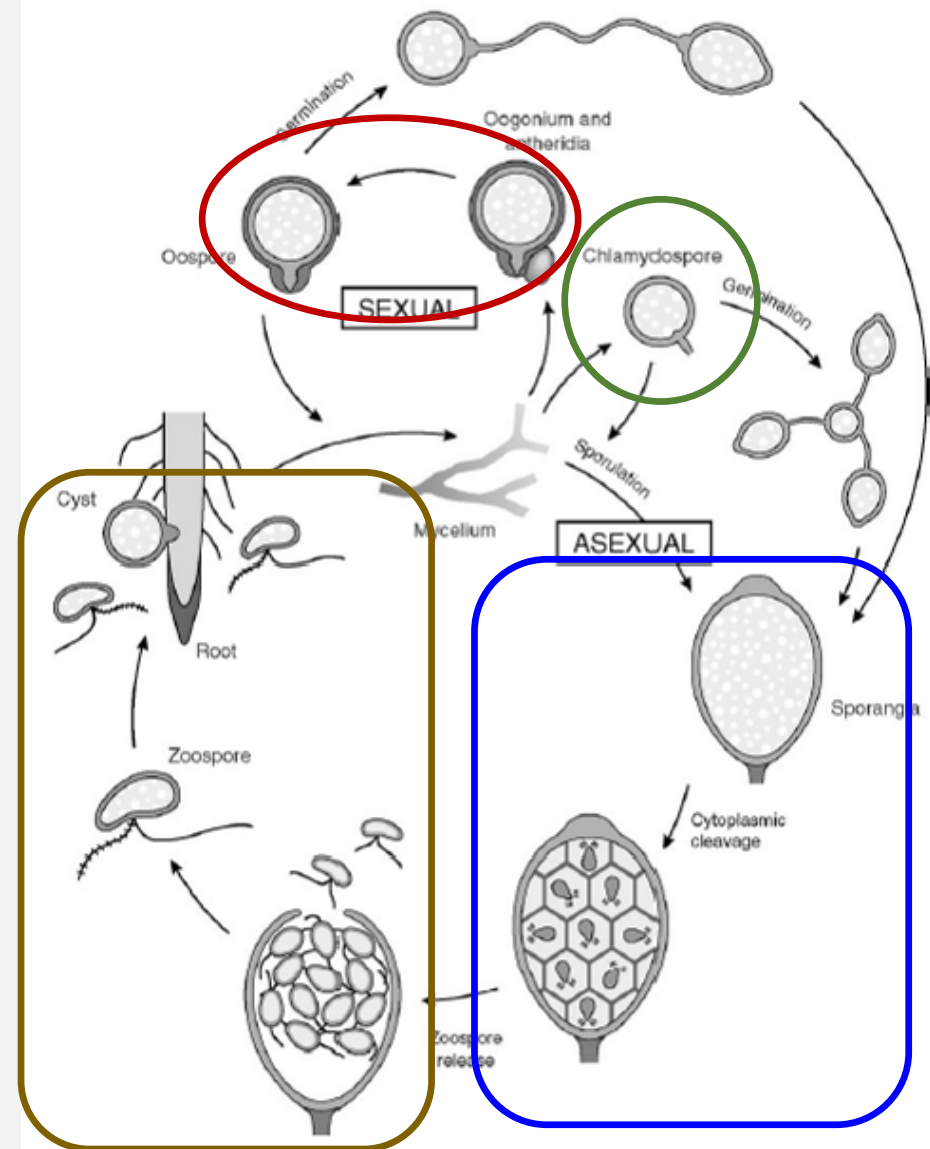
- 200+/- species identified & described
 - new species are described each year
- Attack plants in all agricultural systems
 - fruits, vegetables, field crops, ornamental plants
- Attack plants in forests & natural ecosystems
 - causing diseases in most countries around the world
- Active in most climatic regions of the world
 - tropical, temperate, alpine
 - different species adapted to different climates



Generalized Life Cycle of *Phytophthora*

4 types of propagules

- Oospores – survival, genetic recombination
- Chlamydospores – survival
- Sporangia – dispersal
- Zoospores – infection



Phytophthora species on Lavender in the US

- **10** species have been found associated with PRCR in the US
 - identified by morphology and DNA sequences
 - isolated from roots and baited from root debris and soil
- *P. nicotianae* – most common by far
- *P. palmivora*, *P. citrophthora* – recovered less frequently
- *P. cinnamomi* – only found in SC and naturally occurring
- *P. tropicalis*, *P. cryptogea*, *P. sansomeana* – recovered infrequently
- *P. cactorum*, *P. drechsleri*, *P. megasperma* – recovered very infrequently
- Other isolates still need to be identified...

