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Advanced training: Plant diseases

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Some background information first

- Undergraduate degree at Central Michigan University in Biological Sciences
- Master's degree at Purdue University in Plant Pathology
- Currently a Scientific Advisor at Davey Tree Expert Company

What is a Scientific Advisor?

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- Provide scientific support to arborists, technicians, and crew
  - Diagnostics
  - Risk assessments
  - Policies/labels
  - Safety training
  - Scientific training
- Educational outreach
  - Conferences
  - Colleges/Universities
- Perform research trials
- Innovation

Overview

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- Plant functions
- Diagnostics
  - Process and techniques
  - Tools
- Diseases
  - Signs and symptoms
  - Diagnostic tips
  - Management

Functions of a healthy plant

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- Uptake water and nutrients from the soil
  - Roots, xylem, leaves
- Capture sunlight to make energy
  - Leaves
- Transport sugars and water
  - Phloem, leaves
- Reproduce
  - Fruit

These become targets…

- Uptake water and nutrients from the soil
  - Roots, xylem, leaves
- Capture sunlight to make energy
  - Leaves
- Transport sugars and water
  - Phloem, leaves
- Reproduce
  - Fruit

- Roots, trunks, and leaves are also important for stability, storage and nutrient recycling

Targets…

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So you've got some unhealthy looking trees… Now what?

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Diagnostics

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- The science of deduction
- A process of reasoning in which a conclusion follows necessarily from the premises presented, so that the conclusion cannot be false if the premises are true.

- Reaching a conclusion based on facts and reasoning

Diagnostics

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- A lot like identifying tree species
  - Take in a whole bunch of information and identify it based on that information
  - Not identify it then try and find facts to support your identification

Diagnostics is a multi-disciplinary skill…

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- Plant ID and horticultural knowledge
- Entomology
  - Study of insects
- Plant pathology
  - Study of plant diseases
- Soil science and plant nutrition
- Site history and environmental knowledge

Plant/site history

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- Very important

- Look everywhere!
  - Every plant “target”
- Ask lots of questions
  - Date planted, cultural practices, growing conditions, pesticide history etc.
- Take very good notes
- Take lots of pictures

Diagnosis step 1: Plant identification

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- Do you know what the plant is?

- Do you know what is normal for the plant?
  - Or more importantly, what is abnormal?

What is this tree?

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- It's a Norway maple.

Is this normal?

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- Is this normal for a Norway maple?

Yes, for a ‘Drummond’ Norway maple

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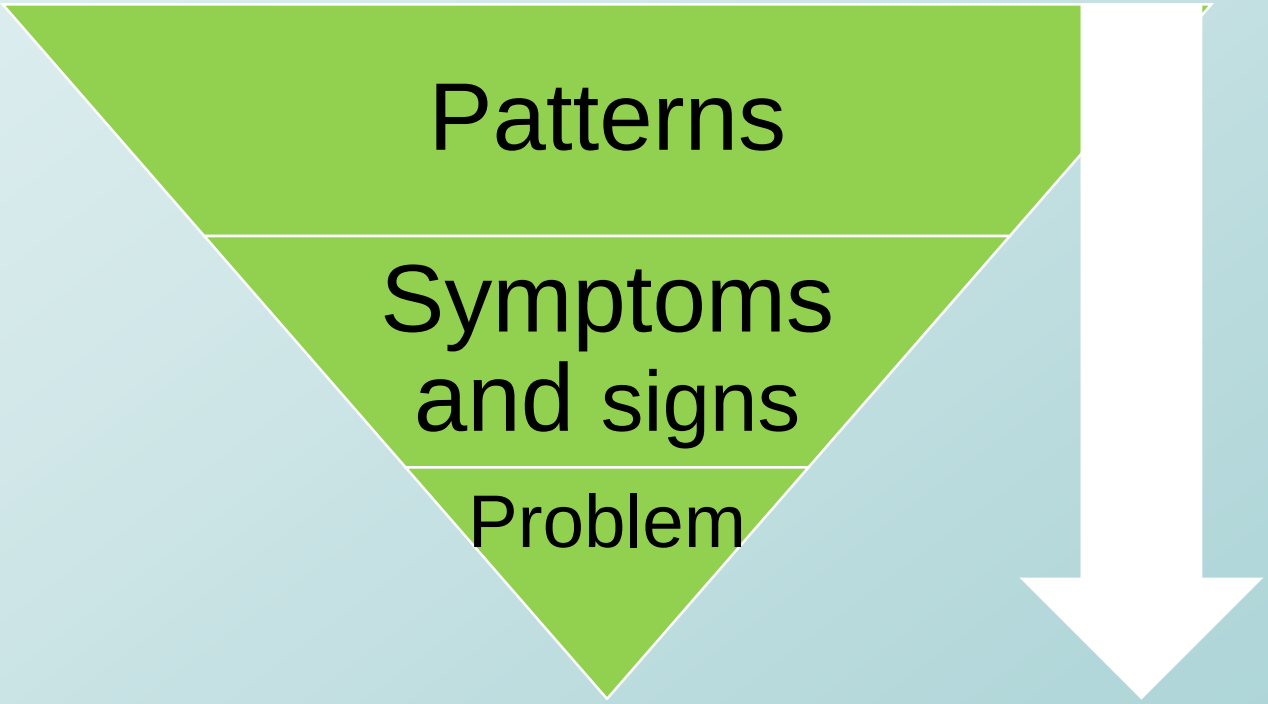
Diagnosis step 2:
Determine the problem



Patterns

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- Uniform or non-uniform?

Photos: Michigan State University Extension

Symptoms vs. Signs

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Symptoms

- Plants reaction to a pest or pathogen

Signs

- Physical presence of the pest or pathogen

Photos: Cornell University Extension

Symptom hunting/history

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- Look at all plant “targets”
  - Note all parts of plants affected
  - Note how long parts have been affected
- Is it spreading?
- Was it gradual or sudden?

- Look at other plants on site too!

Symptoms

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- Necrosis
- Chlorosis
- Spots
- Wilting
- Canker
- Discolouration
- Defoliation
- Early fall colour
- Dieback

Some tools you'll need

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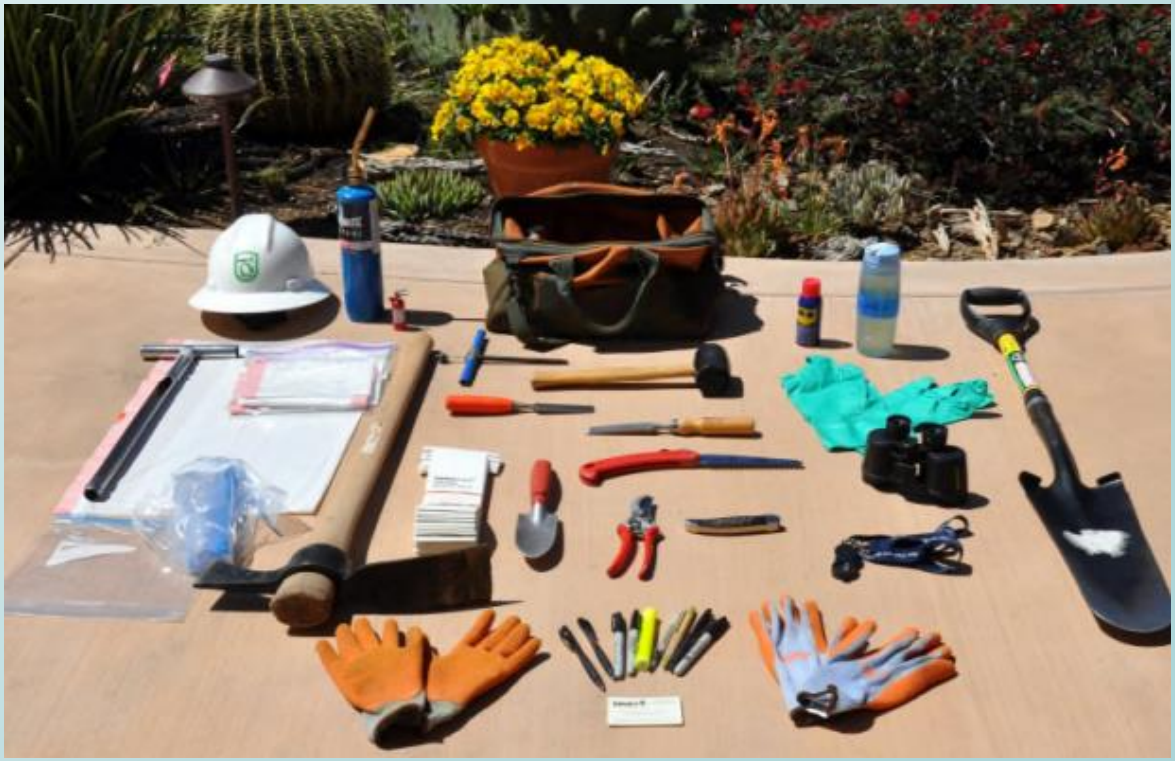
- Hand pruners
- Hand saw
- Trowel
- Soil probe
- Rubber mallet
- Chisel
- Gloves
- Bleach
- Plastic bags
- Soil bags
- Hand lens



An example…

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What's the pattern?

What are the symptoms?

What are the signs?

Photos: www.aps.net

Plant problems

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- 2 broad categories
  - Abiotic
    - Related to non-living things
    - Non-infectious/non-transmittable
  - Biotic
    - Related to living things
    - Infectious/transmittable

Abiotic vs. Biotic

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Abiotic

- Environmental conditions
- Rain, hail, acid rain
- Pollution
- Poor cultural practices

Biotic

- Fungi
- Bacteria
- Viruses
- Nematodes
- Parasitic plants
- Insects

Plant problems

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- Most landscape problems are abiotic
- If it is biotic, its probably insects
  - If it's not insects, 80% of the time its fungi!

If all else fails

- Send to a diagnostic lab
  - Morton Arboretum
  - Purdue University
  - University of Illinois Urbana-Champaign

Sample collection

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- Good quality
  - Sample must be fresh
  - Must show symptoms
    - **Best: infected/dead zone, transition zone, alive zone**
  - Do NOT send dead plants!

