Root Health and Phytophthora Root Diseases

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TREE PLANTING

Careful planning to protect your investment

- Trees are less able to withstand stresses that were previously minor
  - Frequent dieback from freezes can weaken trees
- Root establishment is very important
  - Sustain trees and to get to production and profit
- Choices about grove and planting design may affect root architecture
  - What we see above ground affects below the ground too
- Irrigation methods and timings also affect root health

Site characteristics

- Soil type and water table
  - Does the grove need bedding or not
  - How is the drainage of the soil?
  - Is there a clay pan or clay soil leading to water-logging of trees?
- pH and salinity characteristics of soil
  - What rootstocks are known to tolerate specific conditions?
- Irrigation water quality
  - Salt concentrations
- Disease and pest history of site
  - Phytophthora, diaprepes, nematodes, huanglongbing (HLB), blight?
  - Which rootstocks have tolerance and under what conditions

Rootstock selection guide

- Need to carefully consider rootstock choice before ordering trees
  - Cold tolerance is key for north Florida and Georgia growing regions
  - Some tolerate adverse conditions better than others
  - Not all rootstocks are suitable for all situations
  - Not all combinations of rootstocks and scions have been tested for incompatibility
- Guide is a place to find information in one location
  - https://ask.ifas.ufl.edu/publication/HS1260

Preventable problems

- Not managing root balls of rootbound trees
  - Trim circling roots
- Don’t let the roots dry out
- Don’t jam trees into planting hole
  - Can lead to J-rooting if lower structural roots are bent upward
- Be careful of salt burn when fertilizing
  - Fertilizer in the planting hole will prevent outward root growth and is likely to cause salt burn of roots.
  - Can be as damaging as Phytophthora
- Phytophthora can stunt young trees
  - Monitor and treat as needed to get the best start

Planting and rootbound trees

- Some growers desire larger trees at planting
  - Only helps if the root system is allowed to get larger
  - Waiting for too large a tree may cause root health problems in a few years
- Need to break up root balls at planting
  - Helps establishment and water penetration even in non-rootbound trees
    - Water does not like to move between soil and organic potting medium
  - Gives you a chance to cull trees with unhealthy root systems
- May need to trim off spiraling roots at bottom of root ball
  - More drastic cutting, up to ½" of root ball may be needed

Rootbound trees develop circular structural roots

Rootbound --> Self girdling structural root ball

Summary

- Planting practices affect the success of trees in the field
  - Roots are often forgotten because not easily observed
- Healthy nursery trees are the foundation of a good planting
  - Make sure planters are inspecting the roots before planting
  - Eliminate poor quality root systems or take remedial actions
- Make sure planting holes are adequately sized for root systems
  - Break up the root balls for better soil to potting media contact
  - Encourage the roots to leave the root ball
  - Avoid fertilizer burn! It can permanently damage a tree

PHYTOPHTHORA AND NEW PLANTINGS

Effect of Phytophthora 2 years after planting

Photos courtesy of Jim Graham

- Greatly reduces tree vigor
- Chemical management can provide some improvement
- Best to start with clean trees

Check root health before planting

Root damage up close

- Sparse roots
- Dark unhealthy color
  - Should be creamy white to tan
- Sloughing-off of outer cortex
  - Roots will disintegrate upon slight tug
  - Leave inner vascular tissue known as the steele
- Hopefully never observed

Phytophthora prevention at planting

- Avoid highly susceptible rootstocks in sites with phytophthora history
  - Scions are highly susceptible
  - Plant graft union 6-9 inches above soil
- Adequate drainage and proper irrigation are essential
- Keep area around trunk clear of weeds and avoid wounding
- Remove trunk wraps early in spring and treat for fire ants
  - Fire ants feed on and damage bark leaving wounds for phytophthora

Fungicide use in young trees

- Warranted only if cultural practices fail
- Treatment decision based on:
  - Rootstock susceptibility
  - Likelihood of nursery infection
    - What did you see when you looked at the roots?
  - Site history, e.g. Diaprepes, root rot
  - May want to request nursery treatment with Revus (labelled for nursery use)
- See Florida Citrus Production Guide for treatment options

