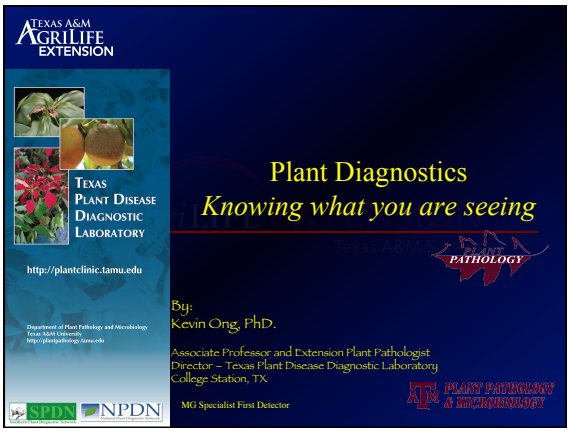
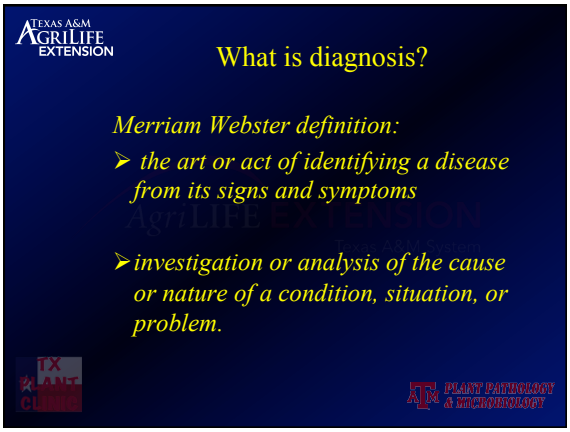
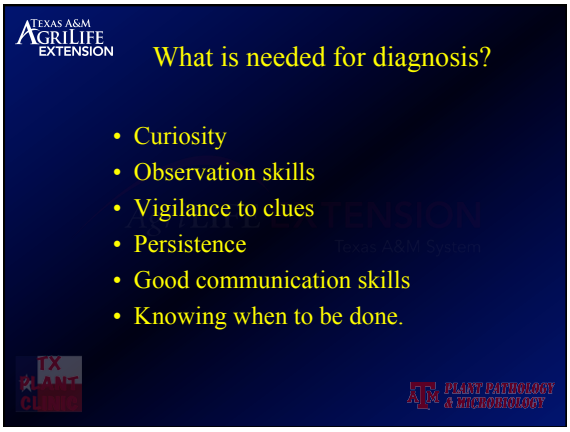

Texas A&M AgriLife Extension
Texas Plant Disease Diagnostic Laboratory
http://plantclinic.tamu.edu
Department of Plant Pathology and Microbiology
Texas A&M University
http://plantpathology.tamu.edu
SPDN
NPDN
Plant Diagnostics
Knowing what you are seeing
PATHOLOGY
By:
Kevin Ong, PhD.
Associate Professor and Extension Plant Pathologist
Director – Texas Plant Disease Diagnostic Laboratory
College Station, TX
MG Specialist First Detector
Plant Pathology & Microbiology


Texas A&M AgriLife Extension
What is diagnosis?
Merriam Webster definition:
the art or act of identifying a disease from its signs and symptoms
investigation or analysis of the cause or nature of a condition, situation, or problem.
Plant Pathology & Microbiology


Texas A&M AgriLife Extension
What is needed for diagnosis?
Curiosity
Observation skills
Vigilance to clues
Persistence
Good communication skills
Knowing when to be done.
Plant Pathology & Microbiology

General approach to field diagnostic requires…

- Organized, logical approach
- Able to ask the "right" questions
- Access to reference materials
- Knowledge of local soil and weather characteristics
- Common sense and a "detective" enthusiasm

Steps in Field Diagnostics

1. Identifying the plant

- Ask person who submitted sample
- Ask your County agent
- Ask a fellow Master Gardener
- Consult literature (books, internet, photos)
- Get at least to the genus

2. Define the problem

- Is there a problem?
- What is the nature of the problem?
  - Insect
  - Fungi
  - Bacteria
  - Etc…

Is there a problem?

Is there a problem?

Is there a problem?