Sample collection

- Note incidence
  - Percent of plant affected
- Note severity
  - Measure of impact on plant
- Send roots if possible
  - Do not pull, but gently dig out plant

Sample submission

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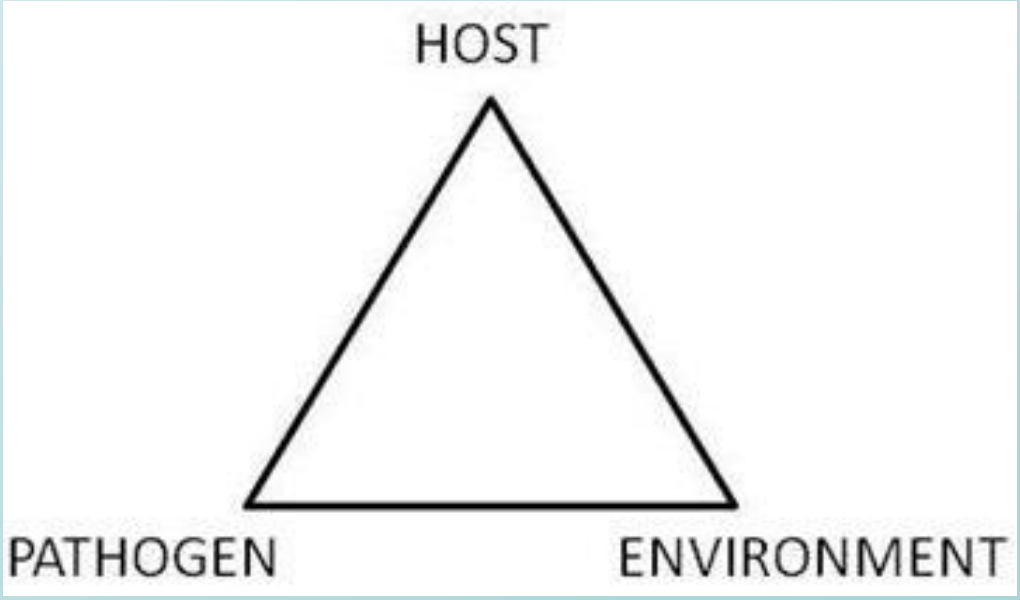
- Keep it cool
- Moist but not wet
- Put in well structure container ASAP after collection
  - Box, padded envelope
- Overnight it
- Include form
  - Can find these on lab website
- Include photos of site
  - A blurry photo, is an unhelpful photo

Disease

- Produce signs and symptoms
- Disease comprise of three components
  - Environment
  - Plant (host)
  - Pathogen



Environment

- Temperature
- Moisture
- Light intensity and quality
- Soil characteristics
- Presence of vectors

Plant (host)

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- Susceptible
- Tolerant
- Resistant


University of Kentucky Extension

Pathogen

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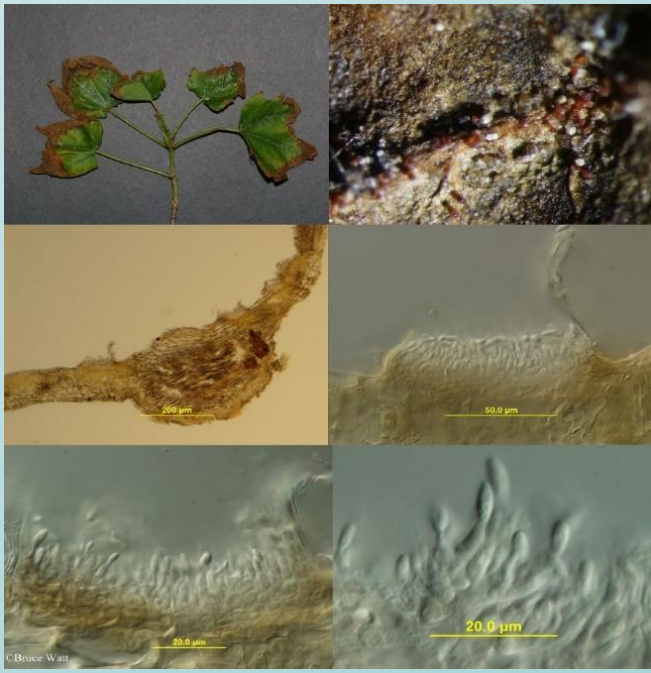
- Causal agent of a disease
- A parasite that causes harm
  - Obtains nutrients from another living organism
- Vs saprophytes
  - Lives on dead or decaying organic matter



Pathogen life cycle

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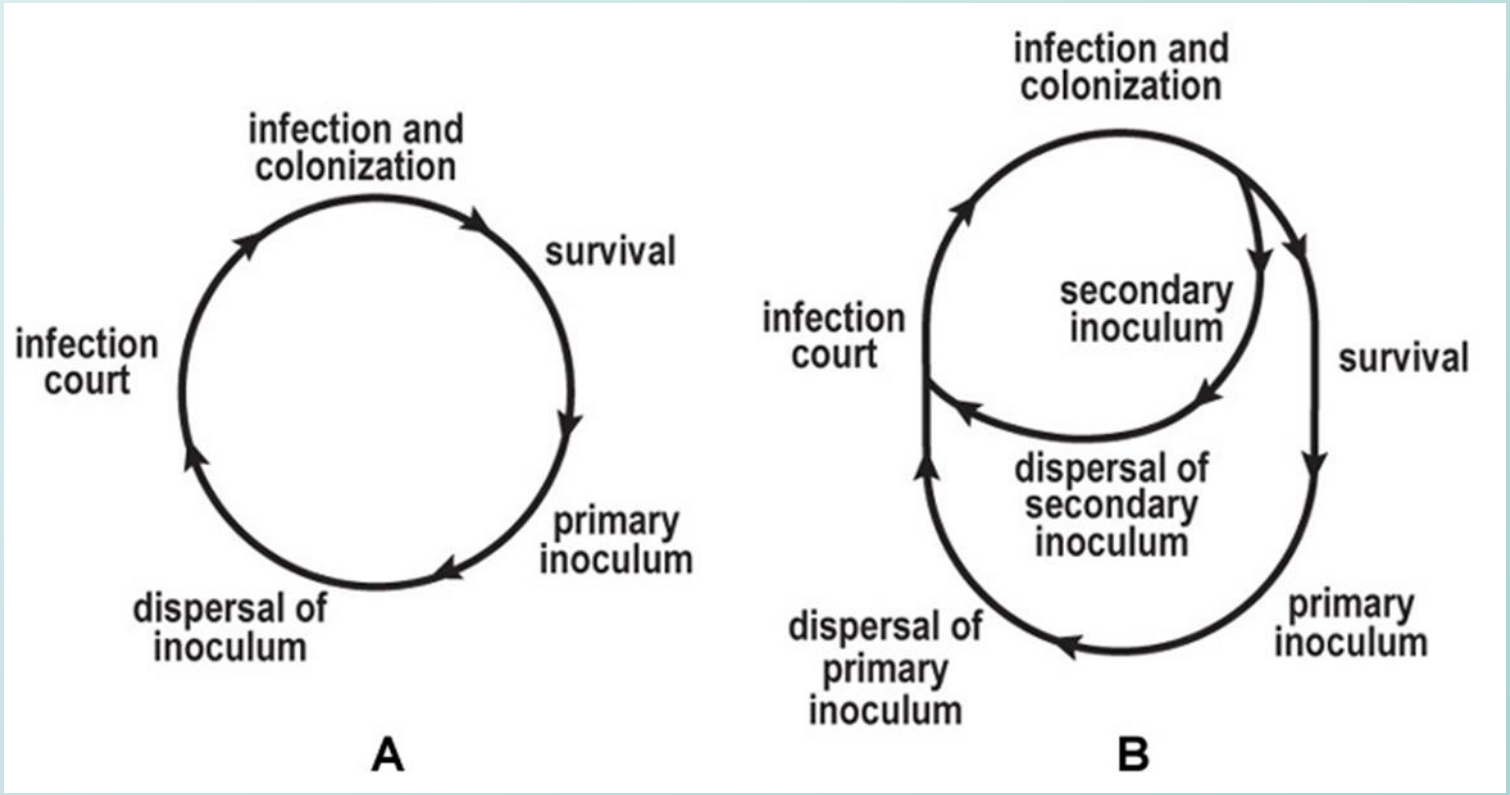
- Can be monocyclic or polycyclic



Fungi

- Nonphotosynthetic
  - Needs a different source of food
  - Decompose and absorb organic matter
- Infecting agent
  - Spores
- Mushrooms, mold, mildews, rusts, etc

Bacteria

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- One celled organisms that are spiral, spherical, or rod-shaped
  - Typically have flagella for locomotion
- Grow in-between cells, does not go into cells
- Fermentation, putrefaction, infectious diseases, or nitrogen fixation




Virus

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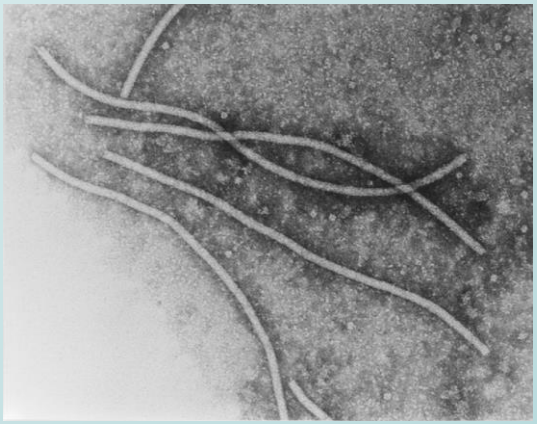
- Microscopic agent that replicates in living cells
- **Systemic**
- Once infected, little can be done to get rid of the virus
- Require wound to infect plant



Nematode

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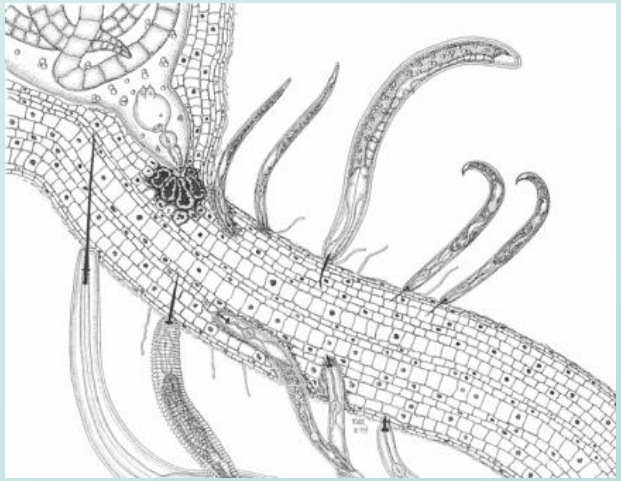
- Unsegmented roundworm
- Affect roots, stem, foliage, flowers
- Monocots and dicots
- Stylet – piercing and sucking



Parasitic plants

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- Use root-like organs
  - Haustoria
- Extract nutrients and water from host plants
- Eg. Dodder, mistletoe

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Fungi

Fungi

- 80% of diseases in the landscape are caused by fungi
- Symptoms can often look similar to other organisms
  - Look for signs of fruiting bodies that will help with diagnosis

Fungal diseases

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- Leaf spots
- Blights
- Cankers
- Galls
- Vascular wilts
- Root rots
- Wood rots
- Rusts

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Leaf spots

Leaf spots - target

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- Leaves
  - Photosynthesis
  - Respiration
  - Transpiration

Leaf spots

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- Patches of damage on plant foliage
- Cough or headache of the plant world
- Usually not serious unless a sufficient number of spots cause leaf drop

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Leaf spots–diagnostic tips

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- Fungal leaf spots will have small fruiting bodies inside the lesions
- Pattern of symptoms usually is bottom up

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Leaf spots - management

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- Fungicides
- Prune
- Remove infected tissue
- General plant health care

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Anthracnose

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- Many different species of fungi
- Can be on many hosts:
  - Ash, birch, sycamore, maple, oak
    - Typically aesthetic on these hosts
    - Repeated defoliation can cause weaken the tree
  - Dogwood
    - Can infect branches resulting in cankers and dieback
      - Is lethal to the tree
- Cool, rainy spring
  - Infection slows during warm/dry summer weather

Symptoms

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- **Irregular necrotic lesions on leaves**
  - **Often associated with the leaf veins**
- Leaves can look distorted and curled
- Severe infection can cause leaf drop in spring

Oak Anthracnose

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Maple Anthracnose

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Sycamore Anthracnose

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Sycamore Anthracnose

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Dogwood Anthracnose

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Photos from ForestryImages.com - Anderson

Apple scab

- *Venturia inaequalis*
- Host: Crabapples, hawthorn, cotoneaster, common pear
  - Bigger issue on older trees that have been weakened over time
- Cool rainy springs
  - Symptoms typically most severe in June/July
  - Disease slows in hot, dry summer weather

