



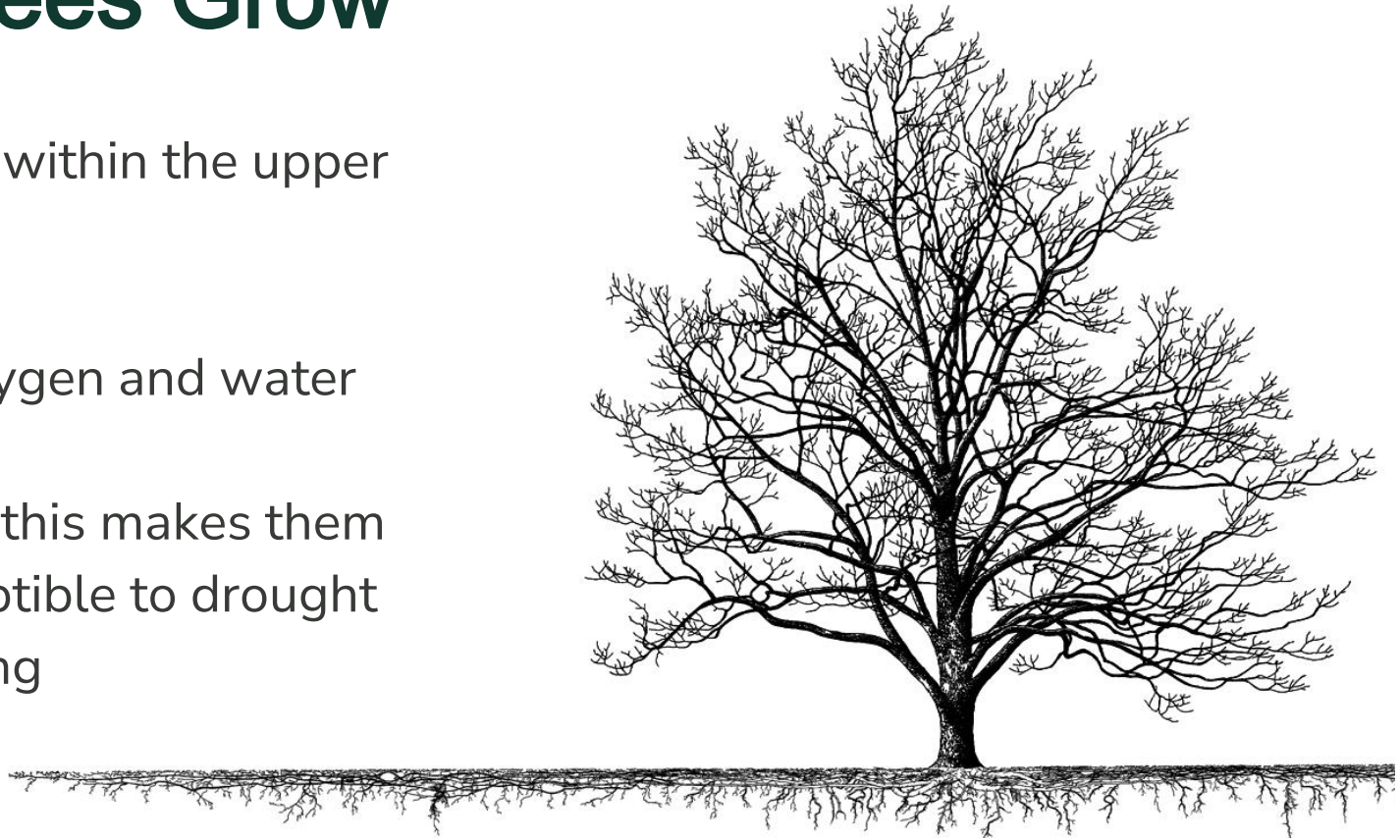
THE  
CHAMPION  
*of* TREES

# Root Rots in Landscape and Nursery Plants

Stephanie Adams, Ph.D., BCMA, Tree Pathologist, Plant Health Care Leader

# How Trees Grow

- Roots grow within the upper 16" of soil
- Need for oxygen and water
- In clay soils this makes them more susceptible to drought and drowning





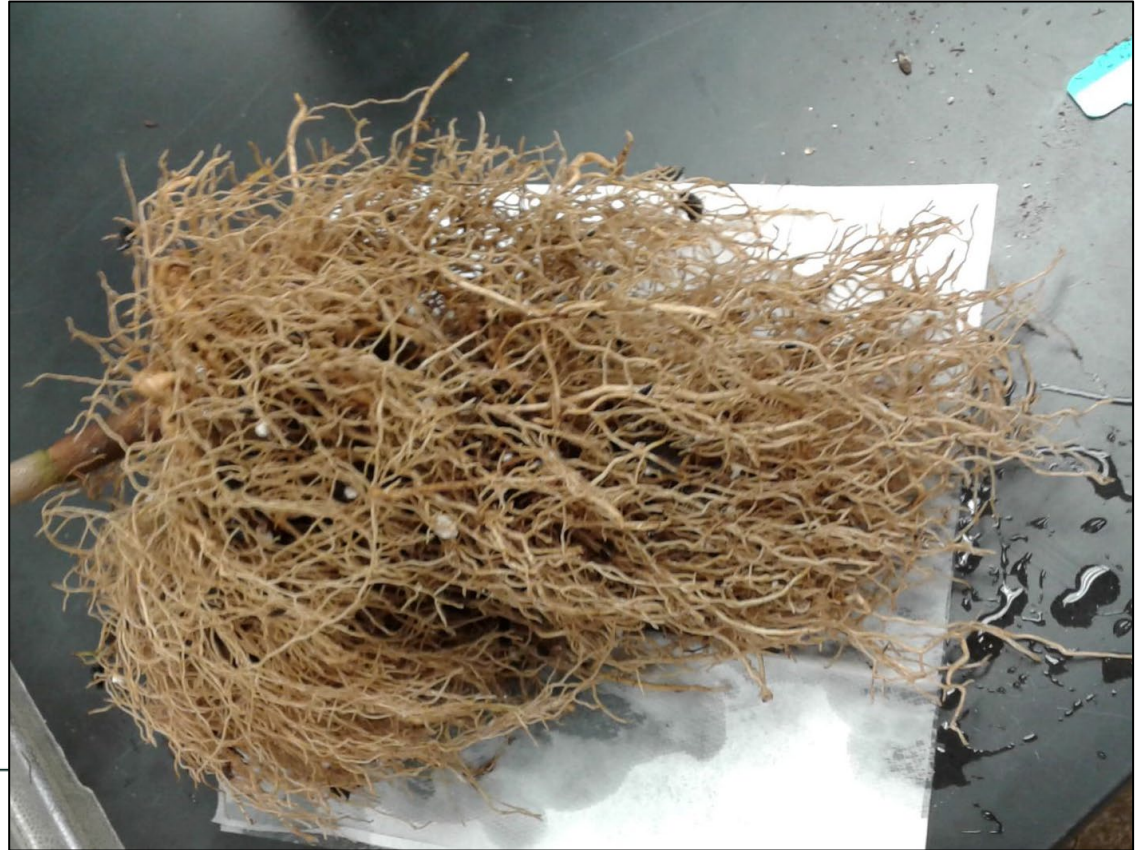


Mulch piled up against a tree trunk is unhealthy for the tree. COURTESY OF XANDERBUILT TREE CARE AND URBAN TREE ARBORICULTURE



