Basic Plant Pathology & Troubleshooting Plant Problems

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Learning Objectives

• Define plant pathology
• Economic importance of plant diseases
• Pathogenic and Non-pathogenic diseases
• Disease triangle
• Fungal diseases, fungi reproduction and fungal infection
• Viruses and how viruses are spread
• How diseases are caused by nematodes

History of Plant Pathology

• American Phytopathological Society – 1908
• Irish Potato Famine – 1844
  • intro. potato in 1760 & pop. grew from 2-9m
  • 2m died, 2m emigrated to America
• Chestnut Blight – 1904 – 1940
  • Chestnuts once composed 50% of eastern hardwoods
• Dutch Elm Disease – 1930 – Present
• Sudden Oak Death – 2000 – Present

Plant Diseases

• Fungi (80%)
• Bacteria (10%)
• Viruses (5%)
• Nematodes (5%)
• Phytoplasmas (<1%)

• Over 10,000 species of fungi can cause disease in plants!!
• Over 100,000 fungi are beneficial – strictly saprophytic.

Disease Disorder Terminology

• DON'T BE FOOLED - DO NOT ASSUME THAT ALL SIGNS AND SYMPTOMS OBSERVED ARE CAUSED BY A DISEASE ORGANISM!
  • Biotic (pathogenic) – living disease with random symptoms
  • Abiotic (non-pathogenic) – environmental/chemical stress with uniform symptoms
  • A positive diagnosis of a plant disease is often difficult or nearly impossible on the basis of symptoms alone...
Disease Symptom Terms

- Canker
- Chlorosis (yellowing)**
- Concentric leaf spot
- Damping off
- Decline
- Dieback
- Galls
- Leaf Curl
- Necrosis
- Root rot
- Scab
- Scorch
- Soft rot
- Wilt
- Witches’ broom
- Anthracnose

I. Foliage Diseases

- Generally not considered lethal
- Primarily an aesthetic issue
- Usually not practical to treat large trees
- Prevention is the key to managing:
  - Sanitation
  - Proper pruning
    - Adequate sunlight and good air circulation
  - Proper watering and drainage
  - Maintain tree/shrub vigor and health

II. Stem & Branch Diseases

- Can cause significant damage to trees/shrubs
- May result in total defoliation
- Cankers may weaken stems/trunks
- Dieback of entire branches or canopy
- Often spread to adjacent plant hosts
- Chemical treatments are limited
- Early Detection is the key to management!
- Vascular wilt diseases cannot be treated!
- If in doubt, cut it out!!!

III. Root Diseases

- Often cause roots to decay or rot
- Results in reduced uptake of water and nutrients
- Trees can become susceptible to wind throw
- Often very difficult to diagnose
- Management options are limited
- Prevention is the key to managing
- Almost always the result of environmental stress**

Troubleshooting Tip:

- DO NOT ASSUME THAT JUST BECAUSE YOU FIND AN INSECT OR A DISEASE THAT THEY ARE THE SOLE REASON FOR THE PLANT’S DECLINE!
  - Secondary Diseases – saprophytic, beneficial, or “weak” pathogens
  - Primary Diseases – parasites
  - Combination of primary and secondary diseases
  - Other Stress Factors..... “complex”
Disease Triangle

- Susceptible Host
- Pathogen
- Environment

Disease Triangle

- Right Timing
- Disease
- No Disease

Hyphae

Fungal Diseases

Disease-causing fungi

Fungal Phylogeny

Black spot on Rose

Prune → Mulch → Spray
Fruiting Bodies

Pycnidia develop releasing conidia in tendrils. The fungus can remain viable for at least 2 years in dead tissue.

Phomopsis tip blight

Powdery Mildew cleistothecium

Fusarium spores

Thielaviopsis spores

Pythium oospore
Powdery Mildew – Fungal disease of leaves on most broad-leaved trees and shrubs causing little lasting damage except possible dwarfing or distortion on heavily infected leaves.

Discula on Dogwood

Primary causal agent: Taphrina sp.

Control:
Chemical control on trees is neither practical nor necessary. Consider raking and removing fallen leaves and composting.