Symptoms and signs

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- **Olive green to black “velvety” leaf spots**
- If infection is severe leaves yellow followed by premature defoliation

Apple scab

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Tubakia leaf spot

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- *Tubakia dryina*
- Hosts: Oaks
  - Red group more susceptible
  - Newly transplanted trees
  - Stressed trees
- Mostly an aesthetic issue
- Rainy springs and summers favour infection

Symptoms

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- Dark to reddish brown spots typically surrounded by a **chlorotic halo**
- Severe infection leads to defoliation

Tubakia leaf spot

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Powdery mildew

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- Many different species of fungi
- Hosts: Catalpa, dogwood, euonymus, hawthorn, lilac, maple
  - Very host specific
- Fungus thrives in humid conditions
  - Cool nighttimes followed by warm day temperatures

Symptoms and signs

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- White to **gray powdery spots** and blotches on stems and buds
- Usually young leaves affected most
- Severe infections lead to yellowing of leaves and premature defoliation
  - Some plants leaves may turn purple to red around the infection

Powdery mildew

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Sooty mold

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- Dark coloured fungi that grows on **honeydew** of sap-feeding insects
  - Aphids, soft scale, mealy bugs, psyllids, and some leafhoppers
- Not pathogenic
  - Can block sunlight and reduce photosynthesis

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Blights

Blights - target

- Leaves
  - Photosynthesis
  - Respiration
  - Transpiration
- Vascular system
  - Transpiration
  - Sugar storage/movement
  - Structure

Blights – diagnostic tips

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- Kills youngest plant tissue
- Sporadic tip dieback
  - Can be entire branch
- Necrotic areas have a “withered” or “burnt” look to them
- Can be associated with cankers or vascular issues, but not always

Blights – management

- Fungicides
- Removal of infected tissue
- Prune
  - Only when dry
- General plant health care
  - Avoid excess water
  - Avoid crowding

Bur oak blight

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- *Tubakia iowensis*
- Hosts
  - Bur oak
    - Stressed trees
- Rainy periods during spring budbreak is crucial for disease development
- Fungus can live as an epiphyte on petioles
  - Overwinters on petioles that remain attached to the branch

Symptoms

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- Necrosis of the leaf tissue along veins with **wedge-shaped** browning at the tips
- Can have **blackened veins**
- Defoliation if severe - August

Symptoms

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Volutella blight

- *Pseudonectria rouselliana*
- Hosts
  - Boxwood, Japanese pachysandra
    - Damaged or stressed
- Disease development favoured by high humidity and temperatures between 65-75ºF (18-22ºC)

Symptoms and signs

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- Girdling and loose bark may be seen on branches
- Leaves turn red to bronze, then eventually straw colour from the tips back
- In moist weather, **salmon fruiting structures can be seen on the undersides of leaves**

Volutella Blight

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Volutella Blight

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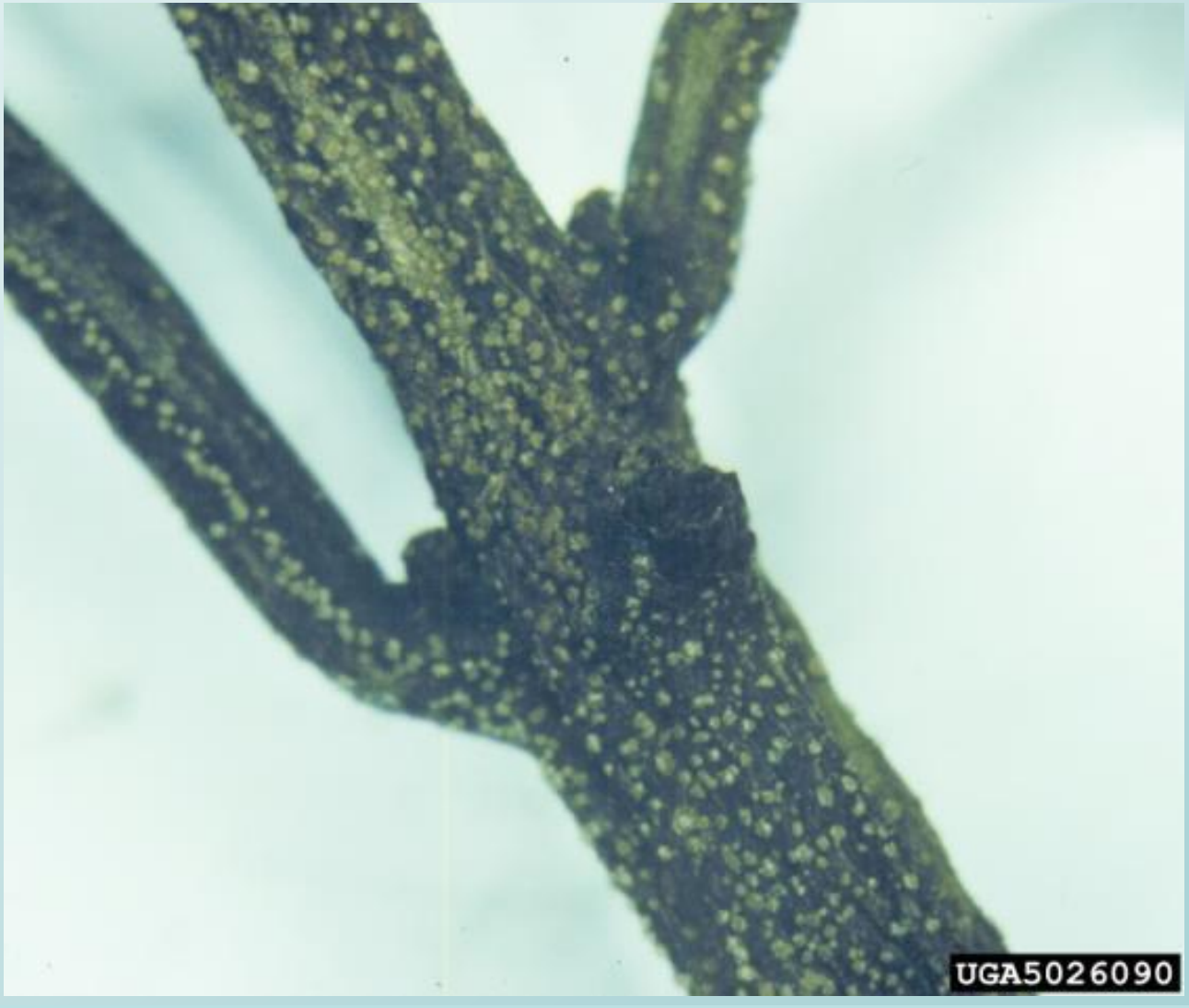

Photo from ForestryImages.com – Fetzer

Boxwood blight

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- *Cylindrocladium buxicola*
- Host: Boxwood
  - Pachysandra can have leaf spots or act as asymptomatic host
- Severe infection favoured by humid and rainy conditions

Symptoms and signs

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- Brown spots with dark borders on the leaves
  - Lesions often have concentric pattern
  - **White sporulation of the fungus can be seen on the underside of the leaf**
- Leaves turn straw coloured, appear blighted
- Diagnostic **black cankers** appear on the stem

Boxwood blight

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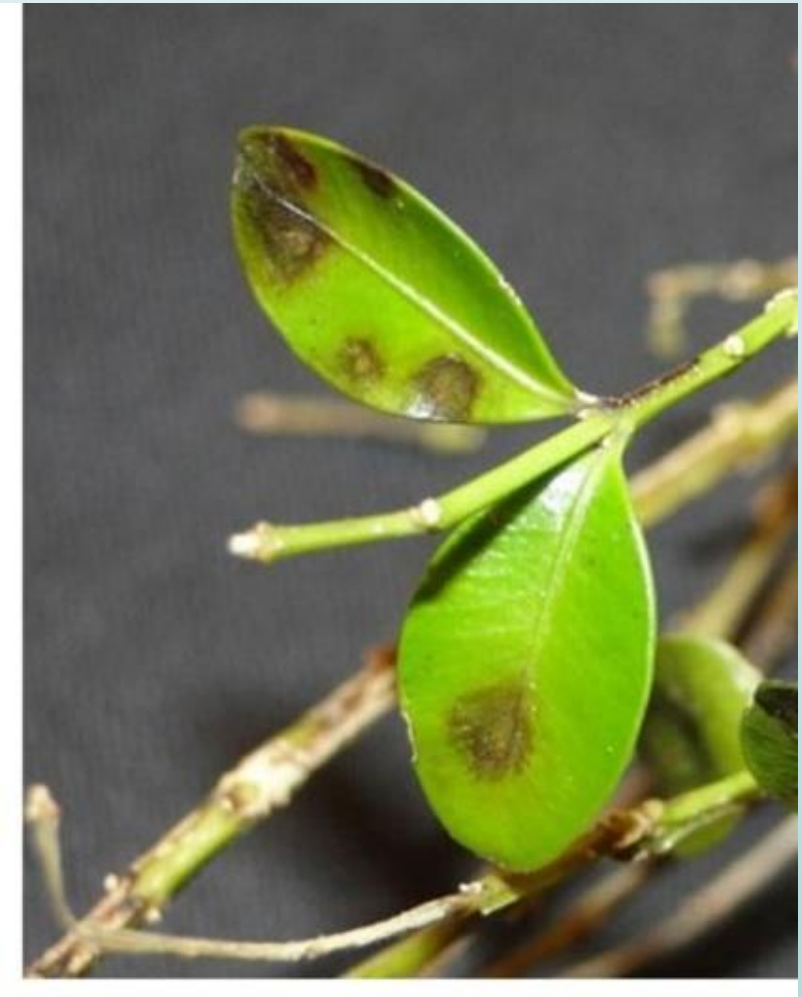

Boxwood blight

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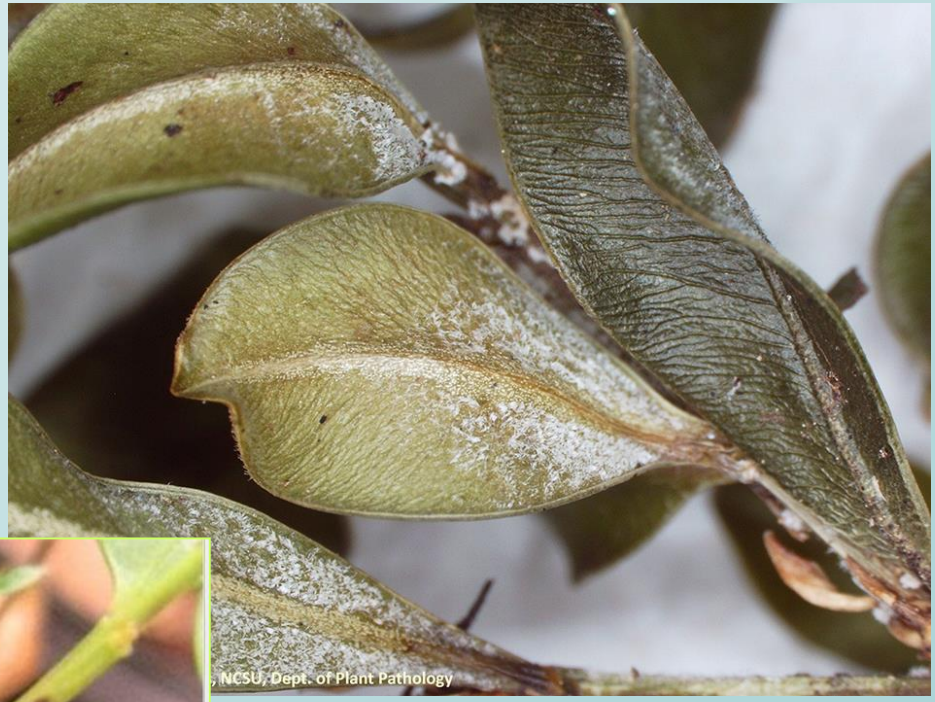