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- **RED: Prefer warmer climates**
- **BLUE: Prefer cooler climates**

Lavender Species Affected by PRCR

- 4 species of *Lavandula* found with PRCR
- **English lavender** (*L. angustifolia*) – very common and most susceptible
 - including many common cultivars
- **Hybrid lavender** (*L. ×intermedia*) – very common and susceptible
 - including many common cultivars
- Spanish lavender (*L. stoechas*) – uncommon and less susceptible
- Sweet lavender (*L. heterophyllus*) – only one sample but susceptible



Spanish lavender in SC

Pathogenicity and First Reports

Pathogenicity proven for the first time:

- Hybrid lavender
 - *P. nicotianae*
 - *P. palmivora*
 - *P. cinnamomi*
 - *P. tropicalis*
- English lavender
 - *P. cryptogea*
 - *P. drechsleri*
- Sweet lavender
 - *P. nicotianae*

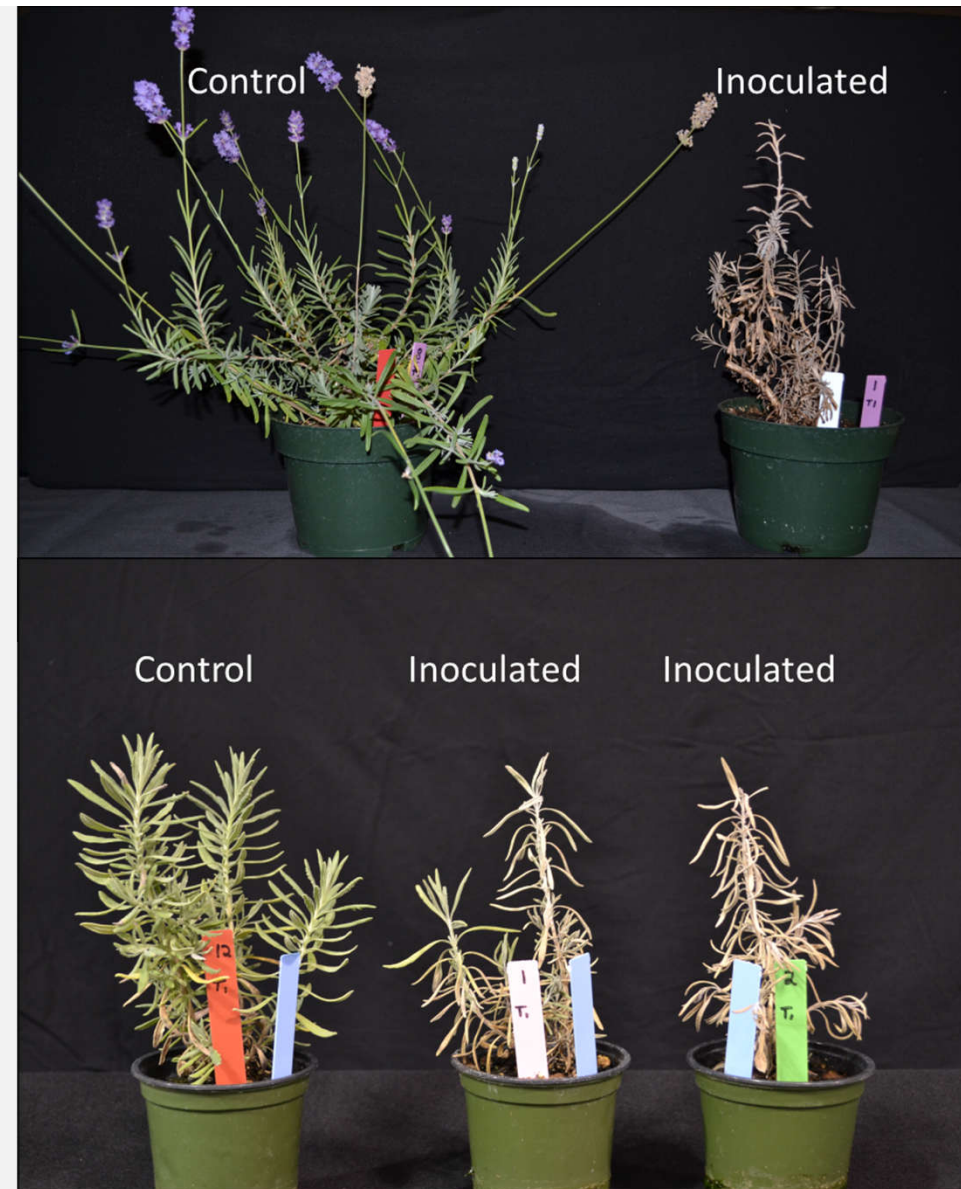
First reports of PRCR in the US:

