Plant Pathology for Master Gardener “Smarties”

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Outline of Session

Part I

- Establish a basic understanding of what a plant DISEASE is?
- Understand WHY and WHEN plant disease occurs.
- Understand the differences between BIOTIC and ABIOTIC plant disease problems.
- Recognizing clues that point to plant disease problems.

“We must be curious to see if what we see is what we seem to see. We must analyze it, open it up, turn it over, look underneath it, and look behind.”
James G. Horstfall.
Recognizing Plant Diseases
Part II
- Abiotic disorders
- Bacterial Pathogens
- Fungal Pathogens
- Viral Pathogens
- Parasitic Plants/Nematodes
- Diseases vectored by insects

Management Strategies
Part III
- Quality nursery stock
- Proper care prior and post transplanting
- Maintenance of landscape
- Avoidance
- Chemical/bio control

Submitting Samples to TPDDL
Part IV
- Sample selection
- Proper care prior to shipping
- Complete form
- Proper packaging
- Back at the lab
Resources available

Part V
• TPDDL website
• AgriLife Bookstore
• Social Media (Facebook)

Part I

• Plant Pathology – The study of plant diseases
  o History Late Blight of Potato in Ireland *Phytophthora infestans*
  o St. Anthony’s Fire ergot on rye producing an alkaloid causing manifestations of nausea, vomiting, epileptic fits, sometimes death
  o Koch's Postulates of causal organisms-1882
    o Experimental proof of a causal organism causing disease pathogenicity
    o Pathogen must be associated with host
    o Isolation
    o Reproduction
    o Re-isolation
What is a PLANT DISEASE?

- Any alteration of a plant that interferes with its normal appearance, function, or value and renders it unfit for its normal use.

What is Plant Disease

The Disease Triangle

- Host
- Pathogen
- Environment
- “Humans”

Disease cycle: *Alternaria* (early) blight

![Disease cycle diagram]
What can make a plant sick?

- Genetic abnormalities
- Viruses, viroids
- Bacteria
- Fungi, oomycetes
- Parasitic plants
- Nematodes
- Insects, mites
- Other herbivores
- Non-living, abiotic
- Living, biotic

HOST CHARACTERISTICS

- Cultural requirements
- Growth traits
- Potential symptoms
  - foliage blights, spots, rusts, etc.
  - cankers and galls
  - vascular wilts
  - root rots
  - heart rots, decays

Role of Environment in Tree Diseases

The 3 factors
1. Predisposing factors
2. Inciting factors
3. Contributing factors
Symptoms vs. signs

**Symptoms** - noticeable effects/plant response
- Chlorosis/necrosis of foliage
- Twig/branch dieback
- Leaf spots
- Wilt
- Root rot

**Signs** - evidence/observance of the causal agent
- Fungal fruiting structures
- Bacterial ooze
- Rust pustules
- Some types of twig/branch canker

Quick Quiz #1
What can cause or encourage diseases of plants
1. Bacteria
2. Humans
3. Fungi
4. #1 and #3
5. All of the above
6. None of the above

Systematic Process for Diagnosing Diseases
1. Look for patterns of abnormality,
2. Identify suspect symptoms and signs,
3. Clinical diagnostic aids
1. Look for patterns of abnormality.

   Systematic Process for Diagnosing Diseases

   - Distribution of abnormal patterns in time and space,
     - Carefully examine site,
     - In the populations of all plants throughout the landscape, production area
     - In individual plants of the affected species,
   - Non-uniform damage patterns indicate biotic factors,
     - Damage restricted to a species,
   - Uniform damage over large areas usually indicates abiotic factors,
     - Across several different plant species.

2. Identify suspect symptoms and signs

   Systematic Process for Diagnosing Diseases

   - Observe the color, size and thickness of the foliage,
   - Check the stems, trunk, branches, twigs,
   - Examine the roots and crown,
   - Often fruiting bodies of fungi, sometimes bacterial ooze, can be observed
   - Are the response of the plant to the presence of the pathogen?