Juniper blights

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- Different fungi
  - Phomopsis tip blight – *Phomopsis juniperovora*
    - Also referred to as juniper tip blight
  - Kabatina blight – *Kabatina juniper*
  - Sclerophoma blight – *Sclerophoma pythiophila*
    - Associated with winter injury
- Hosts: **Juniper**, arborvitae, cedar, jack pine, Douglas-fir
  - Young or newly transplanted

Symptoms and signs

- Necrotic needles at the tips of branches
- May look similar to drought, freezing, dog urine, and transplant shock
  - Gray to **black fruiting bodies on killed needles and stems**
- Pattern: dieback moves from tips back and the bottom of the tree, up

Juniper blights

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Diplodia tip blight

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- *Diplodia pinea* and *Diplodia scrobiculata*
  - *D. pinea* more aggressive
- Hosts: Pines with 2 to 3 needles per bundle
  - Austrian pine, Scots pine, Jack pine, Ponderosa pine
  - Older trees affected more

Symptoms and signs

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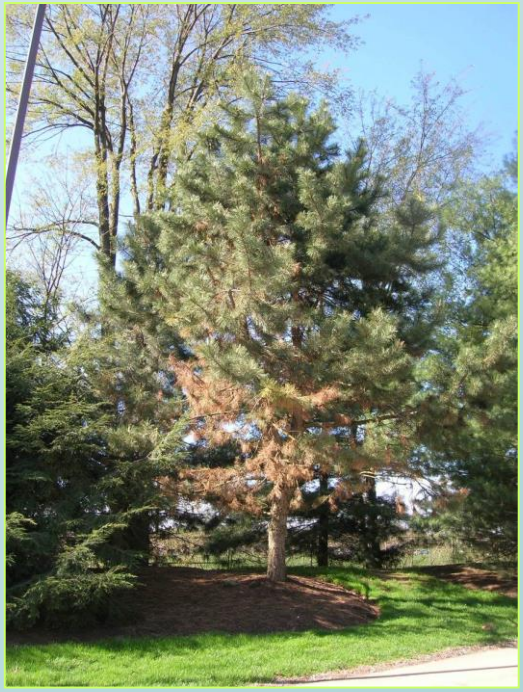
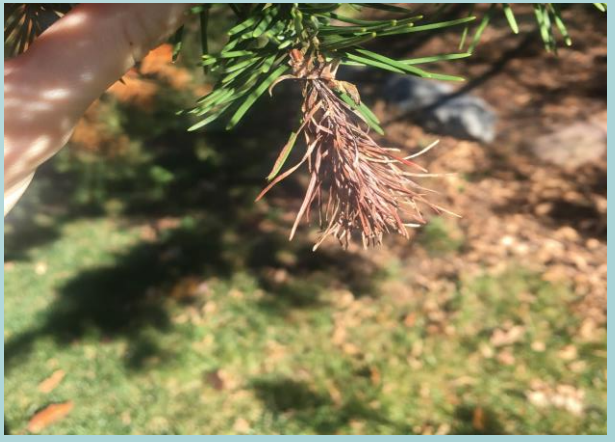
- Needles at the **tips of branches** are stunted and necrotic
- Excess **resin** is produced on infected needles
- Tiny **black spore producing structures can be found at the base of dead needles** and on cone scales





Diplodia tip blight

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Rhizosphaera needle cast

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- *Rhizosphaera* sp.
- Hosts: Spruce
  - Colorado blue spruce and white spruce
    - Stressed trees
- Favoured by extended periods of moisture at temperatures around 77ºF (25ºC)

Symptoms and signs

- Infected needles yellow/mottled in the summer turn **brown/purple by late winter**
  - **Older needles affected**
  - Prematurely defoliate
- **Tiny black fruiting bodies form** on needles in a line

Rhizosphaera needle cast

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Dothistroma needle cast

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- *Dothistroma septosporum*
- Hosts: Austrian pine, ponderosa pine
- Infection favoured by cool wet weather

Symptoms and signs

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- Reddish brown spots that eventually form into **bands**
- Eventually needles turn brown and abscise
  - New needles, **2nd year needles**
- **Tiny black fruiting bodies line infected needles**

Dothistroma needle cast

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Cankers

Cankers - target

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- Vascular system
  - Transpiration
  - Sugar storage/movement
  - Structure

Cankers

- Localized diseased area on stems, roots, branches
- Often associated with an open wound that has become infected by a pathogen
- Can cause girdling of the stem
- Canopy dieback and eventual limb death

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Cankers – diagnostic tips

- Blackened cracked bark
- **Fruiting bodies** on or underneath the bark
- Limb dieback
  - Usually can follow back to canker
- Pattern: sectional, tip to main branch dieback

www.missouribotanicalgarden.com

Cankers - management

- Management via fungicide is difficult.
- Selective pruning when dry, disinfect pruning tools between cuts.
- Where feasible prune 1-2 ft. below cankered area.
- Bark trace - large limbs or trunks
- Important to keep plant healthy, in order to reduce stress

Nectria canker

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- *Nectria* sp.
- Hosts: **Maple, honey locust**, aspen, birch, elm, oak, and walnut
  - Most severe on stressed trees
  - Infections that occur in fall are generally worse than infections that occur in spring

*Be aware that cankers can weaken trunks and branches so that they break off during storms

Symptoms and signs

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- Depressed, discoloured areas of the bark near wounds
- In moist conditions, **creamy red to orange fruiting structures grow around and in depression**
- As plant attempts to isolate fungus callus forms
  - **Target-like shape**

Nectria canker

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University of Minnesota Extension


Missouri Botanical Garden

Botryosphaeria canker

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- *Botryspaeria* sp.
- Hosts: Woody ornamentals like horsechestnut, redbud, dogwood, beech, walnut, crabapple, etc.
  - Stressed plants susceptible

Symptoms

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- **Sunken, blackened areas** form around wounds or natural openings
- Dead bark begins to peel off cankered area
- Leaves dieback
- Cankers elongate along the branch quicker than forming around the circumference
- Some species can form **gummosis**

Botryosphaeria canker

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Phytophthora bleeding canker

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- *Phytophthora* sp.
- Hosts: Beech, beech, birch, cherry, dogwood, horsechestnut, maple, oak, walnut
- Pathogen thrives in wet, compacted soil with poor drainage

Symptoms

- Wilting, early fall colour and eventually dieback of the leaves from the top branches, down
- Causes the **inner bark to turn brown or pink**
  - Canker will have well defined margins
  - Associated with **weeping (bleeding) or red to brown liquid**

Thousand canker disease

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- *Geosmithia morbida* (primary canker)
  - Secondary canker caused by *Fusarium solani*
- Host: Black walnut
- Fungal spores are carried and introduced to the tree by walnut twig beetle
  - Can also be spread by bark weevils and ambrosia beetles

Symptoms

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- Yellowing and thinning of upper crown
- **Death of larger branches**
- Tree death within three years of symptoms
- Cankers can only be seen when bark is peeled back
  - **Thousands of small cankers**

Leaf yellowing, wilting and branch dieback in advanced thousand canker disease – DCNR file photo

Management

- No practical control at this time
- Rapid detection necessary
- Quarantines in effect in most states
- For more information
  - http://www.thousandcankers.com/

1,000 Cankers of Walnut

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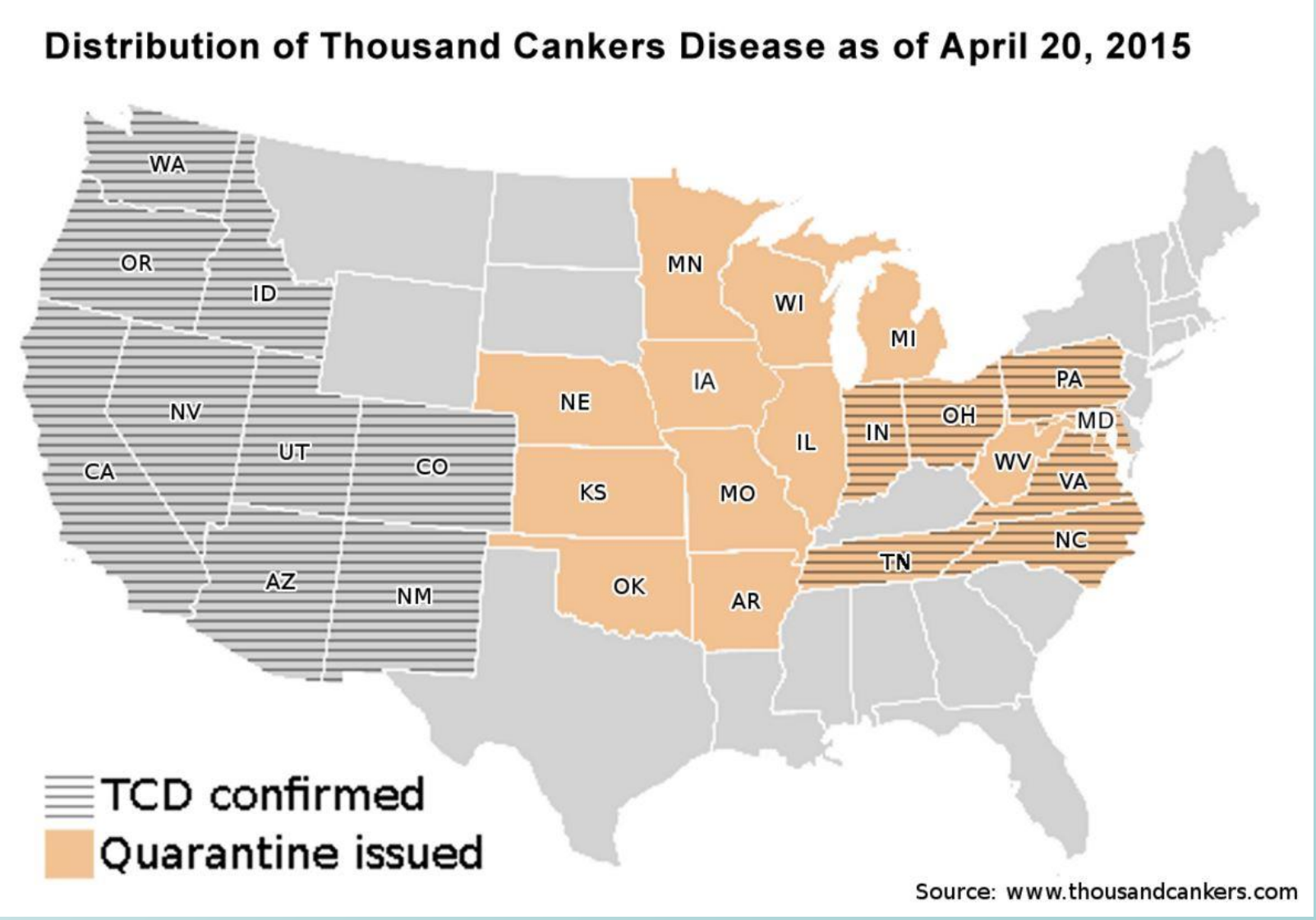

Cytospora canker

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- *Leucostoma kunzei*
- Hosts: Colorado spruce, Douglas-fir, Eastern hemlock
  - Trees stressed by drought or winter injury
  - Older trees (10+ years)

