



### History of Plant Pathology

After the fall of the Roman Empire (800 – 900 A.D.)

- Poor people relied on rye as a primary food source
- Ergot (fungus) infected rye
- Ergot inadvertently ground with grain and made into bread

### History of Plant Pathology

- Ergot poisoning or St. Anthony's Fire
- Hallucinations
- Constriction of blood vessels, Gangrene
- Problem decreased with use of potato as staple food

### History of Plant Pathology

- Potato late blight (fungal disease)
- Cool wet summers in 1840s
- Caused potato famine in Ireland (1845–1852)
- 1.5 million people immigrated to US

### What is Plant Disease?

- Plant Disease = any disturbance of a plant that interferes with its normal growth and development
- Two Types of Plant Diseases
  - Biotic Diseases – caused by **living** agents such as bacteria, fungi, etc. (plant pathogens)
  - Abiotic Diseases – caused by **nonliving** agents such as drought, cold damage, accidental chemical injury, etc. (noninfectious disorders)

### Different Types of Biotic Diseases

Powdery mildew on zinnia (disease)

Cedar apple rust on cedar tree (disease)

Boxwood leaf miner (insect)

## Leaf Miners

Boxwood leaf miner



Columbine leaf miner



Columbine leaf miner

## Different Types of Abiotic Diseases



Leaf scorch on dogwood (drought)



Dog urine damage to turfgrass  
Aka 'Dog spot'

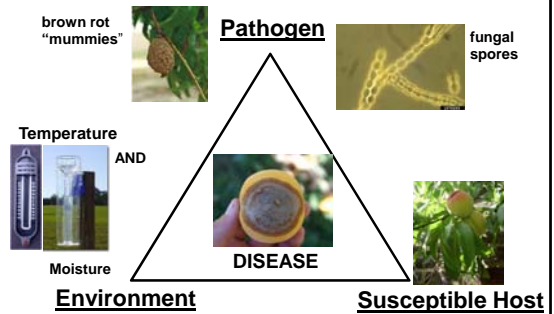
## The Disease Triangle



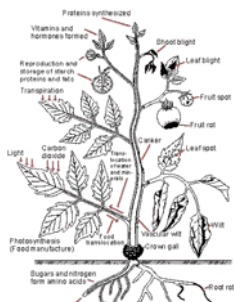
- Pathogen – fungus, bacteria, etc.
- Susceptible Host
- Favorable Environment
- Need all three for disease development

## Disease Triangle For Brown Rot on Peach

Conditions Needed for Disease to Occur



## Disease Symptoms



Agrios 1997

- Symptoms are visible evidence of a change in appearance or function of the plant
- Wilt, leaf spots, fruit rot, leaf blight, etc.
- On-Line Glossary of Technical Terms in Plant Pathology  
<http://ppathw3.cals.cornell.edu/glossary/Glossary.htm>



Phil Harrison  
University of Florida

## Leaf Spot



- Dead spot with definite, regular or irregular margins
- Spots may be circular, angular, or irregular in shape

## Leaf Spots

Cercospora Leaf Spot (fungus) on Bigleaf Hydrangea



Bacterial Leaf Spot on Oak Leaf Hydrangea



## Blight



- Sudden death of twigs, leaves or flowers



## Cankers



- Dead spot on a stem, twig or branch
- Often discolored and raised or sunken
- Cracked surface



## Galls



- A swelling of plant tissue (leaf, stem, root)
- Caused by fungi, bacteria, insects or mites

## Galls

In Mexico, Cuillacoche (kweat-tla-koh-chay) is a delicacy



## Galls

Camellia leaf gall



## Galls



Azalea leaf gall

## Disease Agents (Living or Biotic)

- Fungi
- Bacteria
- Viruses
- Phytoplasmas
- Nematodes

## Fungi

- Most are beneficial decomposers
- Extremely good at breaking down living and dead tissue and absorbing their nutrients
- Have no chlorophyll
- Reproduce and spread by spores carried by wind, water or animals
- Fruiting structures like mushrooms
- Show vegetative growth through fungal threads

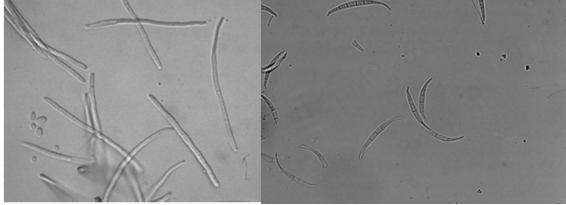


## Fungal Threads (Hyphae)



Vegetative growth - 400X Magnification

## Spores



## Fungi

- 300,000 species of fungi described; most are not plant pathogens
- Fungi cause over 80% of all plant diseases
- Common fungal diseases are powdery mildew, rusts, leaf spots, root rots, etc.