3. Clinical diagnostic aids.

   Getting Laboratory Assistance

   - For some diseases, is the only reliable option,
     - Report may include management strategies,
   - Texas Plant Disease Diagnostic Laboratory,
     - http://plantclinic.tamu.edu/
   - Sample submission tips
     - Always fill out form,
     - Pictures help too,
     - Hand carry sample to lab is useful,
     - Most samples should be fresh and sealed in a plastic bag,
     - Ship early in the week,
   - Sample should be representative of the problem and be at the interface between healthy and diseased tissues,
Clues for non-infectious (Abiotic) problems

- Nutritional
  - Pattern: generally of older or younger foliage BUT not both.
- Chemical
  - Pattern: usually uniform over entire plant with rapid occurrence.

Quick Quiz #2
Using fertilizer high in NITROGEN can mask some disease symptoms.
1. Agree
2. Disagree
3. Don’t know

Part II
TYPES OF PATHOGENS

Abiotic - Non-living
- Nutrient deficiencies
- Poor water relations
- Climatic extremes
- Air pollution
- Toxic chemicals
- Herbicides

Biotic - Living
- Fungi
- Bacteria
- Viruses
- Nematodes
- Parasitic flowering plants

Iron deficiency in rose

Weed and Feed with Atrazine

Where Not to Use
Stay 18-24 inches away from plants, flowers, and mulched areas.
Not registered for use under drip zone of trees and shrubs.
Container Grown Root Systems

Inherent Growth Defects
The case for proper species selection

- Species variability,
  - problems with fast growing species like Bradford pear, Siberian elms, Arizona ash, Chinese pistache, Chinese tallow,
- Brittle wood,
- Weak forks,
- Wind resistance,
- Susceptibility to disease,
  - note problems with hackberry.

Poor Management Practices
Planting Technique/Site Preparation
Examples of Abiotic Pathogen
Severe Drought = Severe Stress = Disease

- Trees respond to drought,
  - compensate for the stress,
- If unsuccessful, symptoms develop,
- If sufficiently severe, tree will die.

Ash Juniper

Blackjack Oak

Green Ash

Summary of Drought Effects

- Mild drought = mild stress = little strain,
  - no detrimental effects,
- Moderate drought = moderate stress = predisposing strain,
  - infection by pests and diseases that normally do no harm,
- Severe drought = severe stress = disease,
  - drought becomes a pathogen,
  - dieback, death………

Quick Quiz #3

What did the last three slides represent?
1. Abiotic
2. Biotic
3. Mother Nature
Bacterial Diseases

Soft Rots
Leaf Spots
Vascular Wilts
Galling

Bacterial Blight of Rose

Bacterial blight- *Xanthomonas axonopodis*, on knock out rose

Crown Gall

*Agrobacterium tumefaciens*
Fire Blight of Bradford Pear

Fungal/oomycete Diseases
- Cankers
- Root Rots
- Vascular Wilts
- Leaf Spots
- Blights

Hypoxylon Canker
Ganoderma butt rot

Texas (Cotton Root Rot)

Basil Downy Mildew
Powdery Mildew on Abelia

Black Root Rot
(Thielaviopsis brassicola)

Botrytis Blight on Hybiscus
Botrytis on poinsettia

Day Lily Rust
(Puccinia hemerocallidis)

Turf/Grass Diseases

Take-all patch on St. Augustine

Gaeumannomyces graminis – lobed hyphopodia (microscopic view)
Turf/Grass Diseases

Brown Patch on golf green
St. Augustine

Entomosporium leaf spot

Cedar Hawthorn Rust
Viruses on Ornamentals

INSV on Kalanchoe

TMV on Coreopsis

Rose Rosette Virus

Plant Parasitic Nematodes

Meloidogyne (Root knot) infestation

Sting Nematode
Plant Parasites

Leafy mistletoe on elm tree.

Dwarf mistletoe on western conifer. Photos courtesy of David N. Appel.

Diseases vectored by insects

Leaf Hopper
Graphocephala coccinea

Nitidulid beetles
Glischrochilus hortensis

Asian Citrus Psyllid
Diaphorina citri

OAK WILT IN TEXAS

Classic veinal necrosis of live oak leaves.