Symptoms

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- Needles on branches turn completely brown to purplish and abscise
- **White to blueish resin encrusts cankers on infected branches**

- Pattern: often starts on the lower branches and moves up

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Galls

Galls - target

- Vascular system
  - Transpiration
  - Sugar storage/movement
  - Structure

Galls

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- A tumor-like, over-growth on any plant part
- Can form on trees by fungi, bacteria, insects, mites & nematodes
- They can girdle branches, stems, and tree trunks

Galls – diagnostic tips

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- Branch dieback
- Physical sign of the gall
  - Can be elusive or can be differently coloured

Galls – management

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- Prune early infections
- Remove inoculum- surrounding trees & debris that are hosting the pathogen
- Preventative fungicide in spring
  Plant resistant varieties

Black Knot of Prunus

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(*Plowrightia morbosa*)

Hosts: ornamental cherry, plum, black cherry

- Fungal pathogen that is spread via wind or rain
- Infects in spring
- Aesthetically unpleasing and destructive

Symptoms

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- 1st year- Small brown swellings on branches
- 2nd year- Brown galls turn olive green/black & become velvety and brittle
- Girdling of branches and trunk

Black Knot Gall

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Vascular Wilts

Vascular wilts - target

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- Vascular system
  - Transpiration
  - Sugar storage/movement
  - Structure

Vascular wilts

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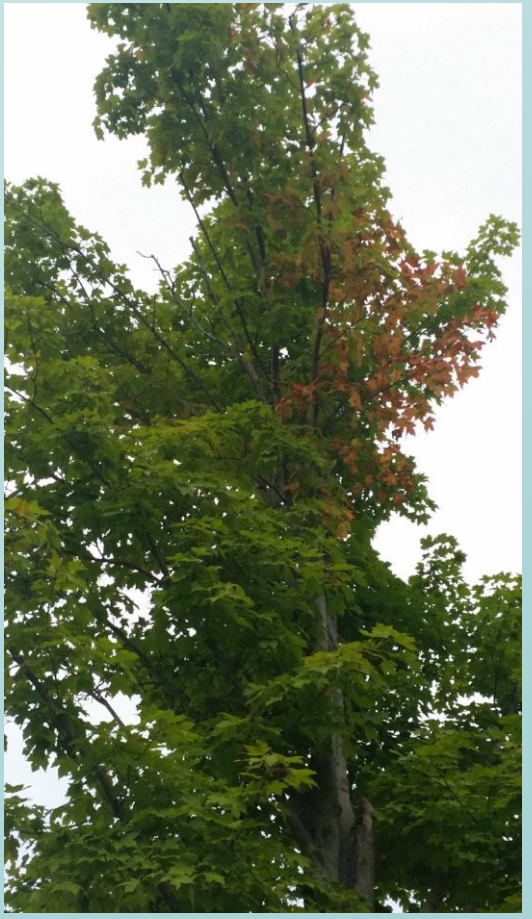
- Systemic pathogen
- Affects the xylem (water) and phloem (nutrients) tissues
- Very difficult to treat



Vascular wilts – diagnostic tips

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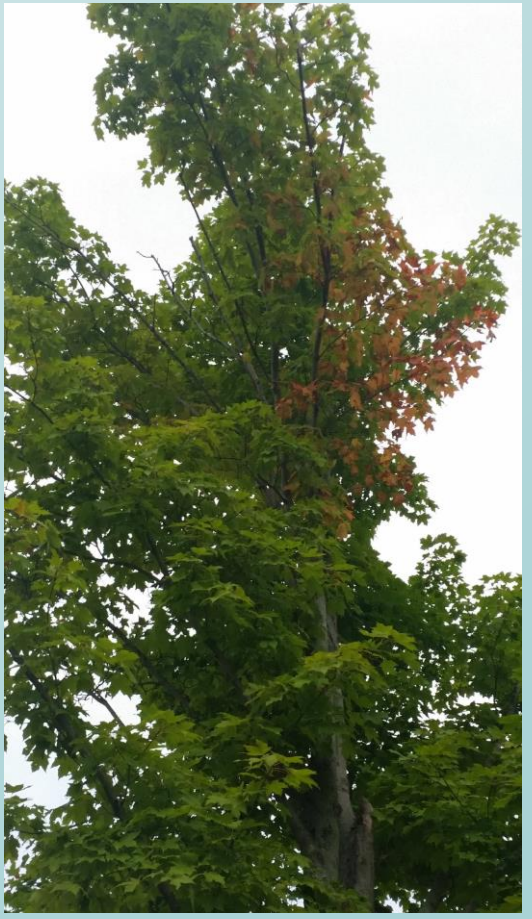
- Causes wilting and discoloration of foliage
  - Very sectional
  - “Flagging”
- Discolouration of vascular system
- Quickly spreads



Oak Wilt

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(*Ceratocystis fagacearum)*

Hosts: Red & White oak families

- Systemic fungus vectored by bark beetles, can also spread via root graft
  - Bark beetles are attracted to the scent of oak wilt mycelium and to the sap of oaks

Symptoms

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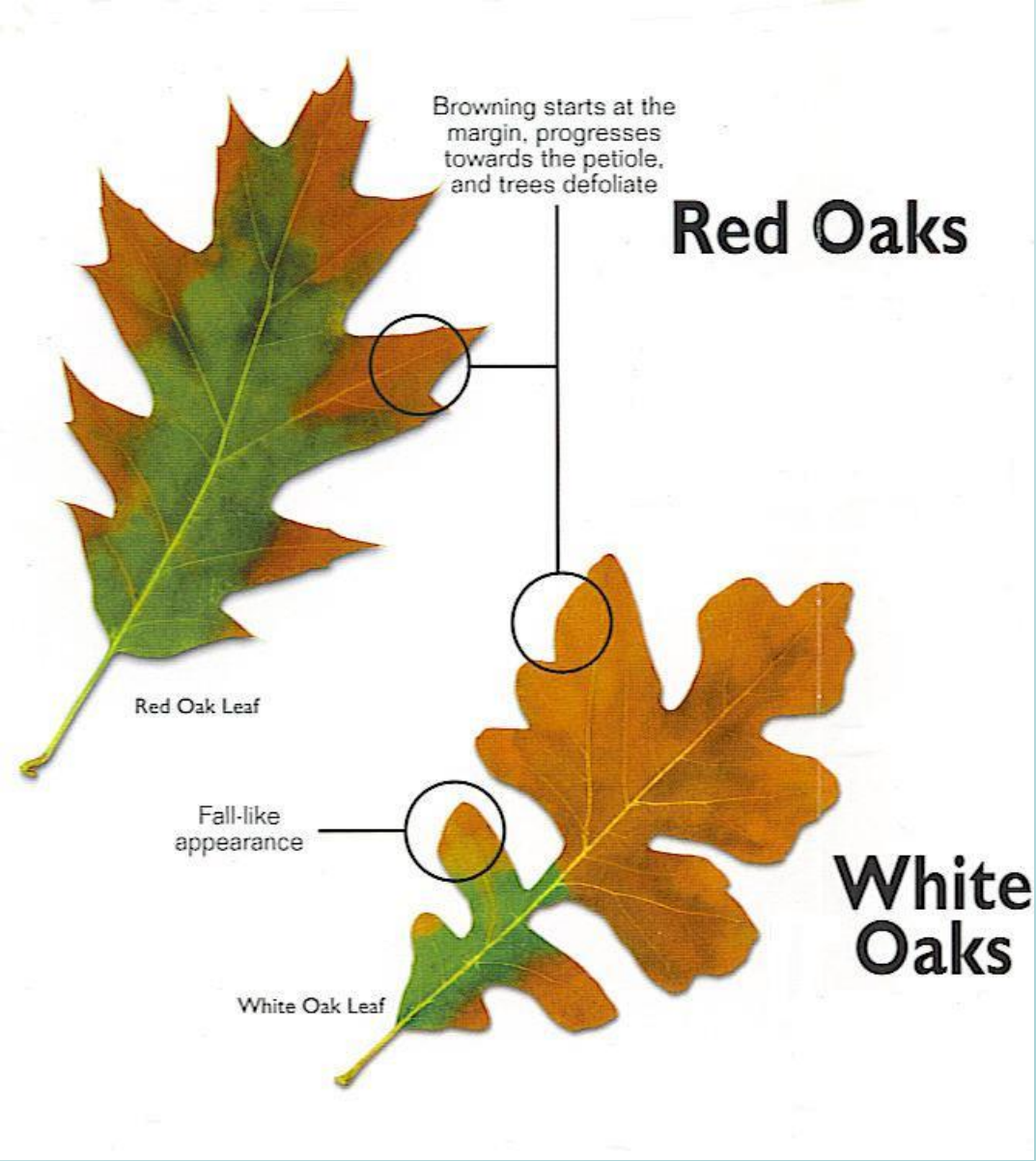
- Branch dieback
- Leaf chlorosis then necrosis
- Premature defoliation
- **Vascular discoloration**
- White oaks can take years to die
- Red oaks can die in less than a year


Browning starts at the margin, progresses towards the petiole, and trees defoliate
Red Oaks
Red Oak Leaf
Fall-like appearance
White Oaks
White Oak Leaf

Oak Wilt

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Oak Wilt

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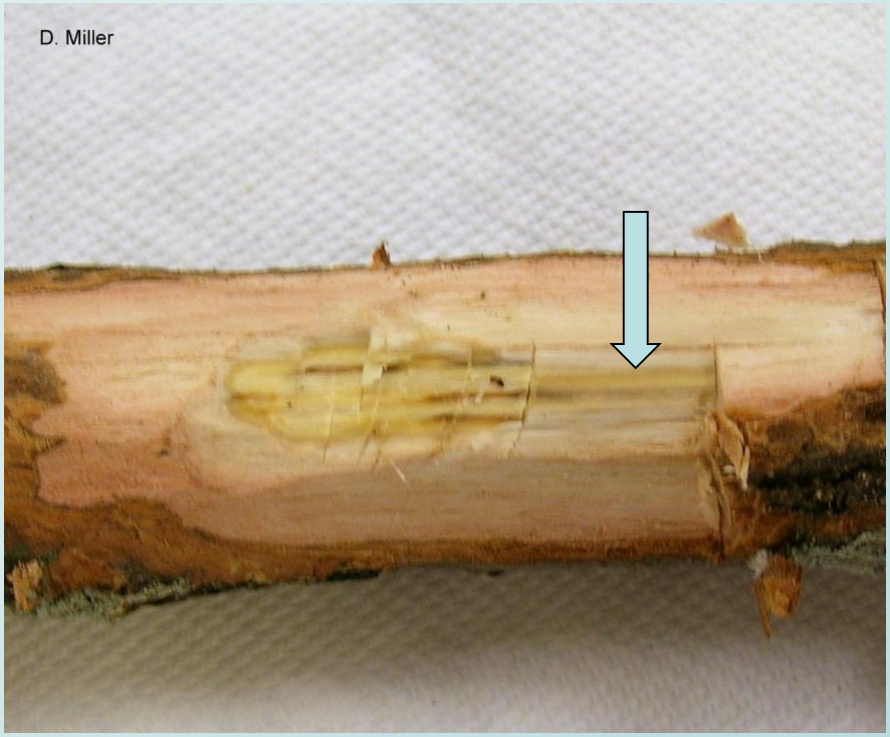

Vascular discoloration

Insect tunneling

Sample Collection

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D. Miller

Management of Oak Wilt

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- Trench between diseased & healthy trees
- Apply preventative fungicide
- Trunk injection:
  - White oak family: curative and preventative
  - No curative for red oak family
- DO NOT Prune during insect flight time (early spring- late fall)

Dutch Elm Disease

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(*Ophiostoma ulmi)*

Hosts: Elm species

- American and European white elms are highly susceptible
- Asiatic species (Siberian Elm, etc.) – tolerant

- DED is a systemic fungal pathogen
- Vectored by Elm bark beetle
- Can also infect via root graft

Symptoms

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- Leaf wilt
- **Vascular discoloration**
- Branch dieback
- Death

Dutch Elm Disease Management

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- Water and fertilize
  - Outbreaks following drought year
- Prune out affected limbs ASAP
- Interrupt root grafts
- Trunk injection
- Plant resistant species:
  - Chinese or lace-bark elm
  - David or Japanese elm

Management of DED

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Trunk injection:

- Preventative: late spring – early summer
- Curative: early - late summer

Verticillium Wilt

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(*Verticillium dahlia)*

Hosts: Maples, dogwood, daphne, red oaks (rare), Catalpa, Ash, Redbud, etc.