Summary

- Phytophthora infection in newly planted trees can lead to severe stunting
  - Trees never thrive or produce adequate fruit
- Trees exhibiting phytophthora damage should not be planted
- Cultural practices are the first line of defense against disease
- Fungicides should only be used when all other measures have failed

PHYTOPHTHORA DISEASES

Phytophthora diseases

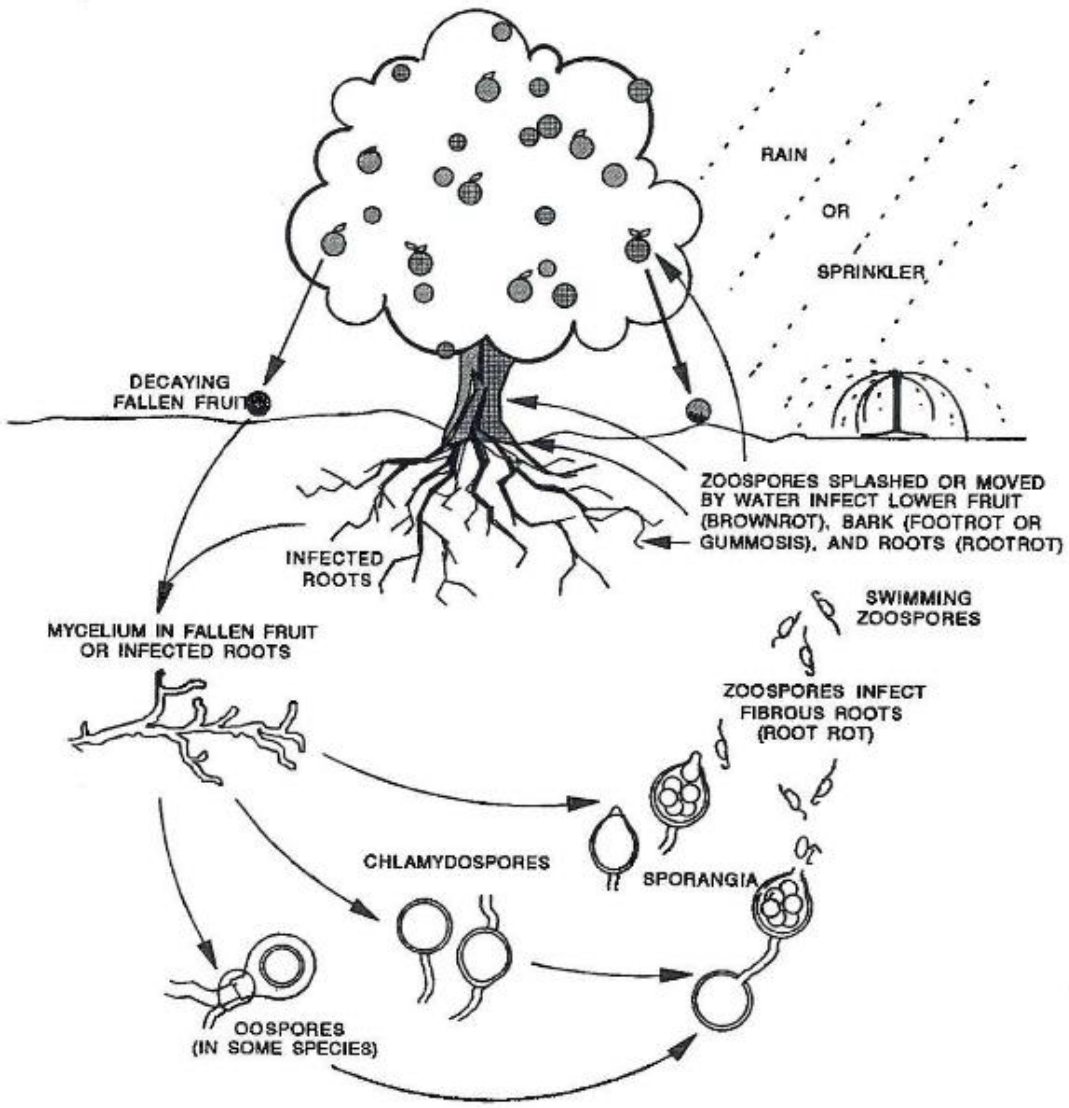
- Soilborne disease that can travel into canopy