# Healthy Root System

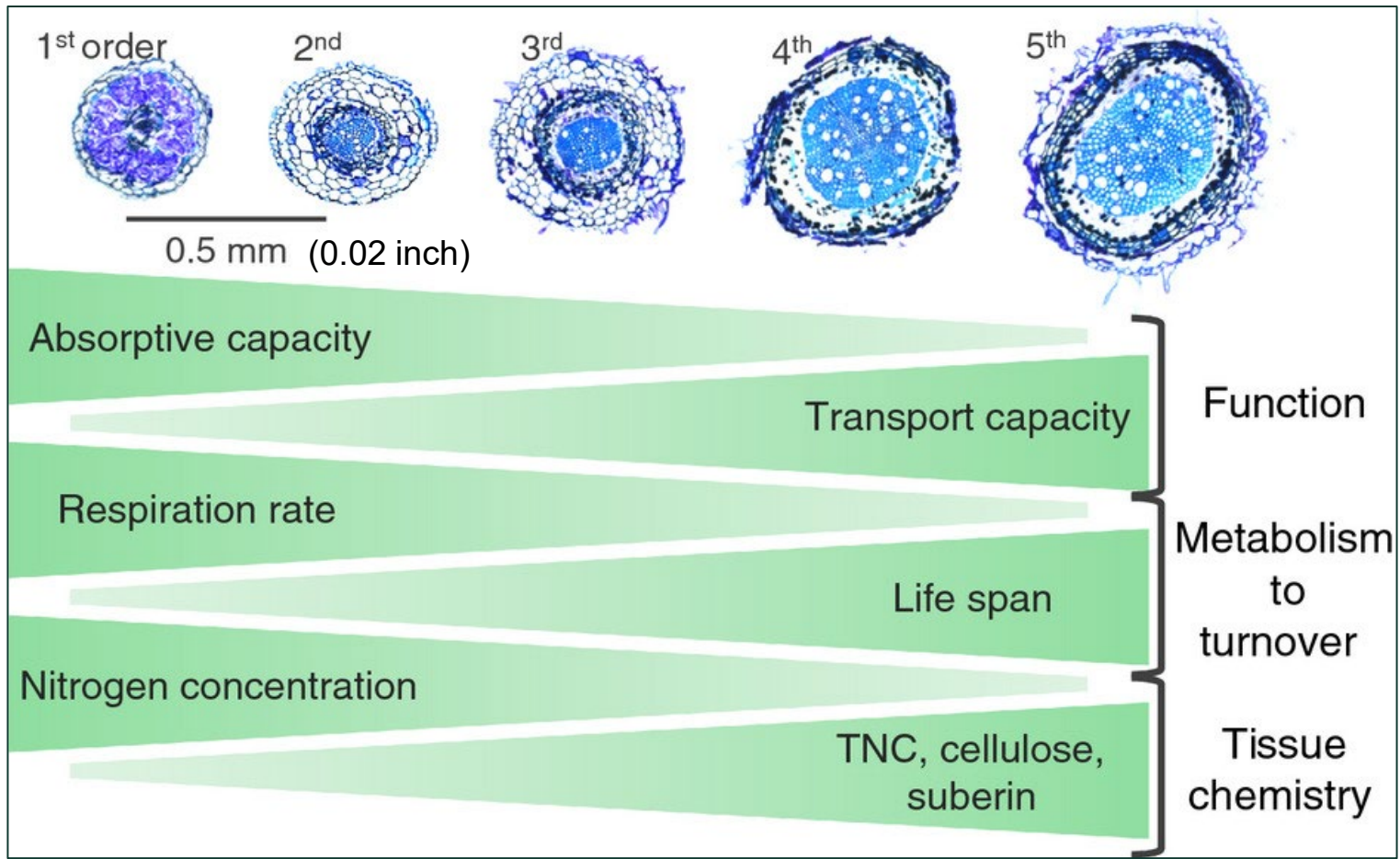
- Roots are creamy white
- Roots are firm
- Even fine root growth across the ball
- Roots are round





# Fine Root Biology and Function

- Arise from perennial woody roots
- Responsible for water and nutrient uptake
- Mycorrhizal associations
- High nitrogen concentrations
  - “Expensive to maintain”
- On mature trees, fine roots are rarely  $> 0.5$  mm in diameter



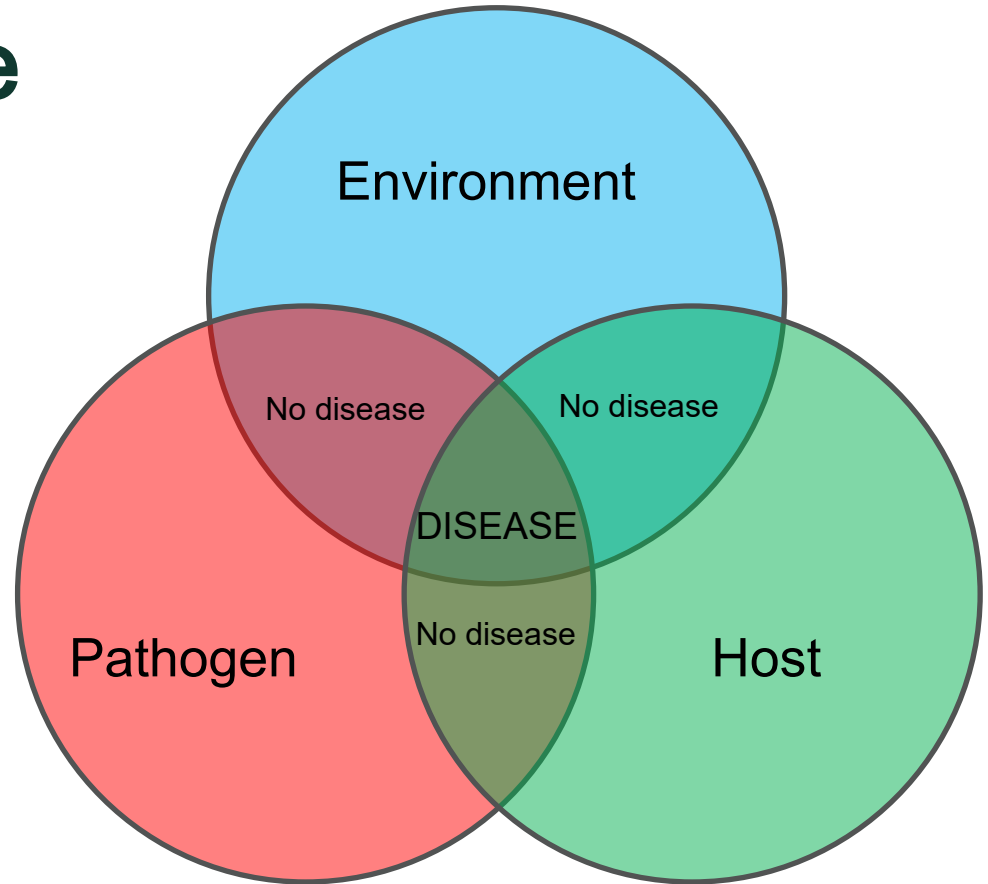
McCormack, M.L., Dickie, I.A., Eissenstat, D.M., Fahey, T.J., Fernandez, C.W., Guo, D., Helmisaari, H.S., Hobbie, E.A., Iversen, C.M., Jackson, R.B. and Leppälammı-Kujansuu, J., 2015. Redefining fine roots improves understanding of below-ground contributions to terrestrial biosphere processes. *New Phytologist*, 207(3), pp.505-518.



# Disease Triangle

If a Host and Pathogen are in the same area and the environment favors the Host > Pathogen, there won't be disease

If the Environment favors the Pathogen > Host, there will be disease



# How to Read Tree Body Language

- Color – Leaves, roots, branches, new growth, fruit
- Form – branching habits, cladoptosis (self pruning, branch shedding)
- Leaf patterns – density of leaves, where the leaves are growing