## Early Blight of Tomato



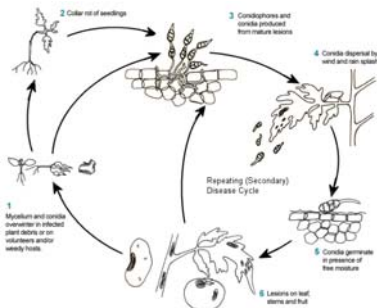
W. R. Stevenson

- Very common disease
- Leaf spots, stem cankers, fruit rot
- Often defoliates plants
- Starts on older leaves and moves up

## Early Blight of Tomato



## Early Blight of Tomato



## Foliar Disease Management

- Remove tomato residue after harvest
- Plant disease-free transplants
- Keep tomato plants healthy and vigorous following a good fertility program
- Scout garden twice-a-week
- Follow a fungicide spray program when environmental conditions favor disease

## Fungicide Program for Tomato

- Begin applications 5-10 days after transplanting or at 'first sign of disease'
- Apply fungicides every 7-10 days
- Active ingredients including chlorothalonil, copper, mancozeb (See list of brand names)
- 5-day Pre-harvest interval (PHI) with Mancozeb
- 0-day PHI for most chlorothalonil and copper products, but check label
- Always read the manufacturer's label directions

## Chlorothalonil and Mancozeb Fungicides

- Chlorothalonil
  - Bonide Fung-onil
  - Ortho Disease B Gon Garden Fungicide
  - Fertilome Broad Spectrum Landscape & Garden Fungicide
  - Hi-Yield Vegetable, Flower, Fruit and Ornamental Fungicide
- Mancozeb
  - Bonide Mancozeb Flowable w/Zinc

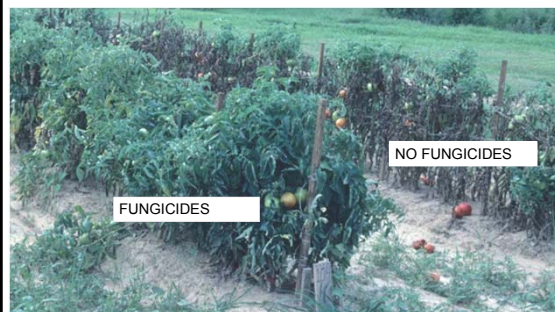


## Copper Fungicides

- Bonide Liquid Copper Fungicide
  - Hi-Yield Copper Fungicide
  - Concern Copper Soap Fungicide \* (OMRI listed)
  - Ortho Elementals Garden Disease Control \*(OMRI listed)
  - Natural Guard Copper Soap Liquid Fungicide \*
- \*Copper Octanoate (copper soap)



## TOMATO WITH AND WITHOUT A FUNGICIDE SPRAY PROGRAM



## Powdery Mildew

- Common fungal disease in southeastern landscapes
- White to greyish mold on leaves
- Fall and spring – cool nights, warm days, high RH
- Use resistant cultivars
- If spraying, start late April/May at first sign of disease
- Fungicides:
  - Bonide Liquid Copper
  - Spectricide Immunox
  - Fertilome Systemic Fungicide



Powdery mildew on dogwood

## Powdery Mildew



Dusty, powdery appearance on leaves

## Too late for fungicides



## Rust



Rust on hollyhock

- Produce 'blister-like' pustules on leaf surface containing powdery spore masses which are brown, reddish-brown, orange, or yellow
- Rust diseases favored by wet weather with moderate temperatures
- Heavily infected leaves turn brown and die
- Common on aster, daisy, daylily, geranium, snapdragon, goldenrod