Oak Leaf Blister
Primary causal agent: Taphrina sp.

Entomosporium leaf spot

Early Blight of Tomato
Brown rot of Peach

Cedar-Apple Rust

Fusiform Rust

Telia

Aecia

Fusiform Rust

Causal Agent: Cronartium quercuum

Cankers and Galls on trunks/branches - Seiridium Canker

Distinct, sunken lesions which lead to dieback and death

Black Knot

Common gall on cherries, plums, and peaches.

Symptoms include dieback of branches, thin crowns, and gnarly black galls on trunk or branches.

Control: Prune branch galls six to eight inches below infection. It is impractical to remove trunk galls.
**Dutch Elm Disease** 
**DED**
Yellowing, flagging and branch dieback

**Verticillium Wilt**
Sample Hosts:
- Maple
- Ash
- Elms
- Magnolia
- Redbud
- Yellowwood
- Tuliptree, Yellow Poplar

Symptoms include curling, drying, interveinal chlorosis or reddening, defoliation, wilting, dieback and death.
Infection occurs on stressed trees and is initiated through the roots and wounds.

**Ganoderma** – secondary fungi causing root and butt rot.

Hosts:
- Maple
- Beech
- Hickory
- Ash
- Walnut
- Sweetgum
- Sycamore
- Oak
- Baldcypress

**NEW DISEASES ON THE HORIZON**
**Sudden Oak Death, SOD, Phytophthora ramorum**

- Phytophthora ramorum is a soil-borne fungal pathogen that was accidentally shipped to the Eastern USA in nursery stock from the west (CA, OR, WA).
- This pathogen has been shown to affect over 100 different ornamental plants.
- At this point, we are primarily examining and testing camellias, rhododendrons, azaleas, viburnums and mountain laurels all of which seem to be very susceptible to attack.
- This virulent pathogen has damaged and/or killed many western tree species but we do not know what it will do to eastern varieties, especially our oaks.

**Dealing with Trunk and/or Root Decay Problems**

- In most cases, refer clients to certified arborists for a proper, on-site evaluation.
- Certified arborists can be located by using the ISA web site: [www.isa-arbor.com](http://www.isa-arbor.com)

Visual examinations of soft spots, wounds or actual decay fungi are only indicators. Devices that take actual cores or use other methods to evaluate the extent of fungal damage are preferred.
Bacterial Diseases are spread by wind-blown rain, insects, and mechanical transmission by people.

**Bacterial spots/blights**

**Bacterial Wilt**

**Bacterial Wilt on Melon**

**Bacterial Crown Gall**
Branch and/or Trunk:

**Fire blight**

Symptomology:
- Sudden blighting, death of blooms
- Bacterial ooze may be visible
- Blighted leaves stay attached
- Forms Sheppard’s crook

Causal agent: *Xylella fastidiosa*

Infection through xylem feeding insects such as sharpshooters and treehoppers. Adults can infect throughout their lives.

**Fire Blight**

**Pierce’s Disease**

Fastidious vascular bacteria
Other Hosts for Leaf Scorch

Viruses

Virus particle magnified 100,000 times!

Virus Vectors

Variegations

Nematodes
Plant parasitic nematodes have stylets.

Root penetration by the stylet can prevent root elongation, disrupt cell division, and provide an entrance for other pathogenic organisms.

Endo- & Ecto-Parasitic Nematodes

Lesion Nematode

Lance Nematode

Foliar Nematodes

Phytoplasmas/Mycoplasma-like

Aster Yellows on Coneflower

Cultural & Environmental Problems that Mimic Diseases

- Soil Compaction
- Improper Planting
- Air Pollution
- Mechanical damage
- Herbicide injury
- Parasitic plants
- Drought stress
- Insects
- Lichens, algae, and Spanish moss

- Nutrient deficiencies
- Cold or Heat damage
- Excess soil moisture
- Soil acidity/alkalinity
- Woodpeckers
- Too much mulch
- Competition/Close planting
- Improper pruning
- Over/Under watering
- Too much sun/shade

Sooty Mold
Molybdenum deficiency

Heat injury to Rhododendron

Herbicide Injury

Mechanical damage – weed eaters and lawnmowers

Herbicide Injury - Oak

Eastern Mistletoe

Parasitic plants that reduce tree vigor. They are primarily spread from tree to tree by bird droppings.