1

3

2



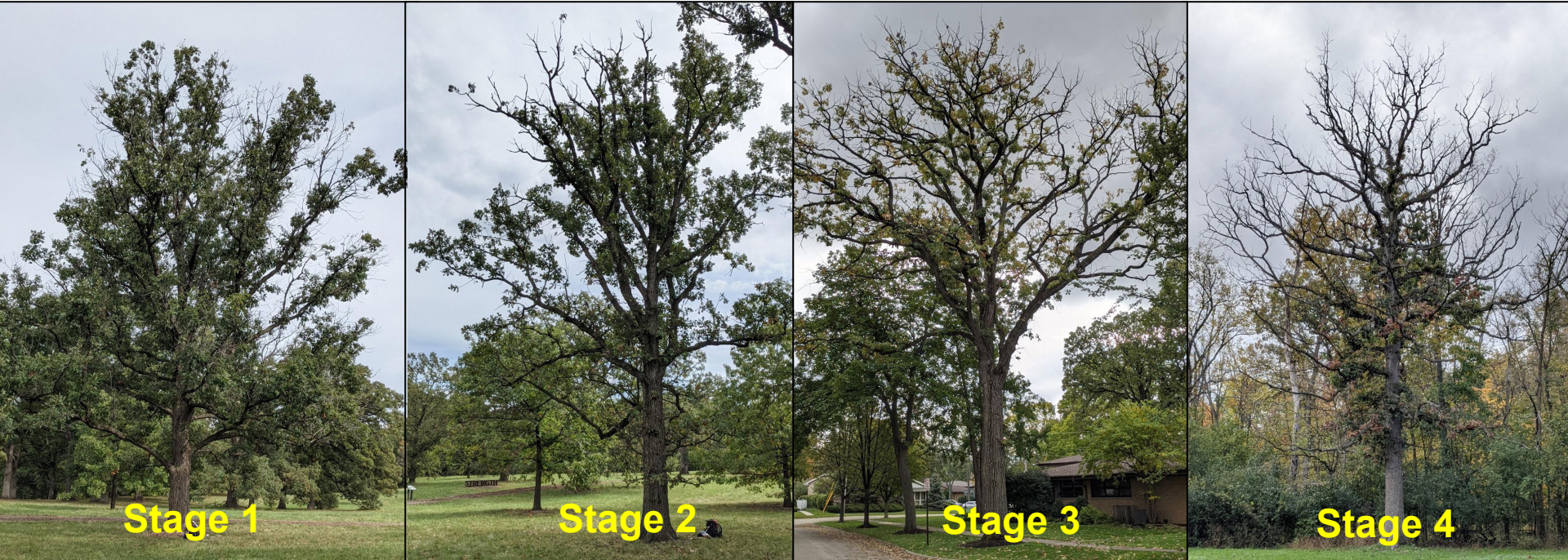


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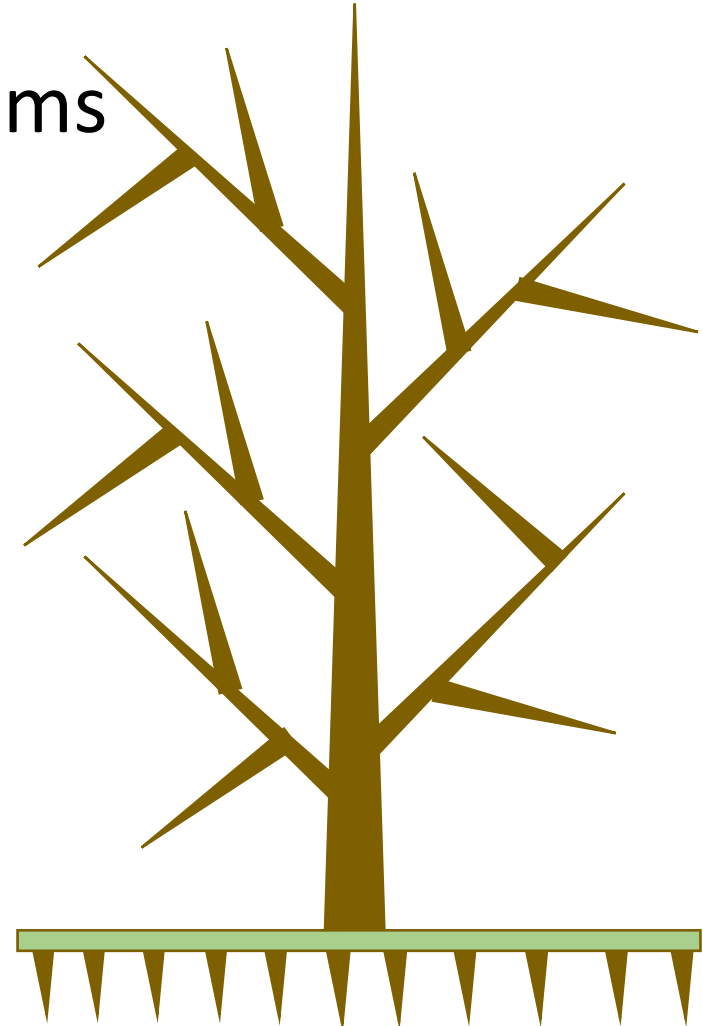
The Morton Arboretum