## Rusts - Leaf undersides have powdery orange deposits



## Daylily Rust



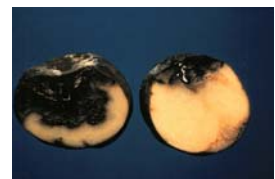
## Daylily Rust



Daylily infected with *Puccinia hemerocallidis*

## Bacterial Diseases

- Microscopic, single-celled organisms that multiply rapidly
- Bacteria enter through wounds or natural openings (stomates)
- Some cause leaf spots, crown gall, wilts



Soft rot of potato



Bacterial Spot on Pepper

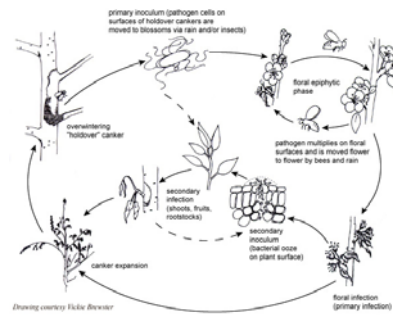
### Fire blight on pear



### Fire blight on apple



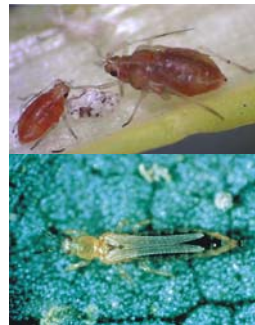
### Fire blight (Pear and Apple)



### Viruses

- Submicroscopic particle that requires a host cell in which to multiply
- Most require a living host to survive.
- May overwinter in weed or ornamental hosts
- Many are spread by insects (vectors)

### Disease Vector

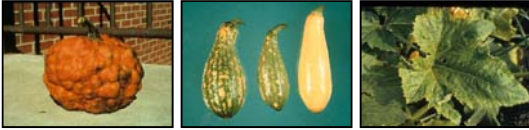


- Organism that can transmit a pathogen
- Insects (aphids, thrips, etc) and Nematodes often transmit viruses



## Virus Symptoms

- Mottled leaves; mosaic leaf patterns
- Distorted leaves
- Stunted plants
- Fruit are often smaller size, mottled and deformed



## Virus Symptoms



Flower Color Breaking on Flowering Tobacco

## Tomato Spotted Wilt Virus

- Virus disease spread by tobacco and western flower thrips
- Infected plants are often stunted, may die
- Terminal leaves stop growing, become distorted and turn pale green
- Leaves have a purple/bronze appearance
- Speckling and ring spots form on leaves
- Dark streaks develop on petioles and stems
- Fruit may also have ringspots



## Tomato Spotted Wilt



## Tomato Spotted Wilt Virus



David Langston, University of Georgia, Bugwood.org

## Tomato Spotted Wilt Virus



## Tomato Spotted Wilt Virus



## TSWV on Pepper



## Tomato Spotted Wilt

- Management options:
  - Resistant Varieties – best option
    - Amelia, Bella Rosa, BHN444 (Southern Star), BHN640,
  - Control thrips – limited benefit
    - Products containing Spinosad
  - Reflective plastic mulch
  - Remove infected plants to limit further spread
  - Control weeds – reservoir for viruses (bittercress, dandelion, chickweed, woodsorrel, and others)

## Rose Rosette Disease



## Rose Rosette Disease Witches' Broom



### Rose Rosette Disease Excessive thorns



### Rose Rosette Disease Red pigmentation of new growth



### Phytoplasmas (Mycoplasmas)

- Similar to bacteria, but lack cell wall, and are smaller
- Submicroscopic (electron microscope)
- Transmitted by leafhoppers, planthoppers, and spittlebugs
- Cause yellowing-type diseases
- Leaves become yellow, leaf size reduced, plants stunted, flowers may be green