- *P. palmivora* on *L. angustifolia*
- *P. citrophthora* on *L. angustifolia*



Examples: Pathogenicity Experiments

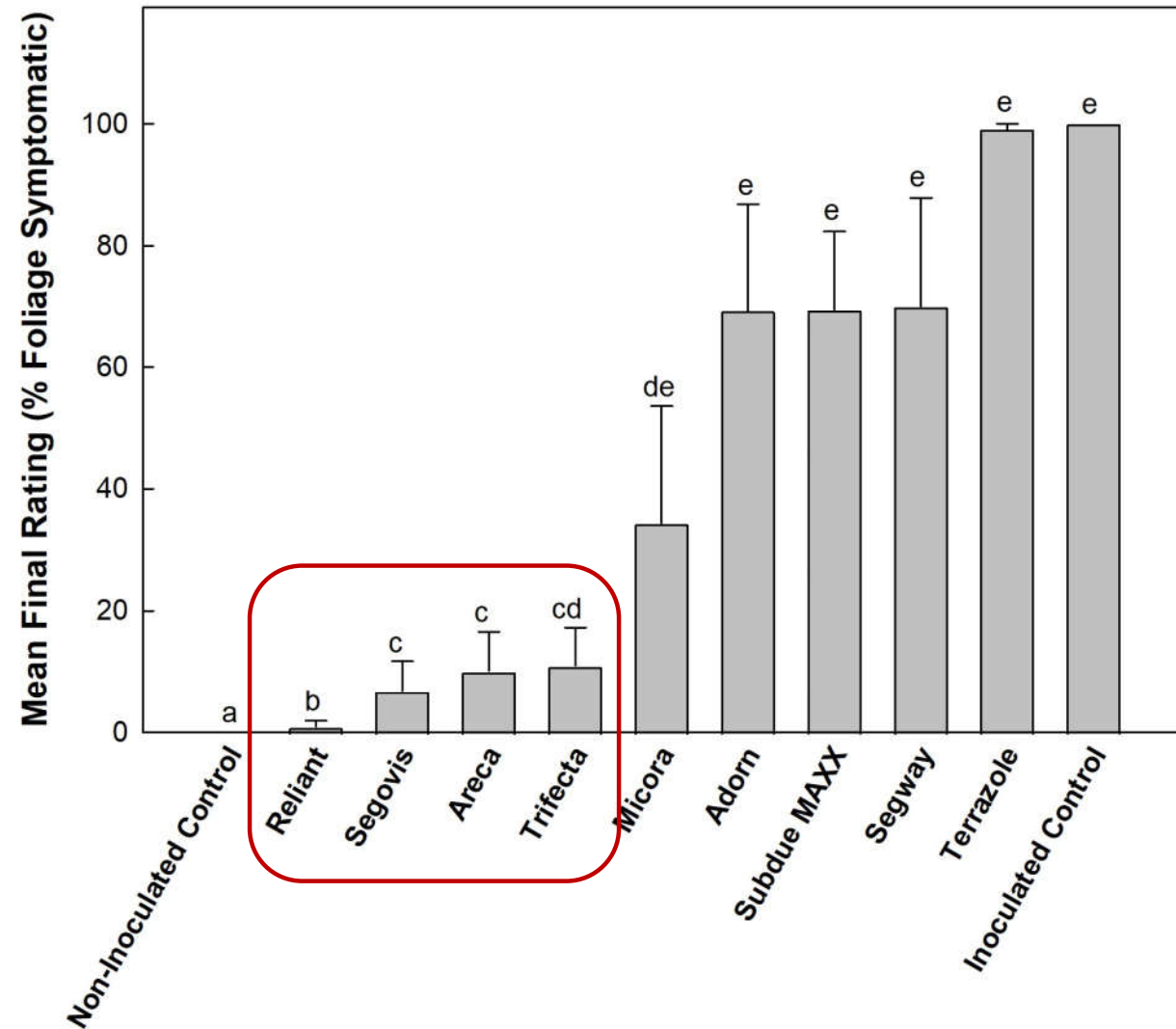
- *P. citrophthora* × *L. angustifolia*
 - first symptoms at 3 weeks
 - first mortality at 9 weeks
- *P. nicotianae* × *L. heterophylla*
 - first symptoms at 3 weeks
 - first mortality at 10 weeks