# Canopy Stages of Decline

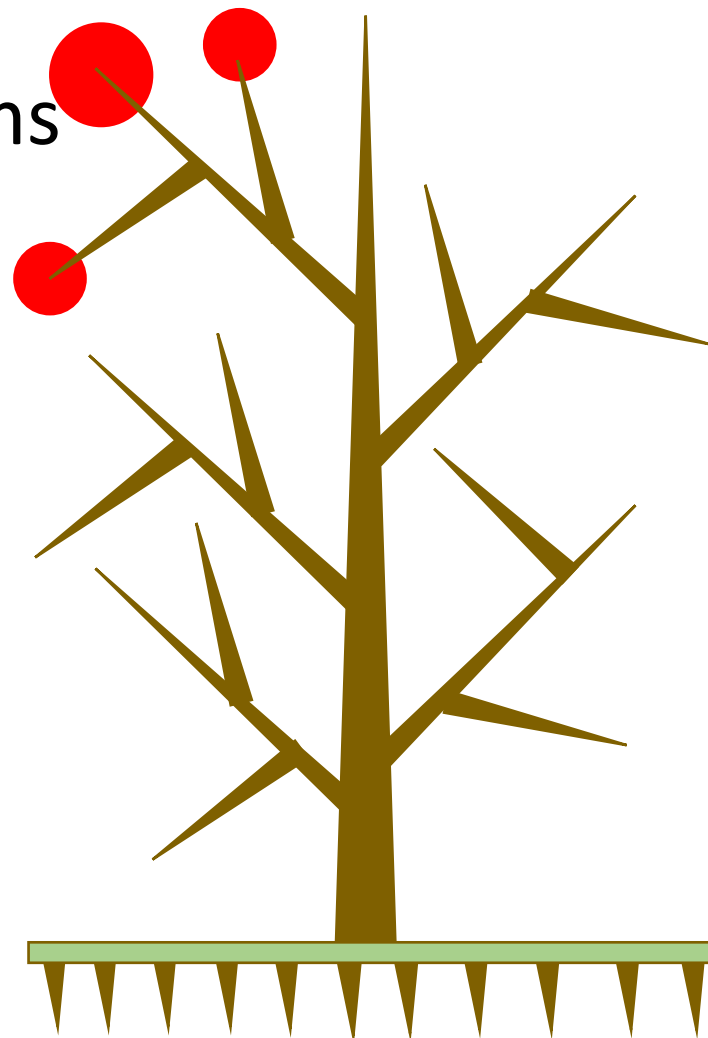


# Investigating Canopy Symptoms



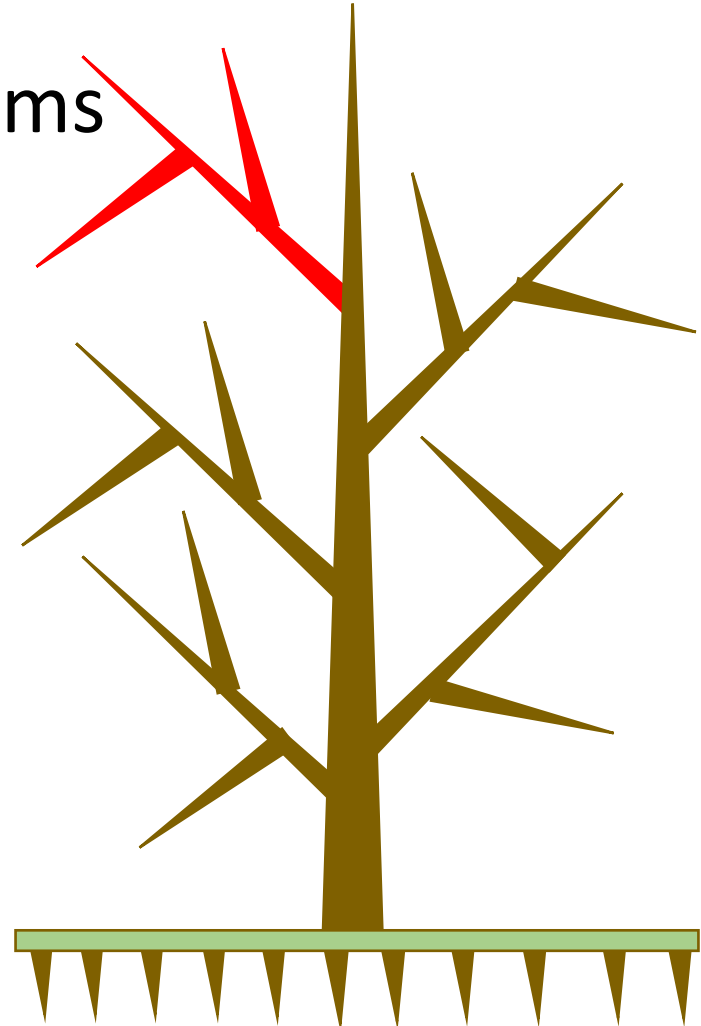


# Investigating Canopy Symptoms



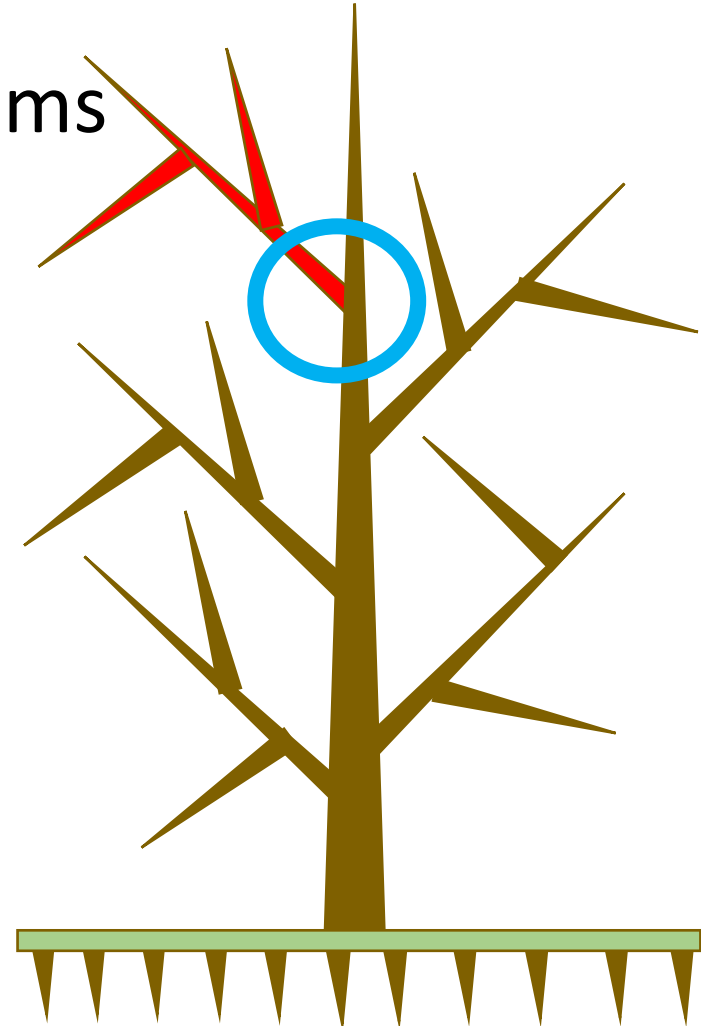
# Investigating Canopy Symptoms

1. Look at the tissues supplying the symptomatic area
2. Identify where live and dead tissue meet



# Investigating Canopy Symptoms

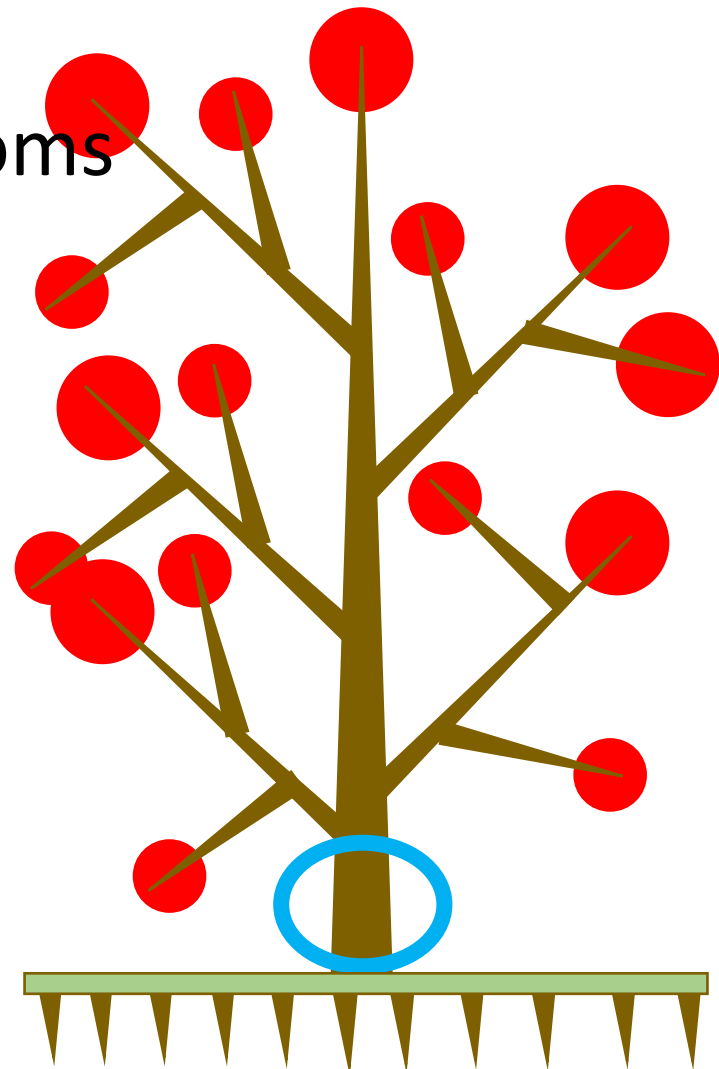
1. Look at the tissues supplying the symptomatic area
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  - This is where water and nutrients are being blocked from moving toward the branch tips





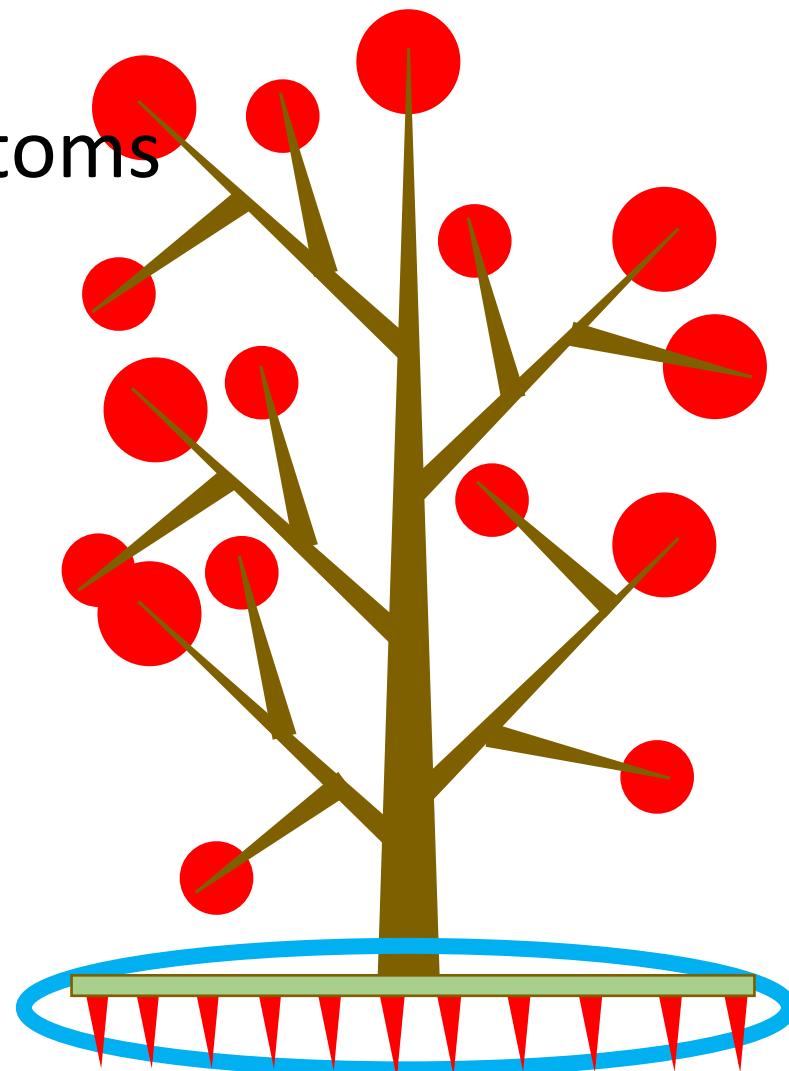
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# Investigating Canopy Symptoms