- Verticillium persists in the soil
- Associated with drought stress and girdling roots
- Can infect roots directly or indirectly

Symptoms

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- Chlorosis
- Leaf curl
- Leaf stunting
- **Vascular discolouration**
- Crown dieback
  - Sectional
- Eventual death

Management

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- No fungicide treatment
- Selective pruning
- Watering and fertilization
- Plant resistant varieties

Root Rots

Root rots - target

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- Vascular system
  - Transpiration
  - Sugar storage/movement
  - Structure

What is a root rot?

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- Fungal pathogen can enter roots directly or indirectly depending on the fungus
- Most enter stressed trees/shrubs via wounds
- Symptoms in canopy:
  - Chlorosis, wilt, dieback
  - Trees can lie: May show no above ground symptoms
- **Fungal fruiting bodies are an obvious sign**

Phytophthora Root Rot

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Hosts: Many including Rhododendron, Zelkova, Boxwoods

- Need excess water to infect tissue
- Persists in soil
- Enters directly and indirectly

Symptoms

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- Chlorosis and necrosis of foliage
- Wilting
- Root rot
- **Bleeding** on trunk of conifers

- Will need to be sent to a lab to confirm

Phytophthora Root Rot

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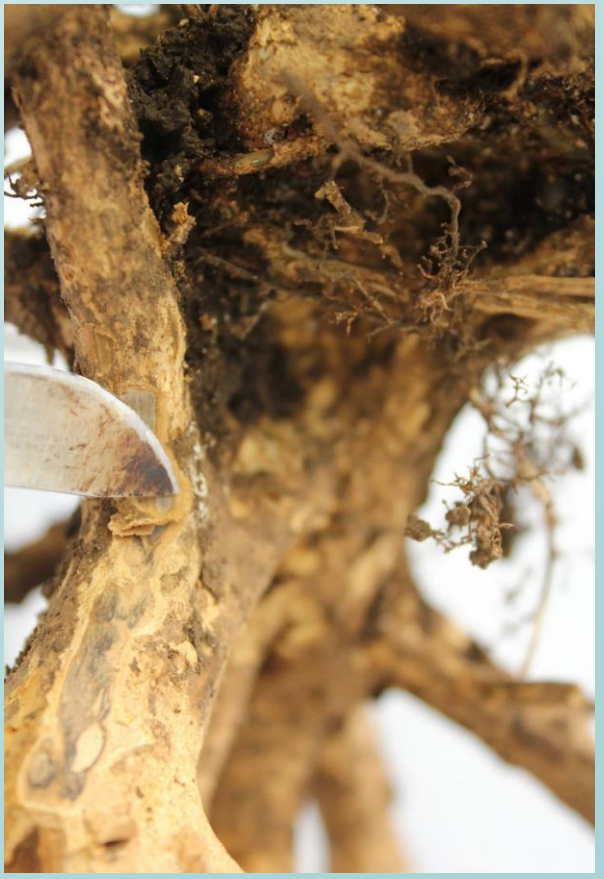

Immunoassay

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Management

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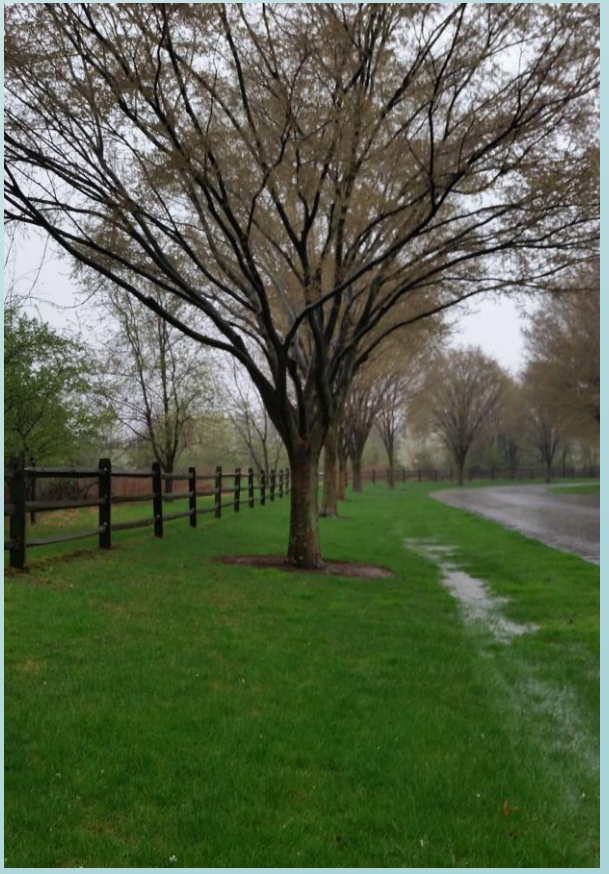
- Pick a site where Phytophthora is not already known to be
- Avoid over-watering
- Good drainage
- Preventative fungicides
- Resistant plants



Wood Rots

Wood rots - target

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- Vascular system
  - Transpiration
  - Sugar storage/movement
  - Structure

Wood Rots:

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- Rots significantly reduce health and growth of tree
- Some trees do not show above ground symptoms
- **Mushroom and conks are obvious sign**
- Create hazardous trees
- Goal is to protect people and property

How Do Wood Rots Gain Entry?

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- Construction damage
- Soil compaction
- Root removal
- Mechanical damage
- Insect/animal damage

Mechanical Damage

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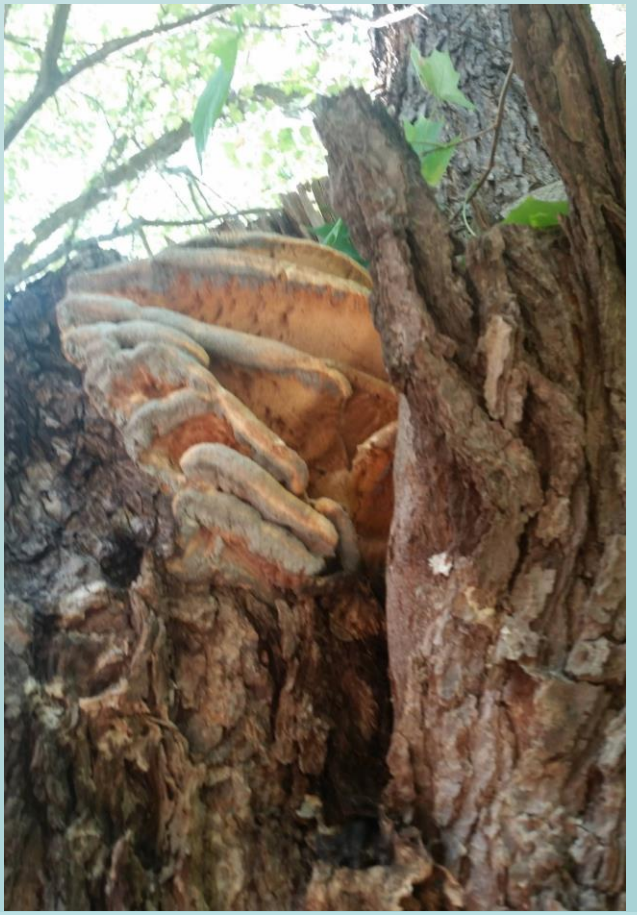
- Lawn mowers
- String trimmers
- Trunk damage



3 Types of Wood Decay

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White rot

- Most common decay fungi
- Degrade **lignin** & erode **cellulose**

Brown rot

- More frequently found on conifers
- Decay cellulose

Soft rot

- Not visibly different than brown or white rot in living trees
- Attack cellulose

Types of Wood Decay

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White rot:

- Leaves a white or bleached appearance to wood
- Wood feels moist, soft and spongy
- Degrade lignin (constituent of cell walls) & erode cellulose
- Significant strength loss only in more advanced stages of decay
- Example: *Armillaria* spp.

Types of Wood Decay

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Brown Rot:

- More frequently found in conifers than hardwoods
- Brown, brittle lignin
- Decays cellulose and hemicellulose
- Significant amount of strength loss in initial stages of decay
- Example: Chicken of the Woods

Oak

Types of Wood Decay

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Soft Rot:

- Soft wood decay
- Attack cellulose
- Significant loss in wood strength
- Attacks links between cell walls and lignin
- Example: *Kretzschmaria deusta*

Wood Rots

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- **The Big 3: *Armillaria* sp., *Ganoderma lucidum*, *Ganoderma applanatum***

- Chicken of the woods
- Hen of the woods
- *Inonotus dryadeus*

Missouri Botanical Gardens

General Wood Rot Management

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- No management available once infected
- Destroy fungal fruiting bodies
- Avoid wounding the tree
- General health care

Armillaria Root Rot

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Hosts: Many deciduous trees and conifers

- Also called: Shoe-string rot and Honey mushrooms
- Multiple species
- #1 of Big 3
- Infects stressed trees through wounds
- Can infect roots via rhizomorphs

Signs & Symptoms

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- Crown dieback
- Leaf chlorosis and necrosis
- Wood rot
- Eventual death

3 Signs of Armillaria root rot:

1. White mycelial mat under bark
2. Black rhizomorphs (look like shoe strings)
3. Mushrooms


U. Of Austin

Crown Dieback

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Signs

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Management

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- Remove severely affected plants and root system
- Trench between affected plants and healthy plants
- Remove soil 2 feet down and several feet in diameter
- Replant with resistant species, such as: crabapple, Leyland cypress, white fir, English holly, maple, madrone, smoke tree, Oregon grape or Scotch pine.
- No chemical treatments for Armillaria root rot

Ganoderma lucidum

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Hosts: Most hardwoods, honey locust, Maples, oaks…

- Also known as ‘Varnish Conk’
- #2 of the ‘big 3’
- Kills cambial tissue of roots
- Moderately fast progressing

Signs & Symptoms

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Sign: Varnish Conk

Symptoms:

- Thinning crown
- Dead branches
- Chlorosis
- Sometimes the tree wont show symptoms, but will have extensive decay

Ganoderma lucidum

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Ganoderma applanatum

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Hosts: Most hardwoods, Maples, Oaks, etc.

- Also known as “Artist’s conk”
- # 3 of the ‘Big 3’
- Perennial conk
- Infect via wounds
- White rot

Signs & Symptoms

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Symptoms:

- Crown dieback
- Root, butt, and trunk rot
- Eventual death

Sign: Conk (fruiting body)

Artist's Conk

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Chicken of the Woods

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(*Laetiporus sulphureus*)

Hosts: Most hardwoods, Oaks, black cherry, etc.