- Causal agents of
  - Root Rot
  - Foot Rot
  - Brown rot of fruit

- Yield reduction estimate in mature trees
  = 3-6% per year

All diseases connected

- Susceptibility of roots
  - Highest during very wet to very dry cycles
- Wetting and drying increases root exudation
  - Attracts zoospores
- HLB infected roots also give out more exudates that promote infection

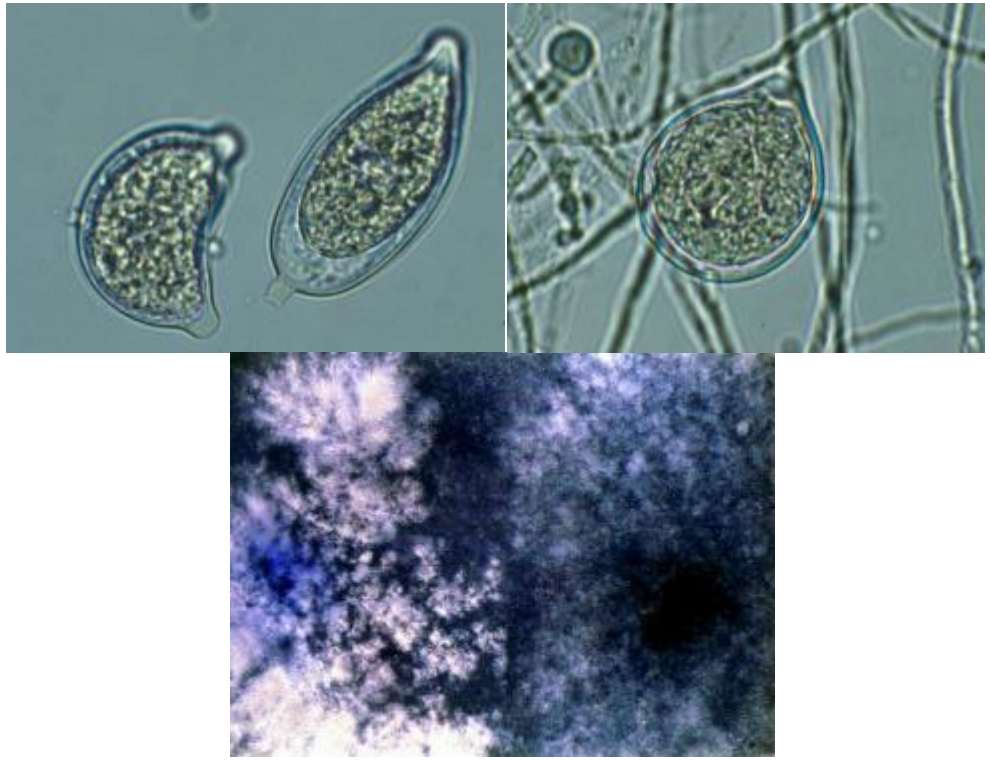


Phytophthora in Florida citrus

- *Phytophthora nicotianae (parasitica)*
  - common cause of foot rot and root rot statewide
  - Minor brown rot problem
- *Phytophthora palmivora*
  - Prefers poorly drained soils with high water tables (Indian River)
  - Sporadic outbreaks
  - Major brown rot concern