1. Look at the tissues supplying the symptomatic area
2. Identify where live and dead tissue meet
  - This is where water and nutrients are being blocked from moving toward the branch tips
3. Have the problem diagnosed
4. Treat a diagnosis, not a symptom



# Problems that Share Symptoms

- Drowning
- Drought
- Root rot
- Limited root systems
- Vascular wilts
- Canker diseases

Water is not getting to the canopy for some reason



# During water stress... (or root loss)

Secondary metabolism is compromised

- Most plant defenses are products of secondary metabolism
- Defense failure
- Stomates close resulting in reduced photosynthate production
- Cavitations (air seeding) in vascular system attract insects (bark beetles) due to noise production

Root orders are colored as follows:

RED is R1/2 (absorptive fine roots)

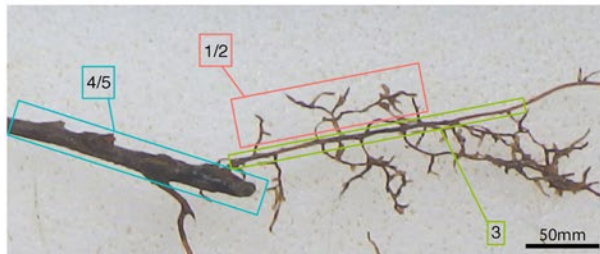
GREEN is R3 (transitional fine roots)

BLUE is R4/5 (transportive fine roots)



AM

*Acer saccharum*



EM

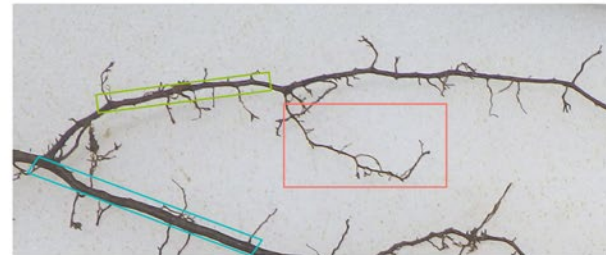
*Carya glabra*



*Juglans nigra*



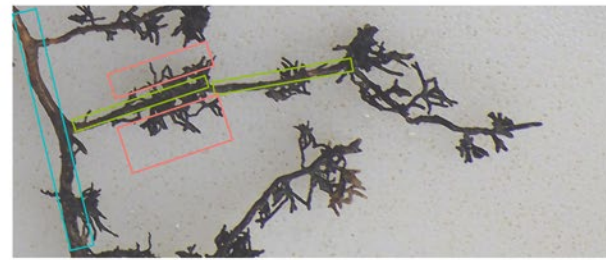
*Quercus rubra*



*Liriodendron tulipifera*



*Pinus strobus*



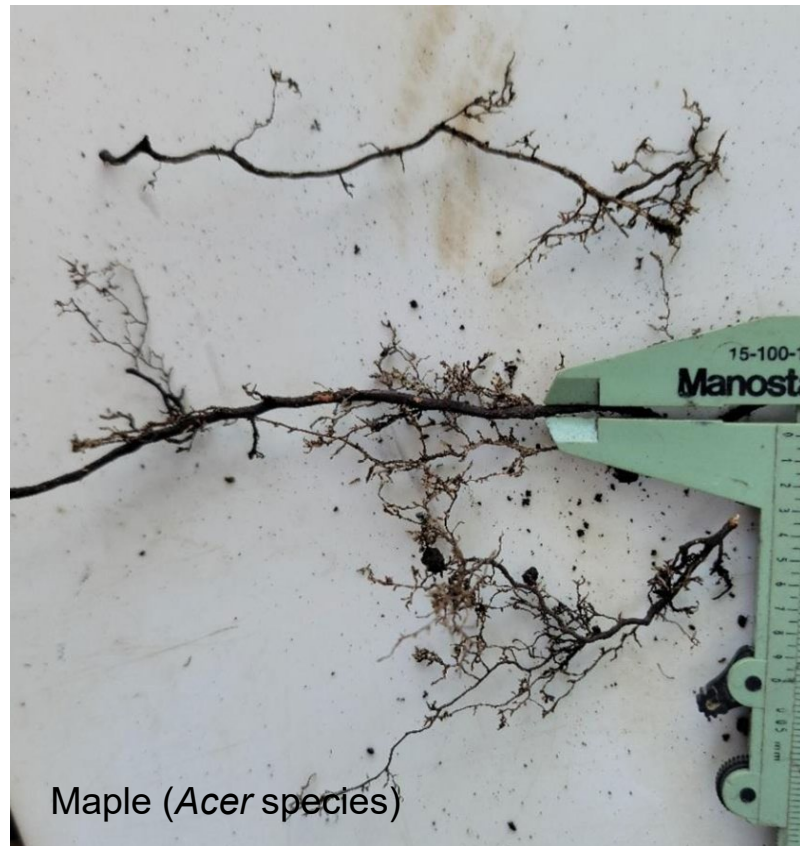
King, W.L., Yates, C.F., Guo, J., Fleishman, S.M., Trexler, R.V., Centinari, M., Bell, T.H. and Eissenstat, D.M., 2021. The hierarchy of root branching order determines bacterial composition, microbial carrying capacity and microbial filtering. *Communications biology*, 4(1), pp.1-9.



SE  
Tulip tree (*Liriodendron tulipifera*)