Disease Management with Fungicides

First experiment

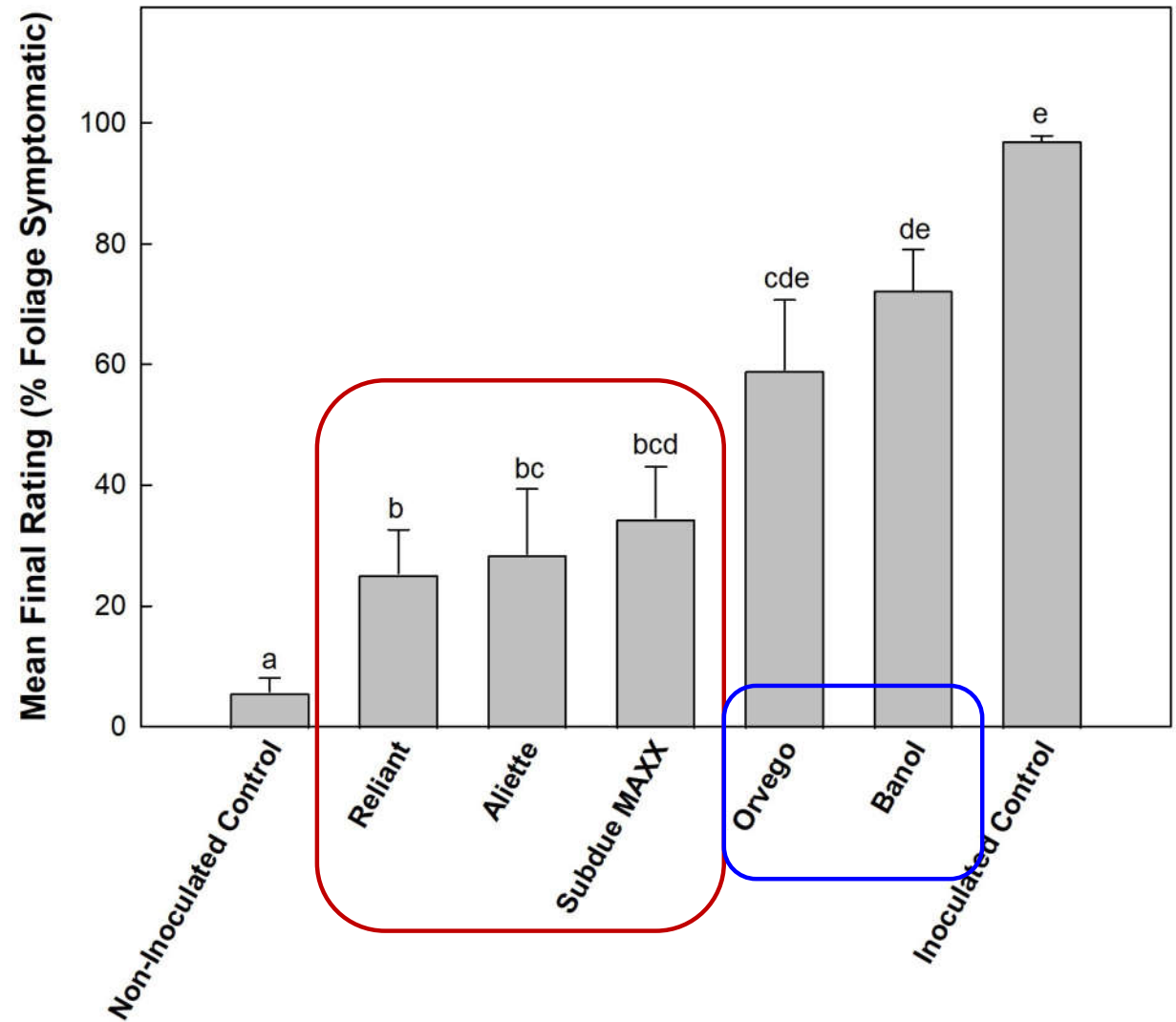
- 9 commercially available products evaluated
- all recommended for *Phytophthora* diseases