2. Define the problem (Information gathering)

1. History of planting and site
2. Check for patterns
   i. Individual plants
   ii. Whole plantings
   iii. Surrounding plant community
3. Identify affected plant parts

3. Develop suspect list

- What could cause the symptoms that were noted?
  - Example: marginal leave scorching could be caused by drought, root damage, bacteria (Xylella sp.), root rotting fungi…

3. Coming up with suspects

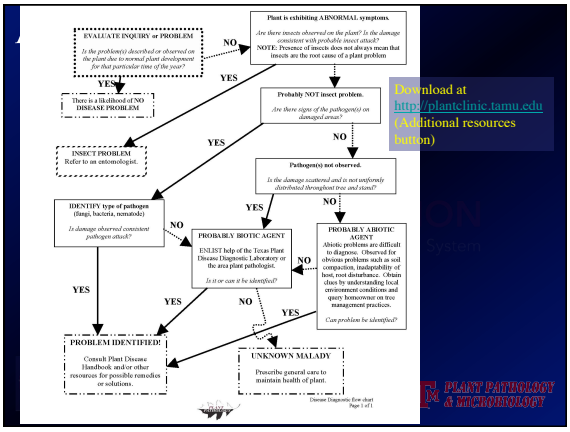
- BIOTIC
  - Symptoms is usually scattered
  - Symptoms develops gradually over time (on individual and whole plantings)
  - Sign of pathogen is observable
- ABIOTIC
  - Symptoms are uniformed
  - Generally appear all at one time
  - Does not appear to spread
  - Affects more than 1 type of plant in immediate area

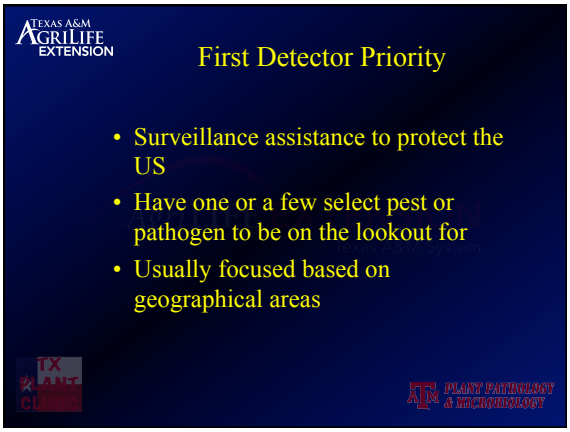
4. Refine diagnosis

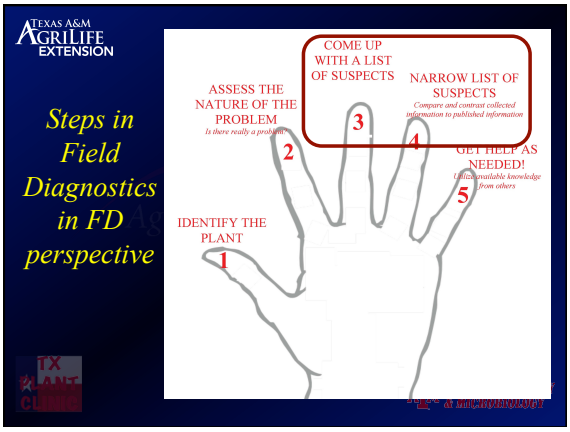
- Asking the right questions!!!
- Match up the symptoms and the potential suspects
  - Example: scorching = lack of water to the leaves. What inhibit water transport?
- Match up notes taken and notes from literature

5. Getting additional help

- Looking for confirmation of diagnosis
  - Sending sample to the Texas Plant Disease Diagnostic Lab
  - Getting opinions from area experts
- Always provide as much pertinent information as possible