Flagging foliar symptom of live oak in crown area. Photo courtesy of Carrie Burns.
An abiotic problem? Or….not

Management Strategies

Part III

- Practicing Cultural Practices
  - Bed preparation addition of organic material,
  - Proper handling of plant material,
  - Monitor soil moisture-proper maintenance of irrigation systems,
  - Avoid compact soils,
  - Proper pruning,
  - Practice good sanitation practice,
  - Fertilize properly,
  - Spacing of plants to avoid microclimates, increases air circulation and avoids water competition,
Preventive

- Quality plant material,
- Plant resistant varieties,
- Soil solarization prior to planting,
- Avoidance,

Chemical/Bio Control

- Proper Fungicide control when necessary ie:
  - Azoxystrobin (Heritage), propiconazole (Banner Maxx), thiophanate-methyl (Cleary's 3336), myclobutanil (Eagle), chlorothalonil (Daconil), fosphenyl, Spectracide Immunox, Ferti-lome Systemic Fungicide, Ortho Lawn Disease Control,
  - Copper based fungicides/bacicides: Physon 27, Bonide,
- Horticultural Oils ie:
  - Neem oil, dormant oil, summer oil,
  - Control insects ie:
    - Imidacloprid (Merit), pyrethroid (Talstar), insecticidal soaps, beneficial insects (ladybug, lacewing).

****Strictly adhere to label directions concerning application rates, retreatment intervals, and plant usage acceptability****

Quick Quiz # 4

Using fertilizer high in NITROGEN to mask disease symptoms is a good strategy for disease management.

1. Agree
2. Disagree
3. Don’t know
Sending samples to TPDDL

Part IV

Proper sampling can ensure a proper diagnosis

- Representation of transition area between symptoms being observed.
- Entire plant if possible, if not foliar symptoms and subsample of root tissue.
  - Fresh and kept fresh.
- Complete information (completed form)
  - Note dates/times (when did symptoms begin to appear?).
  - Description of chemical management practices in the past 4 weeks.
- Photographs helpful when putting the pieces of the puzzle together.

What is a bad sample?
Sample submitted asking what is this white stuff?

Sample submitted for oak wilt and bacterial leaf scorch

Sample submitted for Fusarium of palm

“What is this?”
Proper packaging

- Place completed form(s) in a separate zipper bag or plastic bag and secure tightly.
- Place all samples and form(s) into one (1) zipper or plastic bag and secure.
- Make sure basic information portion of the form is easily visible.
Packaging for Oak wilt

Back at the lab.............
Steps in diagnosing plant disease

1. Identify the plant
2. Define the problem
3. Develop list of potential disease candidates
4. Refine diagnosis
5. Getting additional help

The Diagnostician's “toolbox”

- Symptoms and signs (macroscopic and microscopic)
- Isolation of pathogens in pure culture,
  - morphological ID,
  - fatty acid profiling,
  - nematode extraction,
- Molecular/Serological Analyses,
  - ELISA,
  - conventional and QRT-PCR,
- Koch's postulates – proof of pathogenicity.
TPDDL capabilities

- General microscopy

Culturing of sample tissues for pathogen ID

- Testing for Oak Wilt Sterile technique
- Utilizing selective media
TPDDL capabilities

- Molecular diagnostics for Phytoplasmas, Agrobacterium, Rose Rosette Virus (RRV), Citrus Greening

- Serological Testing for Bacterial leaf scorch (BLS), Phytophthora and viruses
  - Commercially available ELISA (Enzyme Linked Immunosorbent Assay) kits
Resources

- More information at:
  - http://plantclinic.tamu.edu
  - http://Agrilifebookstore.org
  - http://www.youtube.com/watch?v=VgYCTvBSPX8&feature=related
- Find us on Facebook (Texas Plant Disease Diagnostic Lab)

Agrilifebookstore.org

Questions?

“As to diseases, make a habit of two things—to help, or at least to do no harm.”
Hippocrates