Hosts:
- Ash
- Dogwood
- Elm
- Maple
- Oak
- Pecan
- Walnut
- River Birch
Lichens obtain water and nutrients from air and the microbes on bark.

Improper Pruning

Soil Compaction...

Angel Oak, Charleston, SC – 1500 years old!

Drought Stress – on Maple, Pine, Poplar

Woodpecker Injury

Insect Leaf Galls
Applied Controls:
1. Host resistance**
2. Cultural control
3. Mechanical control
4. Sanitation
5. Biological control
6. Chemical control

Resistant Plants
ASK QUESTIONS!!!!
Which disease?
Are diseases in your area?
Has it been tested?

PLANTS MAY LOSE RESISTANCE
Example: Do not plant Bartlett Pears in Georgia!

Cultural Disease Controls
- Avoiding the pathogen
  - Buy seed and plants from a reputable source
  - Inspect plants prior to purchase
  - Control alternate hosts
  - Cultivation & deep plowing
  - Crop rotation
  - Mulching
  - Sanitation

Cultural Disease Controls
- Sanitation
- Disinfect tools
- Remove diseases plants promptly
- Remove senescent plant parts promptly

Cultural Disease Control
- Avoiding conducive environmental conditions
  - Moderate soil moisture; improve drainage**
  - Reduce humidity and increase air circulation
  - Avoid over-head irrigation
  - Water early in the morning
  - Fertilize plants properly
  - Be aware of activities surrounding your plants:
    - Minimize Root disturbance
    - Avoid Soil compaction
Chemical Disease Control

- Fungicides, bactericides, nematicides
- Protectants
- Systemics
- Fumigants

Pest Prevention is Key!

- “REAP” what you sow…
- Resistance: use locally recommended varieties
- Exclusion: use disease-free (or certified) plants & seeds
- Avoidance: fall sanitation program to avoid potential inoculum for next year.
  - remove/destroy diseased plants and plant parts to reduce inoculum.
- Protection: optimal cultural conditions for plants to stay stress-free:
  - scouting/monitoring to catch problems early
  - preventative fungicides at regular intervals
  - manage for resistance; rotate or tank mix chemicals

Georgia Pest Management Handbook

www.ent.uga.edu/pmh

Troubleshooting Techniques

- The Process of Elimination:
  - Have client submit plant samples
  - Have client submit soil samples
  - Have client email pictures
  - Ask questions to investigate problem
- Site Visitations:
  - Rarely “diagnose” diseases in the field
  - Take hand lens or magnifying glass
  - Take sampling equipment i.e. bags, jars, etc.
  - Soil sample probe, bucket, shovel
  - Take digital camera
  - Pruners or pocket knife
  - Take both landscape pictures and close-ups

Sampling Tips

- Advise client how to take a proper sample:
  - 6-8” section of symptomatic plant preferred
  - Include both healthy and unhealthy tissues
  - Keep sample cool and dry!!
  - Bag in a zip-lock bag to contain insects, etc…
  - Collect sample the same day you travel to office
  - If samples are stored, keep in a refrigerator
  - Some clients may need assistance with taking samples… only if really-needed!

Tips on Making Recommendations

- Don’t Forget the “Big Picture”
  - Avoid giving the quick/easy answers
  - Take the opportunity to teach…
  - Integrated Pest Management (IPM)
  - Sustainable Practices
  - Reducing Pesticide use
  - Conserving soil and water
  - Conserving beneficial insects
  - Tree preservation
**Know Your Limitations**

- Master Gardener Volunteers are trained to assist with home horticulture issues/questions:
  - Be sure you know what your client’s question is concerning...
  - Example: Bermudagrass lawn or pasture?
  - All commercial clients/questions should be deferred to the local Extension Agent
  - Don’t try to give too much information over the phone… clients can only absorb so much through conversations.
  - It’s okay to say “We have a great publication on that subject that I can send to you by email or regular mail, whichever you prefer.”
  - Any questions clients may have regarding commercially contracted services and/or disputes should be referred directly to the County Extension Agent.