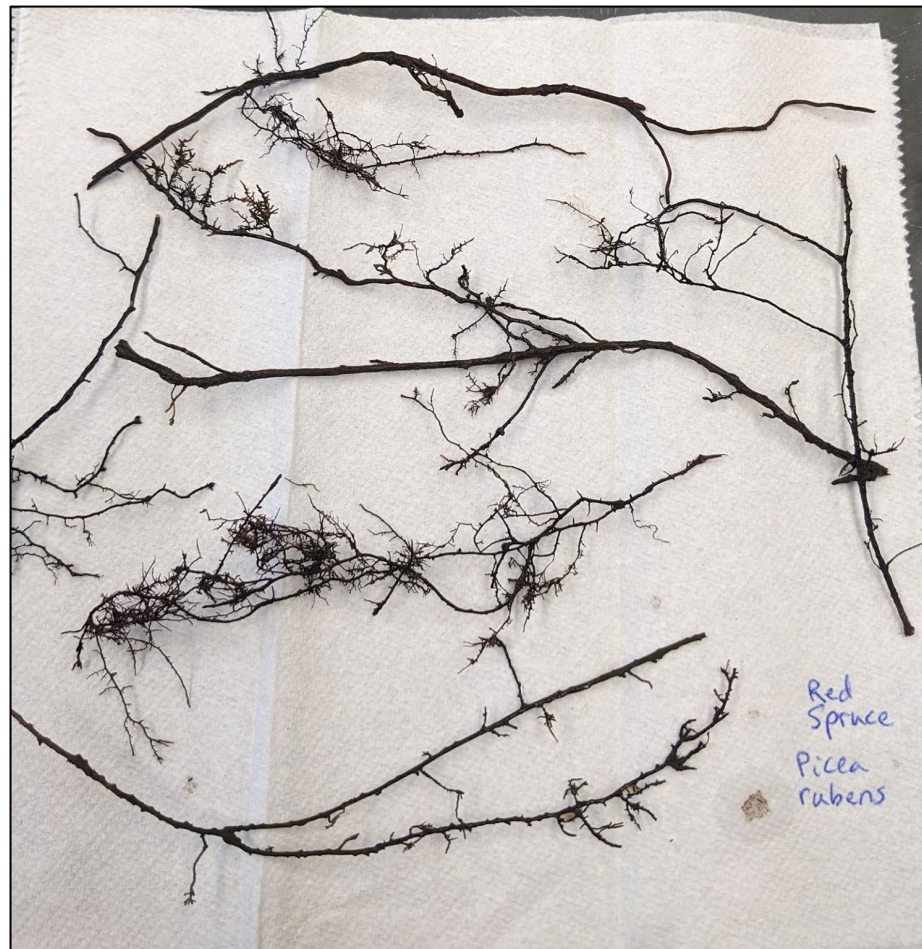
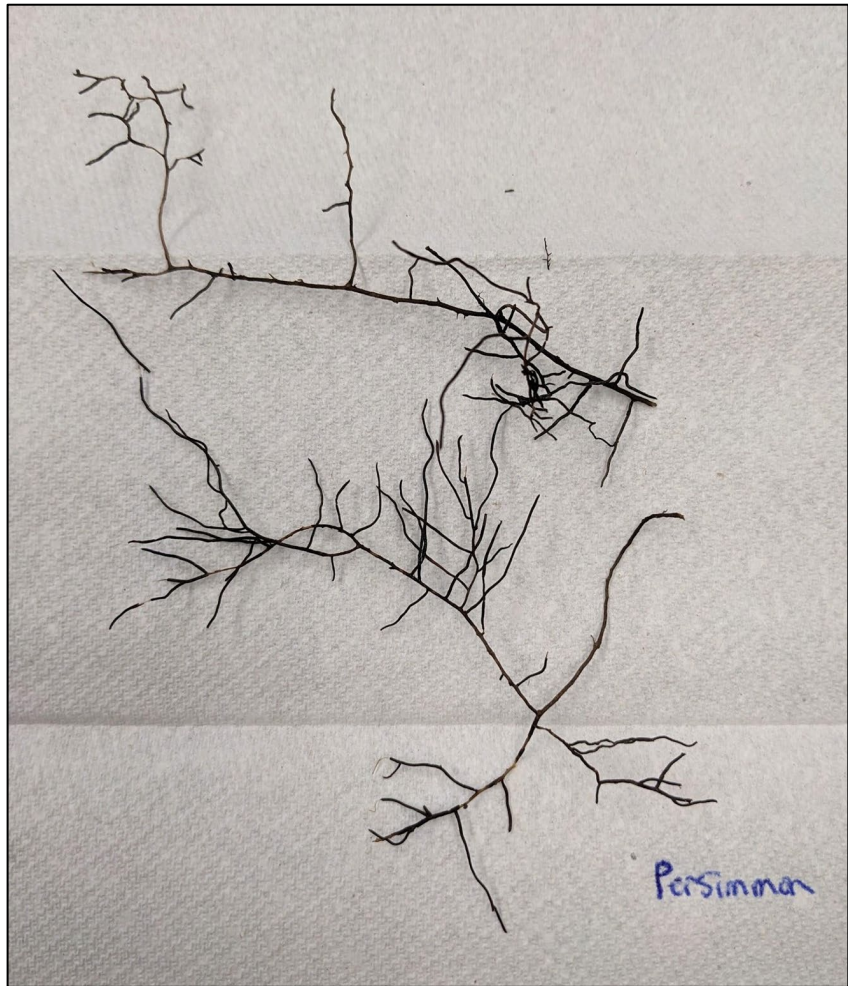
NE

SW



Maple (*Acer* species)









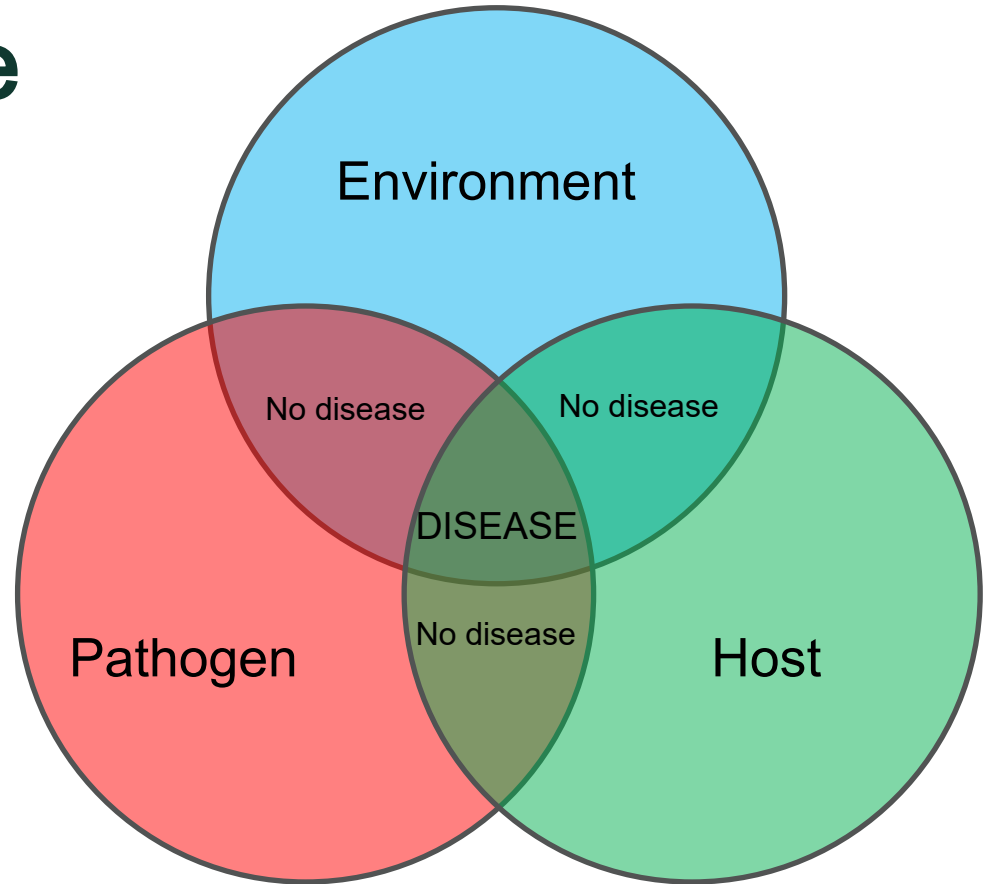




*Quercus alba* (white oak)



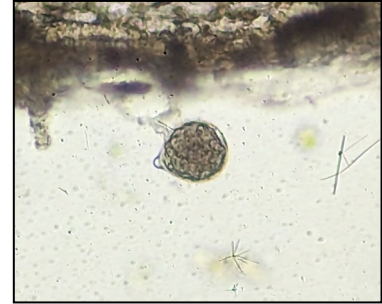
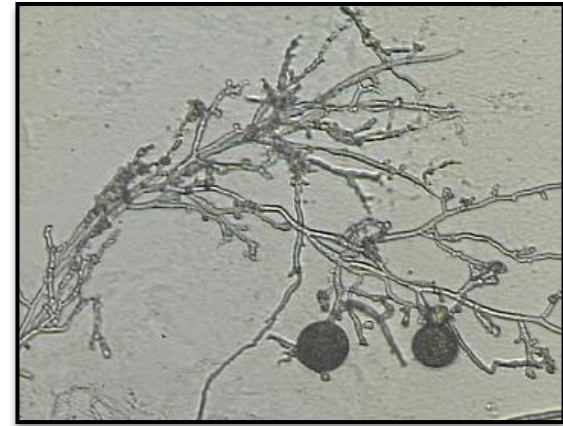
# Disease Triangle



# Root Rot Pathogens

## Three groups

- Bacteria – Smelly soft rots
  - associated with excess water and anaerobic soils
- Oomycetes – *Phytophthora*, *Pythium*, *Phytopythium*
  - Water molds (aka fungal-like organisms)
  - Thrive in excess water
- True Fungi – *Rhizoctonia*, *Thielaviopsis*, *Fusarium*, and others
  - Yeast, mushrooms, conks



# Root Rot Pathogens

- True Fungi – *Rhizoctonia*, *Thielaviopsis*, *Fusarium*, and others
  - Yeast, mushrooms, conks





# Nursery Stock Health



Roots should hold root ball together

Check multiple plants to see if there is uniformity in the root system

Look for uniformity in the crop

Don't assume plants without symptoms are disease-free

They were all repotted at the same time

Sanitation prevents spread

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*Iberis sempervirens* 'Alexander's White'  
(Evergreen Candytuft)