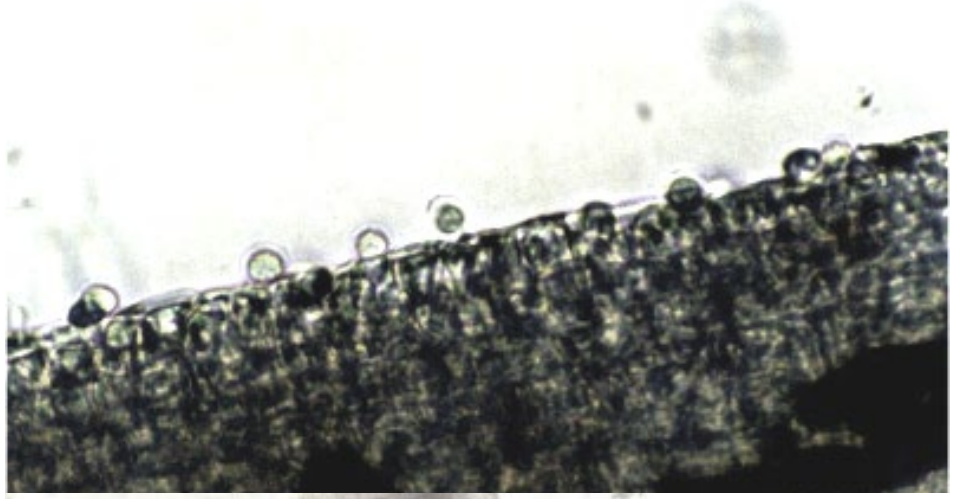
P. palmivora
Sporangia elongated

P. nicotianae
Sporangia round



Phytophthora infection cycle under favorable conditions

- Zoospores are released from sporangia
  - Swim or splash to the root, bark, or fruit
- Spores encyst, germinate, and infect tissues within 24 hours



Phytophthora nicotianae is common

- Can be found in many grove soils at low levels
  - Lower than causes measurable disease
  - Can occur in ridge soils, flatwood soils, and north Florida soils
- Overwatering and wetting of trunks can promote disease

P. palmivora still causes root rot

- More restrictive environmental preferences
- Rootstock sensitivity is different than *P. nicotianae*
- Sporulates more rapidly
- Inoculum can move further

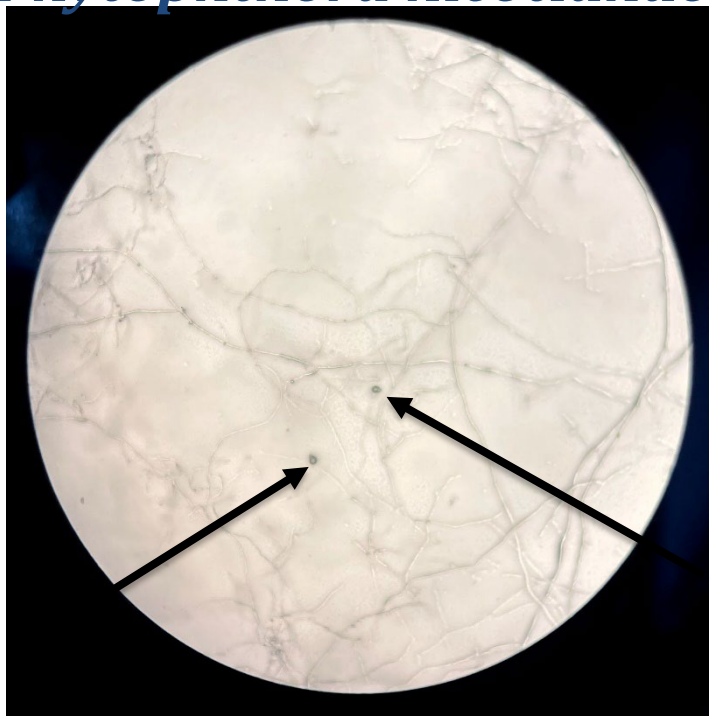
Rootstock susceptibility to root rot depends on *Phytophthora* spp.

	P. nicotianae	*P. palmivora*
Sweet orange	Susceptible	?
Cleopatra	Susceptible	Tolerant
Rough lemon	Susceptible	?
Sour orange	Susceptible	Tolerant
Volkamer lemon	Tolerant	Tolerant
Carrizo citrange	Tolerant	Susceptible
Swingle	Moderately Resistant	Susceptible
Trifoliate orange	Resistant	Susceptible
Rubidoux	Resistant	?