Disease Management with Fungicides

Second experiment

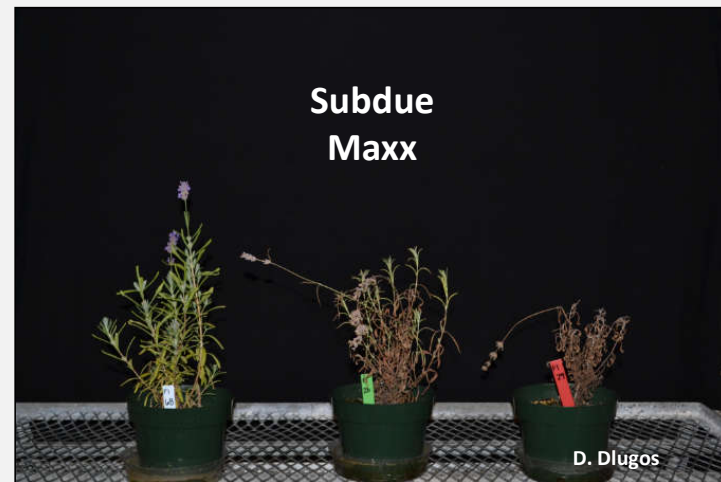
- two additional products evaluated
- compared to standards in first experiment



Ineffective Fungicides



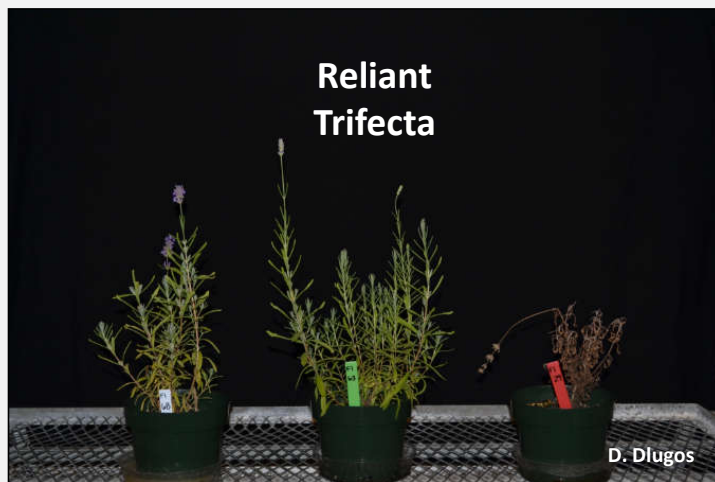
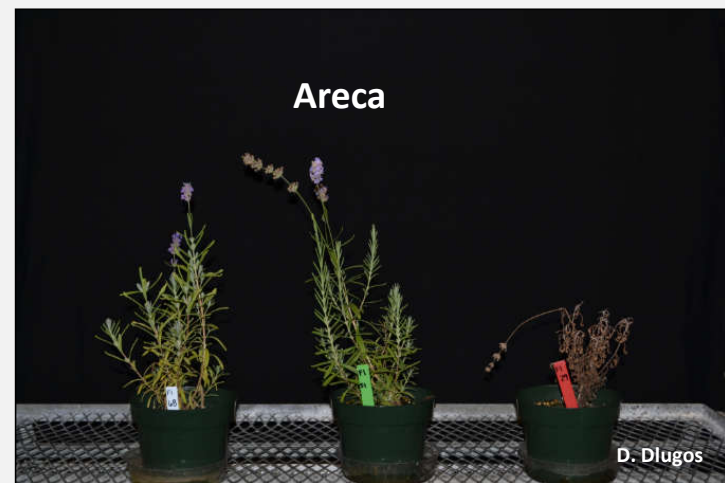
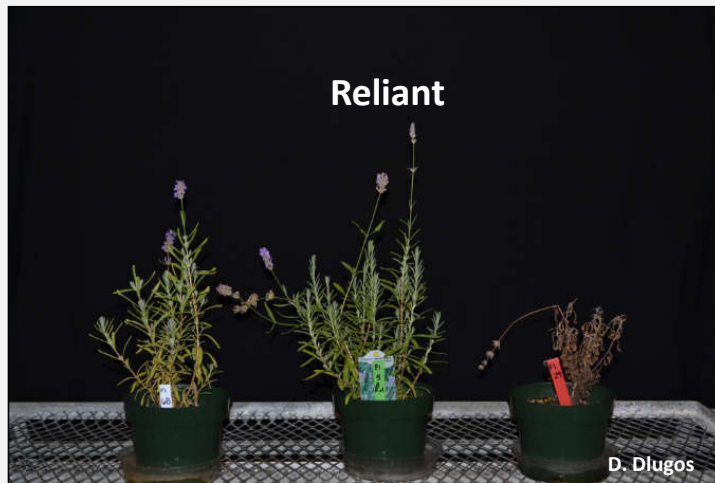
not inoculated inoc/treated inoc/not treated