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The Morton Arboretum





The M





# Symptoms of Root Rots in the Landscape

- Uniform canopy symptoms
- Symptoms indicate that water and nutrients are not reaching the outer portions of the canopy
  - Start finding secondary problems (cankers, needle blights)









*Quercus palustris* (northern pin oak)



roots from 5 cm (2 in) deep

roots from 12.7 cm (5 in) deep





*Quercus palustris* (northern pin oak)



roots from 18 cm (7 in) deep

roots from 5 cm (2 in) deep



# Check for Soil Health



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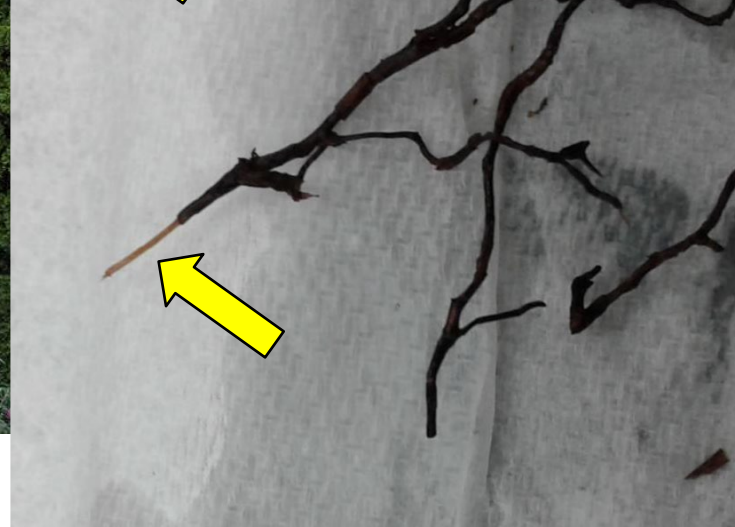
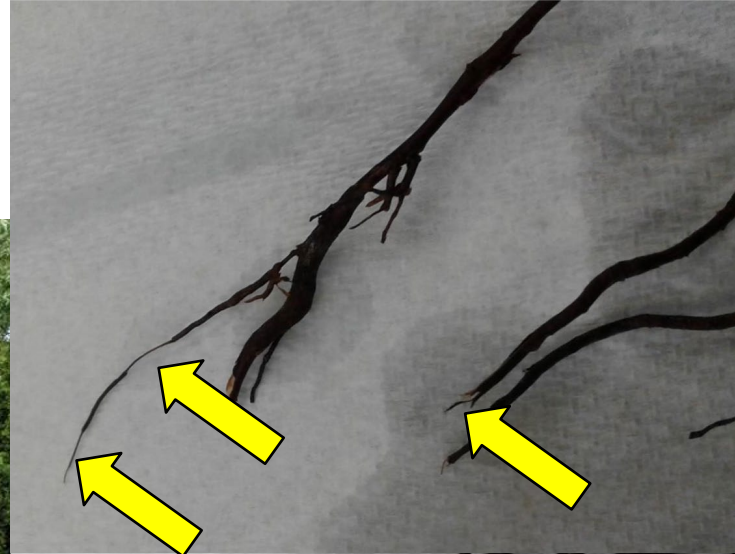
# Dangers of diagnosis “by looking at it”

- Using the wrong pesticides
  - Poor return on you investment
- Don’t know if it is a primary or secondary disease
  - What actually needs to be managed
- Potential of spreading



# POP QUIZ

# Rhizoctonia root rot





# Phytophthium root rot





# Rhizoctonia and Fusarium root rots





# Rhizoctonia and Phytophthora









# Rhizoctonia and Fusarium root rots





# Rhizoctonia Root Rot

## Dwarf lilac

- Tan brown infected roots
- Inconsistent growth of fine roots across the root system
- New healthy growth is white





# Rhizoctonia Root Rot



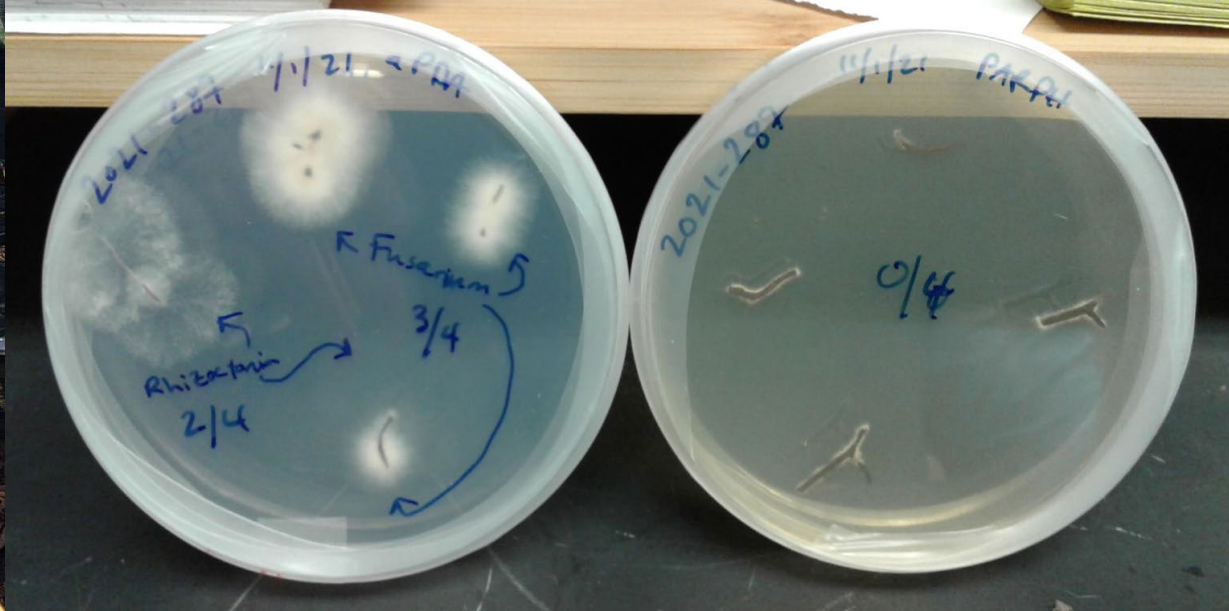
Holly

Tan brown infected roots

New growth is white turning tan

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# Rhizoctonia and Fusarium root rots





# Treating a Symptom vs Treating a Diagnosis

- Treating a Symptom

- Unknown: What type of organism you're treating (true fungus vs. oomycete)
- Using two different fungicides

- Treating a Diagnosis

- Known: What type of organism you're treating
- Use one fungicide  
(unless there's more than one pathogen – treat for the primary pathogen)

# Prevention-Method of Management

- Do not use unhealthy-looking plants
- Pull plants out of containers and examine the roots
- If a plant looks unhealthy, set it aside and have it diagnosed
  
- Prevent the host and the pathogen contact
- Avoid introducing the pathogen to an area
  - Put new plants in quarantine
- Don't use or introduce hosts to an infested area



# Short Term Management Strategies

- Pesticides “Put out the immediate fire” and stabilize the plant
- In the landscape
  - Use a hand trowel or shovel to dig up roots and check their health
  - On new plants
    - Quarantine and treat while still in the container
- In nurseries
  - Check nursery stock – pull them out of containers, examine the root ball