Phytophthora palmivora sporulates earlier

From 1 spore (propagule) after 3 days

Phytophthora nicotianae



100x magnification

Phytophthora palmivora

100x magnification

GROUNDWORK LABORATORY

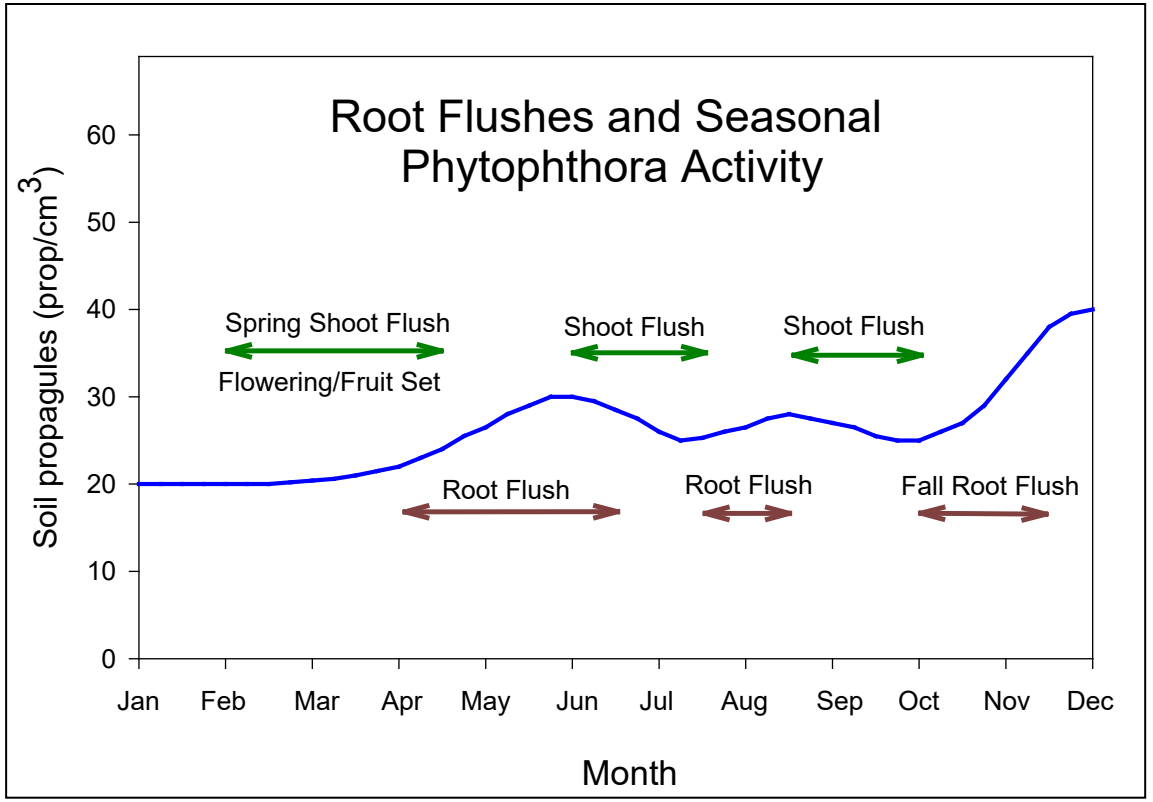
Images courtesy of Groundwork Laboratory

Phytophthora management

- *P. palmivora* can quickly get out of control if unmanaged
- Need to know the species in your groves
  - Susceptibility of rootstock
  - May not be the same in all regions or grove blocks
- Do not assume you require treatment
  - Need to sample for phytophthora to find out how much inoculum present
  - 10 to 20 propagules/cm^3 soil of either species actionable level
  - Needs to be warm enough for root growth to get accurate sample
  - Sampling procedures in Florida Citrus Production Guide

Managing root rot

- Fungicides
  - Phosphites/Fosetyl-Al – induces defenses, limited direct action
  - Mefanoxam – requires root uptake for efficacy
  - Oxathiapiprolin (Orondis)
  - Fluopicolide (Presidio)
  - Mandipropamid (Revus: nurseries ONLY)
- Rotate phosphites with more effective products



Summary

- Phytophthora diseases are interrelated and caused by the same organisms on different plant parts
- Rootstocks are not equally susceptible to the two phytophthora organisms
- It is uncertain whether *P. palmivora* is an issue in the colder soil of the northern growing region
- Measure your inoculum pressure before deciding to treat
- Apply fungicides targeting spring and fall root flushes
  - Sustain fibrous roots through the summer

Acknowledgments

- Former Johnson lab members
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GROUNDWORK LABORATORY

Any Questions?

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