- Choice edible
- Fruiting body emerges from summer to fall
- Brown rot
- Causes extensive decay

Signs & Symptoms

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Signs: porous shelf fungi with multiple overlapping caps

- Soft and fleshy
- Cap color: orange, sulfur, salmon, faded pink
- White to pale yellow flesh
- Yellow to orange pore surface; very small pores

Symptoms:

- Crown decline
- Trunk rot
- Root rot
- Death

Hen of the Woods

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(*Grifola frondosa*)

Hosts: Hardwoods, Oaks, etc.

- Choice edible
- Generally slow progression of white root and butt rot
- See fruiting bodies from late summer into fall

Signs & Symptoms

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Signs: Group of overlapping, grey caps at the base of the tree

- Grey caps with white underside and stems
- Fleshy

Symptoms:

- Sometimes won’t see symptoms
- Crown dieback
- Chlorotic foliage
- White rot

Hen of the woods

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Management

- No products to treat or prevent this
- Not severe

Inonotus dryadeus

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Hosts: Hardwoods, Oaks, etc.

- Also known as ‘weeping conk’
- Slow progressing white root and butt rot
- Very irregular in shape
- Water-like exudate on surface when a fresh specimen
- Found at crown (close to ground) or on roots

Signs & Symptoms

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Sign: Fruiting body with a velvety, cream/tan cap

- When the fruiting body is new, water-like exudate seeps out
- Varies in shapes and sizes
- Soft top, sturdy body

Symptoms:

- Crown dieback
- White rot of roots and butt of the trunk
- Eventual death

Inonotus dryadeus

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Inonotus dryadeus

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Dryad's Saddle

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(*Polyporus squamosus*)

Hosts: most hardwoods, Maples, Elms, etc.

- Infects from wounds
- Fruiting bodies from spring to
- White rot

Signs & Symptoms

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Signs: shelf fungus with a stem

- Whitish cream color with feather-like, brown scales on the cap
- Large pores
- Can be high up on trunk

Symptoms:

- Crown dieback
- White rot of infected area
- Death (slow)

Dead Man's Fingers

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(*Xylaria polymorpha*)

Hosts: Hardwoods including Maples and beech

- Black finger-like structures (stomata) appear in spring
- White butt and root rot
- Can kill cambium
- Only attack stressed trees

Signs & Symptoms

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Signs: black finger-like fruiting bodies

- Usually in groups of 3 or more
- Will persist for the season

Symptoms:

- Thinning canopy
- Bark lesions
- Damaged roots
- Decline/death

Importance of Hazardous Trees

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- They are everywhere
- Dangerous
- The can kill & injure people and cause serious problems

Rust Fungi

Rusts - target

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- Leaves
  - Transpiration
  - Respiration
  - Photosynthesis

Rust

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- Rust fungi have multiple types of spores
- Most need two different hosts: primary and alternate
- Called ‘rust’ because one spore type looks like rust

Cedar Apple Rust

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Hosts: Juniper & Apple/Crabapple

- Requires 2 hosts
- Different symptoms on each host
- 3 spore types

Signs & Symptoms

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Signs:

- On Juniper- orange gelatinous ball with horns
- On Apple- Aecia on underside of leaf

Symptoms:

- Juniper – Brown, perennial galls
- Apple- yellowish orange leaf spots after bloom

Juniper host

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Apple host

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Hawthorne Signs & Symptoms

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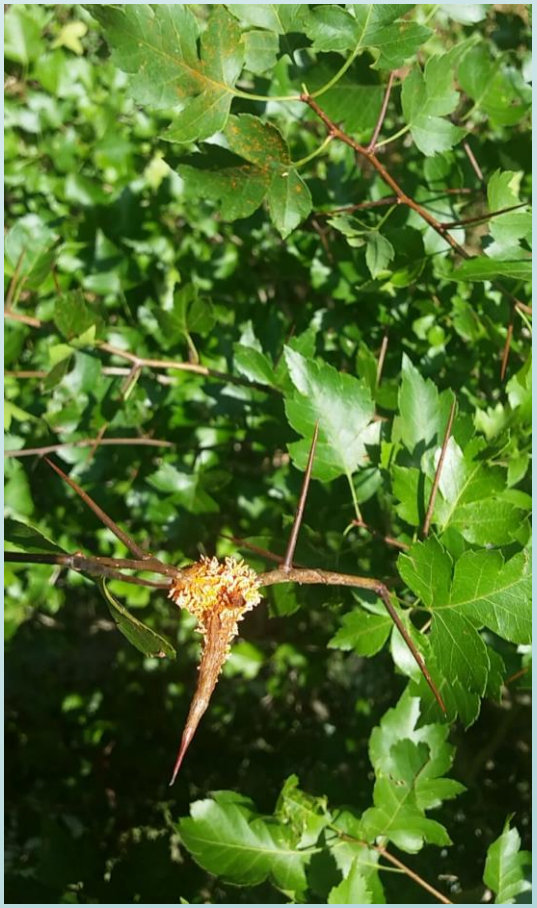

Management

- Destroy alternate host
- Prune
- Preventative fungicide
- Leave it alone- typically only aesthetic

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Bacteria

Bacteria

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- Few of diseases in the landscape are caused by bacteria
- Symptoms can often look similar to other organisms
  - Laboratory diagnosis looking for signs will be needed to confirm

Bacterial diseases

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- Leaf spots
- Blights
- Scorch
- Wetwood

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Leaf diseases

Leaf spots - target

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- Leaves
  - Transpiration
  - Respiration
  - Photosynthesis

Leaf spots – diagnostic tips

- Can look very similar to fungal leaf spots
  - Can sometimes have “halos” around the lesion
  - More angular

- For sure way is if there are no fruiting bodies present and there is bacterial streaming

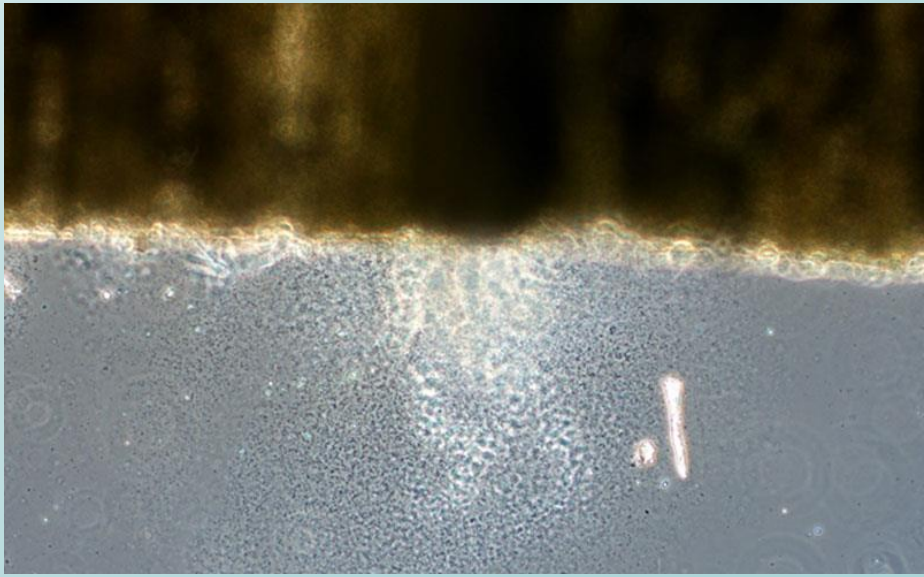

Photo: www.aps.net

Bacterial leaf spot

- *Xanthomonas campestris*
- Hosts: English Ivy

- Bacteria is favoured by wet, rainy weather
  - Wounding allows entry

Symptoms

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- Water-soaked spots that are dark brown
  - Can have yellow halos
- Premature defoliation
- Black cankers on the petioles and stems

Management

- Prune out infected stems
  - Sanitize pruners in between cuts
- Apply bactericide in the spring

Bacterial leaf spot

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- Can be confused with Colletotrichum leaf spot which is caused by a fungus
  - Diseases occur at the same time

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Scorch

Scorch - target

- Leaves
  - Transpiration
  - Respiration
  - Photosynthesis

Scorch

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- Marginal necrosis on leaves

- Can be caused by moisture extremes, wind, salt, and nutrient extremes
  - Symptoms will look uniform, affecting older and newer leaves similarly
- Scorch caused by bacteria will be irregular
  - A yellow or red band will appear between the green and scorched tissues
  - Will be progressive

Bacterial leaf scorch

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- *Xylella fastidiosa*
  - Xylem-limiting bacteria
- Hosts: buckeye, dogwood, elm, maple, oak, plum, sycamore
  - Enhanced by trees stressed by abiotic factors
- Insect vectored
  - Leafhoppers feeding in spring

Symptoms

- Chlorosis and necrosis of the leaf margins
  - Distinct transition zone
- Dieback leading to death
- Symptoms appear in late summer/early fall

Bacteria leaf scorch

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Management

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- PHC
  - Proper watering
- Root flare injection of an antibiotic annually

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Vascular issues

Vascular wilts - target

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- Vascular system
  - Transpiration
  - Sugar storage/movement
  - Structure

Blights – diagnostic tips

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- Sporadic tip dieback
  - Can be entire branch
- Necrotic areas have a “withered” or “burnt” look to them
- Can be associated with cankers or vascular issues, but not always

Fire blight

- *Erwinia* sp.
- Hosts: ornamental pear, Prunus species, crabapple

- Favoured by rain
- Vectored by bees
- Can enter through wounds
  - Hail

Symptoms

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- Necrotic tip dieback
  - Can lead to entire branch dieback
- **Shepard's crooking at the tips**
- Can form oozing cankers in springtime


Texas Plant Disease Diagnostic Lab

Management

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- Prune out infected branches in the dormant period
  - Late summer into winter
  - Sanitize between cuts
- Preventative treatments
  - Begin treatment before blossom and reapply 5-7 days after.

Viruses

Virus- target

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- Leaves
  - Transpiration
  - Respiration
  - Photosynthesis
- Flowers/fruit
  - Reproductive potential

What is a Virus?