not inoculated inoc/treated inoc/not treated



Effective Fungicides



Phosphonates provided the best protection and have very good potential for field use

Disease Management with Fungicides: Summary

- Fungicides can be effective at managing PRCR
 - but need to be reapplied in a season-long management program
- *Remember:* Fungicides cannot cure infected plants
- Most effective in our studies:
 - products containing phosphonates – i.e., phosphite, phosphorous acid



- also Segovis – greenhouses, nurseries, shade houses, commercial landscapes
 - cannot use on field-grown plants!

Disease Management with Biofungicides

- 8 biocontrol products evaluated
 - 3 contained fungi
 - 5 contained bacteria
 - *products with new names
- Reliant fungicide for comparison
- Greenhouse experiment with 'Hidcote Blue' plants
- Inoculated with *P. nicotianae*

Product	Microbe Type	Microbe
Prestop*	Fungus	<i>Gliricladium</i> sp.
RootShield Plus	Fungus	<i>Trichoderma</i> spp.
Obtego	Fungus	<i>Trichoderma</i> spp.
Actinovate SP	Bacteria	<i>Streptomyces</i> sp.
Mycostop*	Bacteria	<i>Streptomyces</i> sp.
Triathlon BA	Bacteria	<i>Bacillus</i> sp.
Companion Maxx	Bacteria	<i>Bacillus</i> sp.
Zio	Bacteria	<i>Pseudomonas</i> sp.

Disease Management with Biofungicides: Summary

- All products had some effect on plant survival
 - 25%-87% of plants survived
 - 100% survival with Reliant
- None of the products reduced disease severity
- Not an option for managing PRCR on lavender in the greenhouse
- May be useful as part of an integrated disease management program in the field...
 - need field data



Recommendations for Managing PRCR in the Field

- Evaluate the field site before buying plants
 - get a complete soil test – contact your local Extension office
 - is site suitable for growing lavender?
- Test soil for presence of *Phytophthora* species
 - avoid sites where pathogen is present
- Do your homework:
 - what lavenders should do well in your location?
 - buy plants from a reputable nursery – ask USLGA members
- Have plants tested for *Phytophthora* species BEFORE planting
 - our lab has developed non-destructive sampling procedures for early detection on nursery plants
 - two detection methods that are effective – but have limitations

Why Test Plants?

“One bad apple can spoil the whole bunch...”