**Know Where to Find the Answer…**

- It’s okay to tell the client “I don’t know”
- You are NOT expected to know the answer to every question… practically impossible
- Never make up an answer!!
- Let the client know that you will research their question and get back with them…
- Recommendations should be based on University or Government research
- Always look up pesticide recommendations!!

**Troubleshooting Tips**

#1: Ask most of your questions so that they cannot be answered by a yes or no.

#2: Form your initial opinion, if you must, but keep it to yourself and try to eliminate everything else first. Don’t jump at the obvious!

#3: Don’t be afraid to say you don’t know, and don’t feel that you have to apologize for not knowing.

**Troubleshooting Tips**

#4: Never be absolutely positive in your diagnosis—tell the client what you think is the problem.

#5: If in doubt about any information, tell the client you will check on the control recommendation and call them back.

**Troubleshooting Tips**

#6: When a third party might be involved or there is a chance for legal repercussions - Remember we are Government. Do the taxpayers or your county really want you to get in the middle of something that might turn into a lawsuit? If you think “yes” in this particular situation, give it to your agent. A visit will need to be made. Such cases cannot be handled over the phone.

Example: Tree health questions involving a “target”.
Example: Misapplication of pesticides by a landscaper.

**Troubleshooting Tips**

#7: Use the plant diagnostic clinic whenever you have some doubt of what could be the problem.

#8: Don’t worry about telling a person what they don't want to hear. Tell them what you think, and don't let them put words in your mouth!
Troubleshooting Tips

#9: If someone says they read or heard that you do something a certain way and they are asking if you agree, answer with your honest thoughts. However, never disparage the person or article being quoted. This will immediately destroy your credibility. Instead say, "Perhaps that's the experience of that person, but I feel (or the University feels) this ______." Never belittle an authority! NOTE: Quoting the University or a specialist and crediting them with the information gives you immediate credibility.

Troubleshooting Tips

#10: If you pick up on the fact a person seems happy with the way they are doing something, no matter how foolish or wrong it might seem to you, don't come out directly and tell them they are doing something wrong! Only an open mind will accept suggestions to change.

Troubleshooting Tips

#11: Don't work with Commercial Clients (i.e., Pesticide Companies, Nurseries, Lawn Care Maintenance People, Farmers, Bee keepers, etc.). Let the agent handle their special needs.

#12: Never make appointments for the Agent by saying: "I'll ask the agent to stop by and see you." or "The agent will return your call this afternoon" unless you know what you are saying is likely to happen. Let the office secretary make those statements.

Five Steps to Trouble-shooting Ornamental Plant and Site Problems

Step #1
Identify the Plant

Step #2
Learn About the Site
- Weather records
- Observe other plants in the neighborhood
- Structure/texture of the soil
- Drainage
- Soil pH and nutrients
Step #3
Ask Questions

• Never insult the client
• Never make rash statements until you have all the facts
• Take the lead during the conversation

Step #4
Be Prepared to Ask for Samples

• Helpful Diagnostic tools:
  ➢ Hand lens
  ➢ White paper
  ➢ Pocket knife
  ➢ Zip-lock plastic bag
  ➢ Container for insects
  ➢ Soil bags

Step #5
Focus on the Plant

Above ground symptoms

Leaves:
➢ Leaf spots – possibly caused by diseases, spray damage or chemical injury
➢ Marginal burn – drought or excess fertilizer
➢ Shot Hole – insect feeding, disease
➢ Yellowing – deficiency, spider mites, lace bugs or root problems**

Stems:
➢ Cankers
➢ Mechanical injury
➢ Insect wounds
➢ Borers
➢ Internal decay fungi
➢ Animal browsing

Below ground symptoms

Roots:
➢ Are they healthy white or dark brown?
➢ Rotted, decayed appearance?
➢ Planted too deep?
➢ Internal bark browning?
80% of Plant Problems Result from the Inability of the Plant to Tolerate or Adapt to the Environment

More plants are killed in Georgia from too much water than from the lack of water

Avoiding Plant Stress
It’s a Killer!!!