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- Systemic
- Obligate parasite
- Transmission:
  - Insect vectored
  - Grafting
  - Mechanical
- Microscopic

Virus Vector

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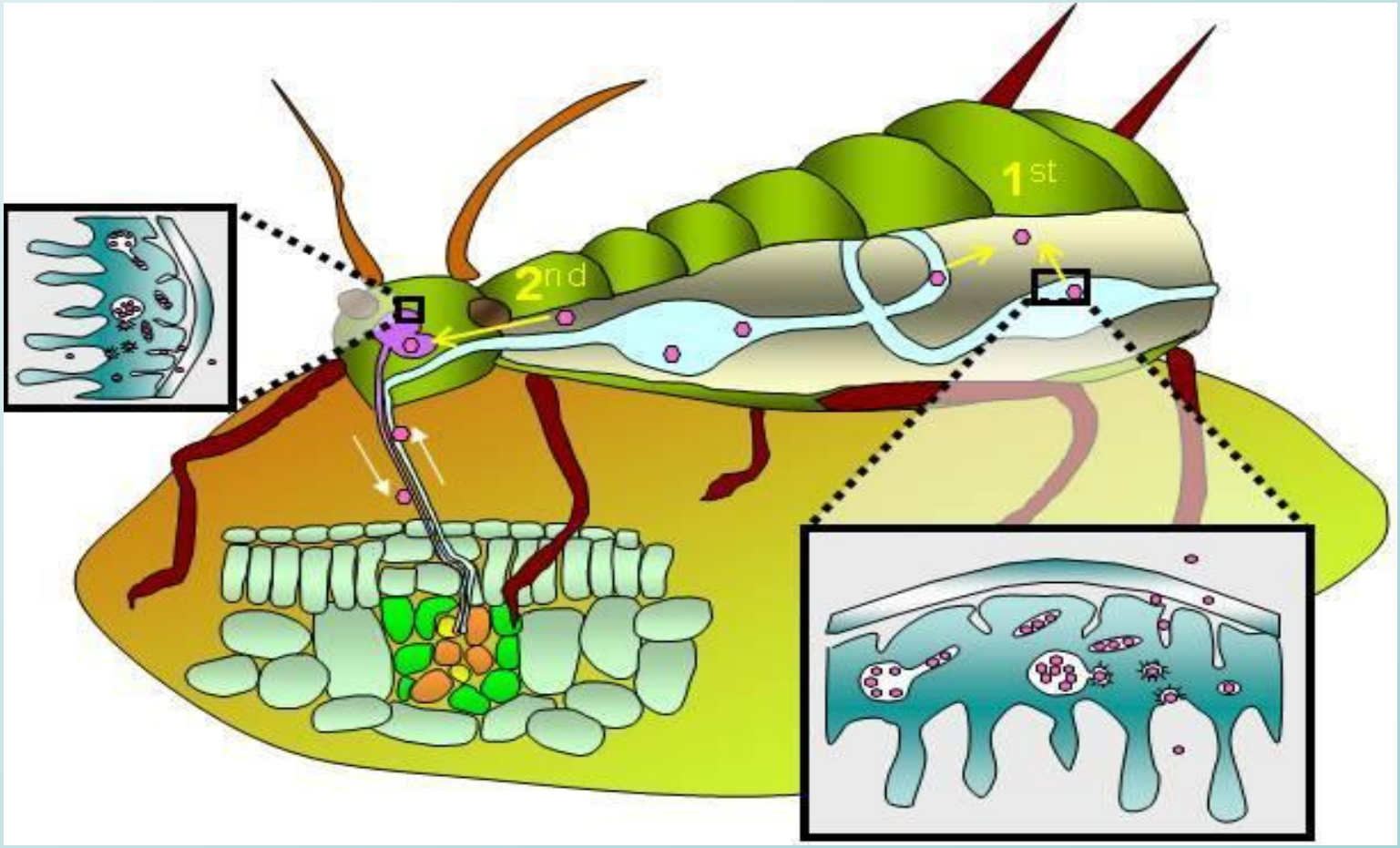

Rose Mosaic Virus

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Complex of viruses- Prunus Necrotic Ringspot Virus, Apple Mosaic Virus and Arabis Mosaic Virus

Host: Roses

- Not contagious in field (maybe root graft)
- Nursery stock

Rose Mosaic Virus Symptoms

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- Highly variable symptoms
- Mottling: color-breaking in foliage
- Flower, bud & foliage distortion
- Reduced vigor
- Less flowers
- Generally not harmful to plant

Rose Mosaic Symptoms

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Rose Rosette Disease

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Hosts: All cultivated *Rosa* spp. are susceptible

- Virus transmission: May through mid-July (active growth)
- Vectored by eriophyid mites
- Small plants can die within 2 years
- Large plants may survive in a deteriorated state for up to 5 years

Rose Rosette Symptoms

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- Increased growth of vegetative shoots - Witches' Brooming
- Leaves become:
  - deformed, brittle, crinkled, red, stunted
- Often mistaken for **herbicide** damage

Rose Rosette Disease

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Rose Rosette Management

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- Completely destroy all infected plant tissue
- Spray **miticide** every two weeks during growing season
- Get plants from reputable source

Nematodes

What is a Nematode?

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- Unsegmented round-worm
- Microscopic
- Plant parasitic- must have stylet
- Extracts plants nutrients
- Extremely detrimental

Pine Wilt

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(*Bursaphelenchus xylophilus*)

Hosts: Pine species

- Can kill tree in a matter of weeks – months
- Pine Sawyer beetle vectors nematode
- Blue fungus vectored by a nematode

Signs & Symptoms

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Signs: nematode, Pine Sawyer beetles, blue stain fungus in wood

Symptoms:

- Needle discoloration > death
- Browning from top down
- Retention of dead needles
- Death

Management

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- Timely removal and destruction of trees killed by pine wilt disease
- Do not save firewood
- Sample submittal:
  - Branch sections 2.5 “ dia. 6 “ long or
  - Several 2” X 2” lower trunk sections
- Preventative **insecticide** injections
- Moderately to highly resistant: Eastern white pine, jack pine, loblolly pine, lodgepole pine, pitch pine, and ponderosa pine

Lesion Nematodes

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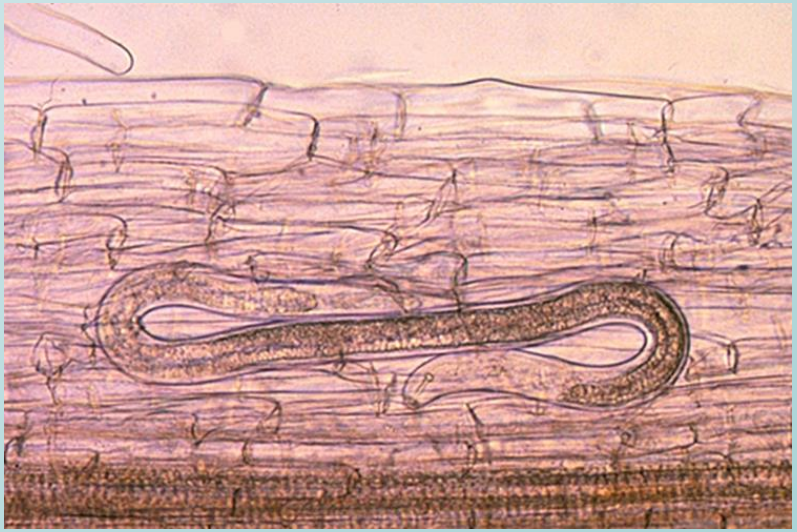
(Pratylenchus spp.)

Hosts: Over 400



- Migratory, intercellular root endoparasites
- Can have synergistic reactions with root rot pathogens
- Detrimental to crops

Signs & Symptoms

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Signs: Nematode

Symptoms:

- Stunting
- Nutrient and water deficiencies
- Lesions
- Eventual dieback

- Nematicides (typically not practical)
- Sanitation
- Replant non-host
- Destroy affected plant

Harmful Plants

Different Types of Harmful plants

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Parasitic- need host to live; obtain nutrients and water from host

- Host becomes weaker; may die

Invasive- does not directly penetrate host, but can slow growth

- Competition

Allelopathy- chemical(s) produced from one plant that can harm another plant/ organism

Harmful plants

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Parasitic:

- Dwarf & American Mistletoe
- Dodder

Invasive:

- Kudzu
- English Ivy

Allelopathy:

- Black Walnut

Dwarf Mistletoe

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(Arceuthobium spp.)

Hosts: Gymnosperms (Conifers)

- Each species tends to be host specific:

  1-2 hosts
- Obligate parasite
- Endophytic – anchor to tissue and extract nutrients
- Mistletoe shoots visible 3-5 years after infection

American/Leafy Mistletoe

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(*Viscum* spp.)

Hosts: Angiosperms and some gymnosperms

- **Hemiparasitic-** derives portion of nutrients from its own photosynthesis
- Seeds spread by birds
- Initially attaches to branch via sticky material, **viscin**, on the seed

Signs & Symptoms

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Signs: **Dwarf Mistletoe & American Mistletoe shoots**

Symptoms:

- Swelling of the stem
- Chlorosis
- Wilting
- Witches' Brooming
- Tree decline/ death

Dwarf Mistletoe Management

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- Prune infected branches
- Plant non-host
- Sanitation- remove infected trees

Dodder

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(*Cuscuta* spp.)

Hosts: Many

- Germinate independently of host
- Each plant is capable of producing several thousand seeds
- **Haustoria** directly penetrate host tissue
- Extract water and nutrients

Dodder Signs & Symptoms

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Sign: Dodder plant

Symptoms:

- Reduced plant growth
- Reduced vigor- entry for other pathogens
- Discoloration of foliage

Management of Dodder

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- Remove and destroy plants before the seed sets in host
- Destroy host plants if severely infected
- Plant resistant plants

Kudzu

(*Pueraria lobata*)

Hosts: Vine that grows on anything it can grab

- Can grow 60 ft each growing season (1ft / day)
- **Structural parasite**- grows on other things to reach light
- **Paraheliotropic** leaf movement- maximize photosynthesis; leaves move with sun movement

Symptoms & Management of Kudzu

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- Loss of carbohydrate production due to photosynthesis inhibition
- Breakage in branches and trunks due to weight of Kudzu
- Stunting
- Death

Management:

- Burning
- Grazing by animals
- Herbicides

Kudzu in IL

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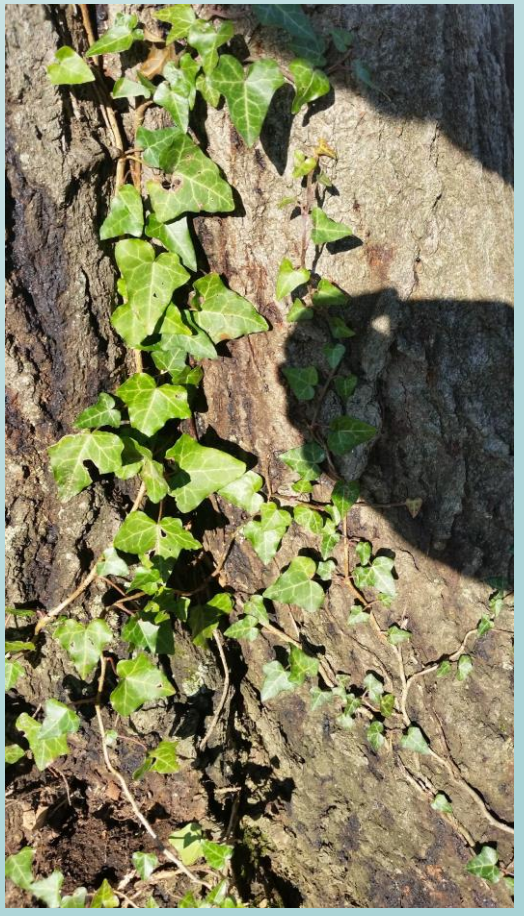
English Ivy

(*Hedera hibernica* and *Hedera helix*)

Host: Anything it can grow on/up



- Vine that can grow on most anything- i.e. Houses, trees, etc.
- Complete coverage of trees and shrubs
- Rapid growth

Symptoms of English Ivy

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- Can cover a plant, reducing or inhibiting photosynthesis
- Weight of the plant can cause breakage or weaken the plant

Black Walnut

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(*Juglans nigra*)

Produce **allelochemicals** that disrupt many plant species

- Hydrojuglone oxidizes into Juglone- Highly toxic
- Can cause chlorosis, wilt, and even death

Management: Clean up debris from Black Walnut

- High level of organic matter in soil
- Plant resistant species to juglone

New, Unknown Disease

Beech Leaf Disease

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(unknown)

Host: American and possibly European Beech

- Lake County, Ohio 2012
- Ohio, NW Pennsylvania, and SW New York

Symptoms: Striping on leaves

- Darkening between leaf veins
- Discolored & shriveled leaves