26 May 2020



16 Jun 2020



05 Nov 2020



Early Detection of *Phytophthora* species: Leachate Method

- Pour-through leachate collected from individual flats
- Leachate tested for *Phytophthora* spp.
 - using a standard baiting bioassay
- Limitations:
 - requires a site visit by lab personnel
 - not-grower friendly
 - time sensitive



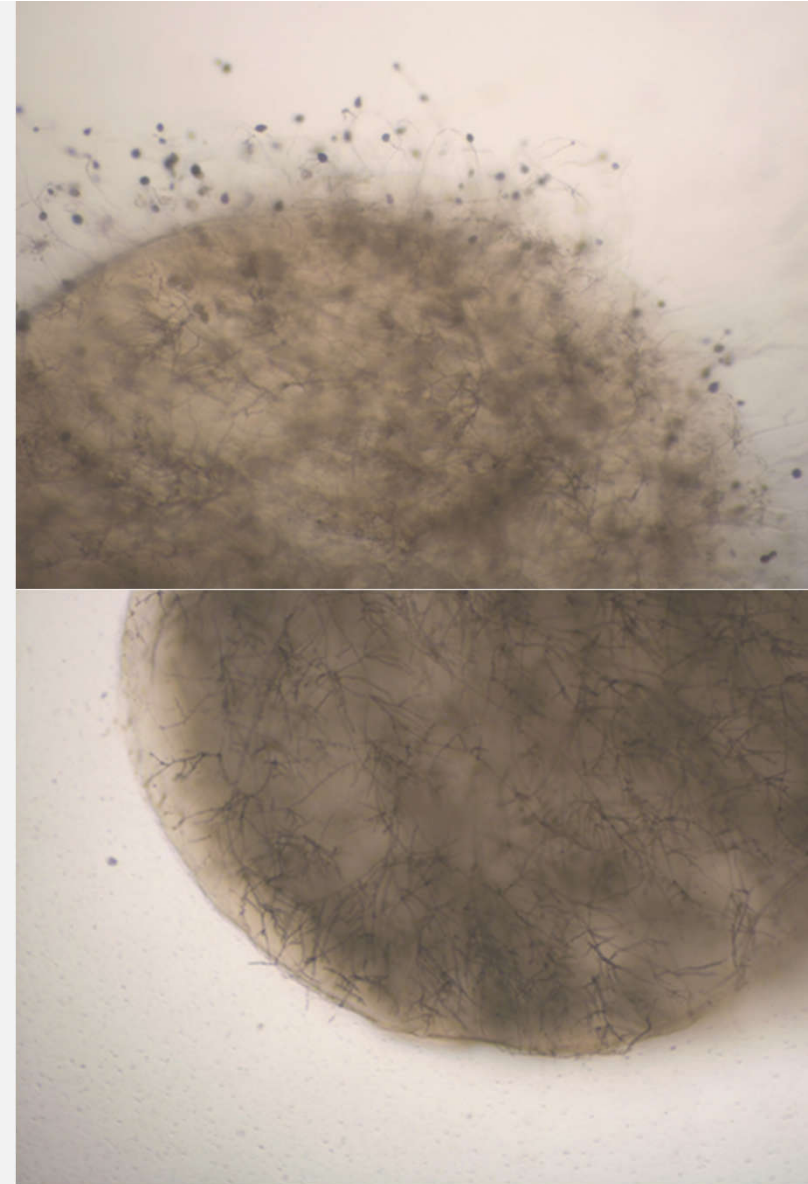
Early Detection of *Phytophthora* species: Root Clipping Method

- Root clippings collected by the grower from each tray of plants
- Use a specified sampling plan to collect a representative composite sample from individual plants
- Root sample baited for *Phytophthora*
 - using a standard baiting bioassay
- Limitations
 - must follow directions
 - requires over-night shipping to our lab



Early Detection Can Be Challenged by Fungicides

- **Fact:** Many fungicides used on nursery plants can prevent early detection
 - even when *Phytophthora* is present
- Fungicide presence can be detected with a sporangium production bioassay
 - using pour-through or root leachate
- Because most fungicides inhibit sporangium production
- **Opinion:** Nurseries should not use fungicides on lavender plants
 - can prevent pathogen detection
 - will not prevent disease development later on



Prospects for Future Research

- Evaluate resistance of English and hybrid lavender cultivars
- Efficacy of fungicides in the field
- Efficacy of biofungicides in the field
- Effects of biocontrol products on lavender growth
 - when *Phytophthora* spp. are not present
 - greenhouse study in progress at Clemson
 - then, a field study will be needed
- Potential for innovative soil treatments to manage *Phytophthora* spp.
 - soil solarization: feasibility study in progress at Clemson
 - anaerobic soil disinfestation (ASD)
- Others? ? ?

Save Questions to the End...