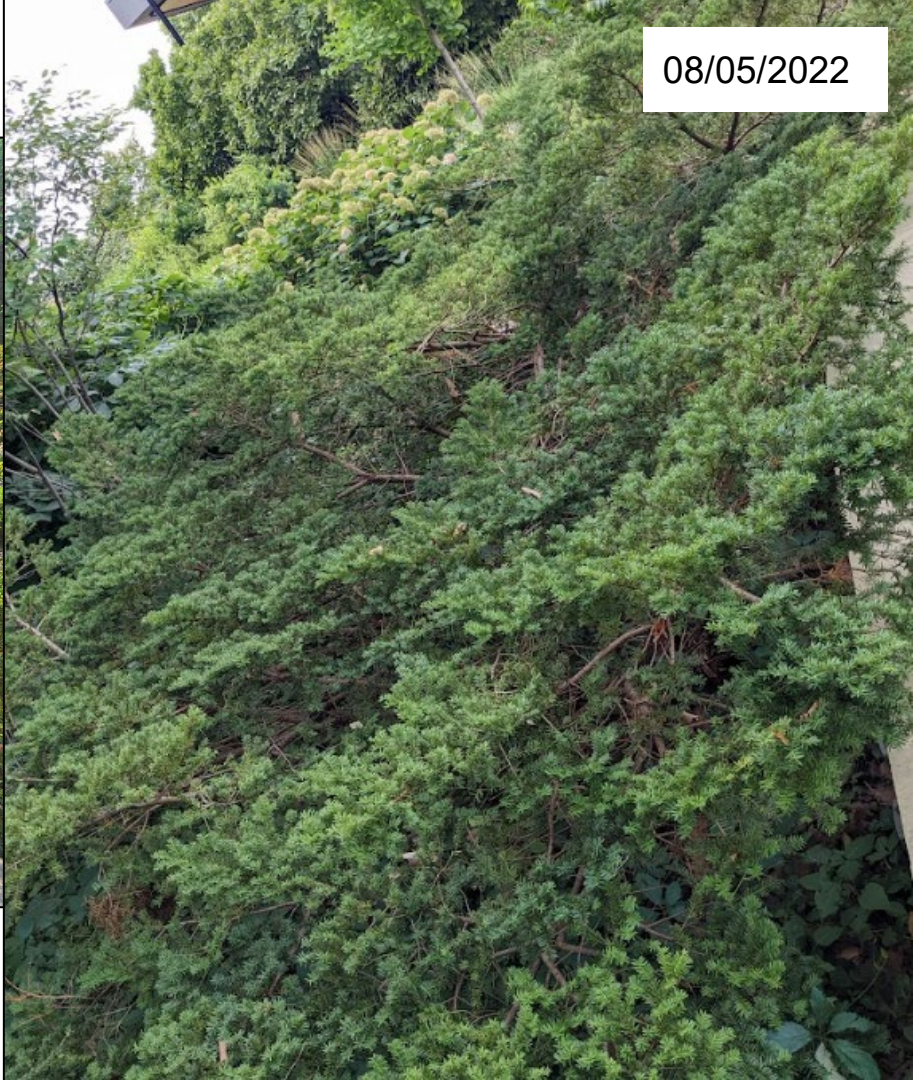
# Plant Response to Fungicide Treatments

- 2 weeks – 3 months
  - Trees and Plants will stabilize
    - They will not continue declining
  - Plants will green-up
    - Getting the water and nutrients they need to photosynthesize
  - They will start growing and keeping fine roots
- 1-2 years
  - Put on new canopy growth





05/26/2022



08/05/2022





07/08/2022



08/05/2022



The Mor



2022 June 24



2023 June 30



# Recovering Fine Roots



- Firm
- Round
- White to creamy-white
- Smell earthy



# Long Term Management Strategies

1. Create environments that favor the host over the pathogen
2. Soil management
  - Create ideal root-growing environment with air and water pore spaces
  - Suppressive soils
  - Integrating biocontrols
3. Water management
  - Water for the plant species needs, soil type, and humidity
  - **Don't blindly water**
    - Use water meters
    - Use soil probes

# Tools for Root Examination

- Dig a hole no bigger than a standard sheet of paper (A4)
- Dig below turf roots (5 – 10 cm, 2-4 in)
- Collect roots from (15.3 – 41 cm, 6-16 in)
- **Hori Hori (soil knife) or small shovel**





# Bring Plant Health in the 21<sup>st</sup> Century

## We need to...

- Improve diagnostic habits
- Stop diagnosing plants “just by looking at them” in the field
- Treat a diagnosis, not a symptom
  - Prescriptive treatments
  - Better outcome = Fewer losses

# Tool Sanitation

- 70 or 91% isopropyl alcohol at drug stores
- Lysol™, most have >60% alcohol

Sterilized Pruning Tools: Nuisance or Necessity?

Dr. Linda Chalker-Scott

WSU Puyallup Research and Extension Center





# University of Wisconsin Plant Disease Diagnostics Clinic

**[pddc.wisc.edu](http://pddc.wisc.edu)**

608-262-2863

Plant Disease Diagnostic Clinic  
1630 Linden Dr. Room 183  
Madison, Wisconsin 53706

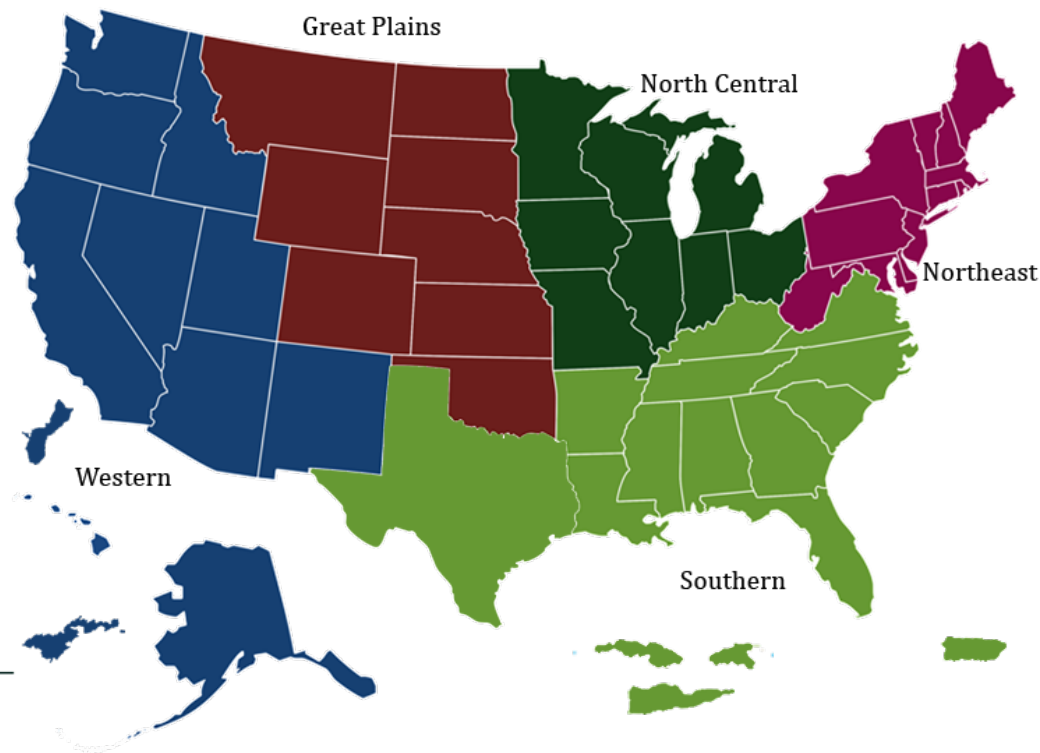




Find your state or territory's  
lab at: [NPDN.org](http://NPDN.org)

Gold standard for diagnostics

Average 3 week for results







# R is for ornamentals

Mary Hausbeck  
Department of Plant, Soil and Microbial Sciences

Share Tweet

Know the ABCs of ornamental greenhouse diseases, including Phytophthora root rot.

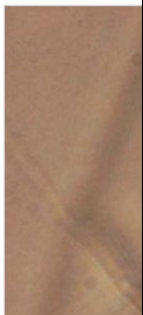


# P is for ornamentals

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Department of Plant, Soil and Microbial Sciences

Share Tweet

Know the ABCs of ornamental greenhouse diseases, including Phytophthora root rot.



# T is for ornamentals

Mary Hausbeck  
Department of Plant, Soil and Microbial Sciences

Share

Know the ABCs of ornamental greenhouse diseases, including Thielaviopsis root rot.



# P is for Pythium root rot on ornamentals

Mary Hausbeck, Blair Harlan and Sheila Linderman, Michigan State University, Department of Plant, Soil and Microbial Sciences - May 05, 2017

Share Tweet Save Share Print Email

Know the ABCs of ornamental greenhouse diseases, including Pythium root rot.



# Questions

For more information contact:

Stephanie Adams  
Plant Health Care Leader  
[SAdams@mortonarb.org](mailto:SAdams@mortonarb.org)





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*of* **TREES**

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