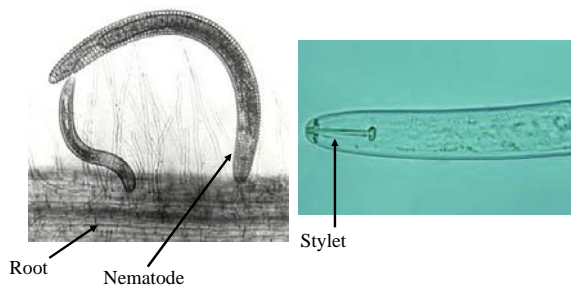


Aster yellows on coneflower

### Nematodes

- Microscopic worm-like organisms
- Majority do not feed on plants. Many feed on microorganisms.
- Some are parasites on grubs and other insect pests.
- Most plant parasitic nematodes feed on roots, some on leaves

### Nematodes



### Symptoms of Nematode Damage

- Stunting
- Leaf yellowing
- Loss of plant vigor and/or overall health
- Reduced yields
- Wilting (when soil is wet)
- Non-uniform distribution of symptomatic plants in garden
- Symptoms more pronounced when plant under stress from other factors

## Symptoms of Nematode Damage



Comparison of healthy and diseased impatiens

## Root Knot Nematodes



## Root Knot Nematodes

Damage on Gardenia



Damage on Watermelon



## Root Knot Nematode Control

- Nematode control can be difficult
- Most nematode problems go unnoticed until damage is severe
- Inspect new plants
- Examine dying plants for root damage, remove plants and surrounding soil

## Root Knot Nematode Control

- Choose plants that are poor hosts. See ANR--0689.
- Soil Solarization (6-8 weeks)
- Laboratory Soil Sample Analysis
- No effective chemical nematicides that can be applied in the landscape.

## Soil Solarization



## Abiotic (Nonliving) Diseases

- Nutrient Deficiencies/excesses
- Moisture Deficiencies/excesses
- High or low pH soils
- Misapplication of a fertilizer or pesticide
- Air pollution
- Cold damage

## Abiotic Diseases

- Nutrient deficiencies
- Iron Chlorosis
- Usually associated with high soil pH



## Abiotic Diseases

- Unintentional herbicide drift
- Distortion and curling
- May look similar to virus symptoms
- Affects multiple plant types in same landscape location



## Roundup Injury

Injury on left – healthy on right

Application to non-dormant turf



## Human Error and Weather

Droughty soil over drain line

Frost damage (fall)



## Abiotic Disease



Strap Girdling Stem (Improper planting)

## Planning can Avoid Problems

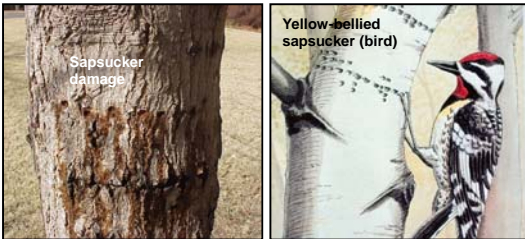
Example: Buyer's inspection will see root rot



## Common Plant Problems

### Sapsucker Damage

Sapsucker damage can be confused with boring insect damage



### Sapsucker Damage



Symptoms barely noticeable at distance

### Sapsucker Damage on Chinese Holly



### Blossom-end Rot from Calcium Deficiency

Early symptoms of blossom-end rot

Later symptoms of blossom-end rot



## Dog Vomit Slime Mold

Feeds on organisms living on mulch



## Lichens – Do Not Infect Tree



There are 3 types of lichen growing here. Can be indicator of slow tree growth

## Human Error



Fertilizer misapplication

## TESTING YOUR KNOWLEDGE



Biotic or Abiotic Disease?

## Answer - Fungal Disease



Phomopsis Dieback



Biotic or Abiotic?

Answer – insect larvae



Boxwood Leafminer

Biotic or Abiotic?



Notice the sap weeping from branches

Answer – Sapsucker damage



Look closely for line of bird's pecking damage

Biotic or Abiotic disease?



Answer – blossom-end rot, calcium deficiency

Biotic or Abiotic disease?



Phil Harmon  
University of Florida



### Biotic or Abiotic disease?



Answer - **Herbicide damage** from glyphosate (Roundup) application in dormant season

### Biotic or Abiotic disease?



Answer - **Early blight** on tomato

### Biotic or Abiotic disease?



Answer - **Sunscald** often occurs on shade loving plants if rapidly re-situated in full sun

## Questions?

Jim Jacobi  
jacobjc@auburn.edu