EVALUATE INQUIRY or PROBLEM
Is the problem(s) described or observed on the plant due to normal plant development for that particular time of the year?
NO
YES
Plant is exhibiting ABNORMAL symptoms.
Are there insects observed on the plant? Is the damage consistent with probable insect attack?
NOTE: Presence of insects does not always mean that insects are the root cause of a plant problem
YES
There is a likelihood of NO DISEASE PROBLEM
Probably NOT insect problem.
Are there signs of the pathogen(s) on damaged areas?
YES
NO
INSECT PROBLEM
Refer to an entomologist.
Pathogen(s) not observed.
Is the damage scattered and is not uniformly distributed throughout tree and stand?
YES
NO
IDENTIFY type of pathogen (fungi, bacteria, nematode)
Is damage observed consistent pathogen attack?
NO
PROBABLY BIOTIC AGENT
ENLIST help of the Texas Plant Disease Diagnostic Laboratory or the area plant pathologist.
Is it or can it be identified?
NO
PROBABLY ABIOTIC AGENT
Abiotic problems are difficult to diagnose. Observed for obvious problems such as soil compaction, inadaptability of host, root disturbance. Obtain clues by understanding local environment conditions and query homeowner on tree management practices.
Can problem be identified?
YES
YES
NO
YES
PROBLEM IDENTIFIED
Consult Plant Disease Handbook and/or other resources for possible remedies or solutions.
UNKNOWN MALADY
Prescribe general care to maintain health of plant.
Disease Diagnostic flow chart
Page 1 of 1
Download at
http://plantclinic.tamu.edu
(Additional resources button)
PLANT PATHOLOGY & MICROBIOLOGY


TEXAS A&M AGRILIFE EXTENSION
First Detector Priority
• Surveillance assistance to protect the US
• Have one or a few select pest or pathogen to be on the lookout for
• Usually focused based on geographical areas
PLANT PATHOLOGY & MICROBIOLOGY

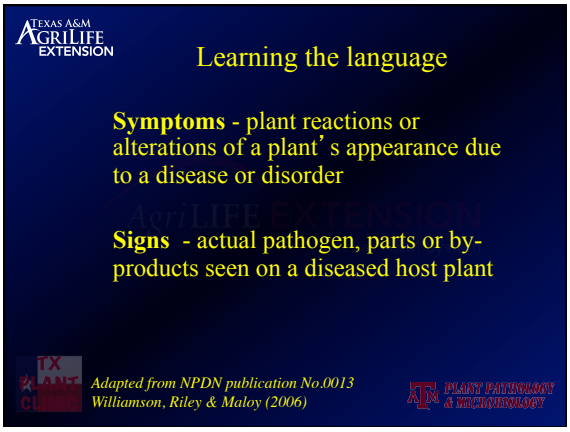

TEXAS A&M AGRILIFE EXTENSION
Steps in Field Diagnostics in FD perspective
COME UP WITH A LIST OF SUSPECTS
3
NARROW LIST OF SUSPECTS
Compare and contrast collected information to published information
4
ASSESS THE NATURE OF THE PROBLEM
Is there really a problem?
2
GET HELP AS NEEDED!
Utilize available knowledge from others
5
IDENTIFY THE PLANT
1

RECAP

- *First Detector skills*:
  - *Be knowledgable*
  - *Be observant*
  - *Be calm*
  - *Be decisive*

SCENARIOS


Texas Plant Disease Diagnostic Laboratory
http://plantclinic.tamu.edu
Information collection workshop
Telling it like it is!
By:
Kevin Ong, PhD.
Associate Professor and Extension Plant Pathologist
Director – Texas Plant Disease Diagnostic Laboratory
College Station, TX
MG Specialist First Detector – Plant Disease


Learning the language
Symptoms - plant reactions or alterations of a plant's appearance due to a disease or disorder
Signs - actual pathogen, parts or by-products seen on a diseased host plant
Adapted from NPDN publication No.0013
Williamson, Riley & Maloy (2006)

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

- Identify and classify symptoms
  - Underdevelopment
  - Overdevelopment
  - Necrosis or death
  - Alteration of normal appearance
  - Wilting
- Identify plant parts affected
- May need to identify source of symptoms within plant system

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Photo: J. Dunez, www.forestryimages.org

Chrysanthemum stunt viroid infection of chrysanthemum showing stunting and earlier blooming of affected plants; healthy plants in middle.

Underdevelopment

- Stunting of plants, leaves
- Shortened internodes
- Inadequate chlorophyll production
- Caused by many types of pathogens

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms - Overdevelopment

Photo: Joseph O'Brien, USDA Forest Service, www.ipmimages.org

Oak leaf blister, caused by *Taphrina caerulescens*.

Overgrowth of leaf tissue causes thickening and distortion.

Photo: Edward L. Barnard, Florida Department of Agriculture and Consumer Services, www.ipmimages.org

Gall on stem of eastern redcedar caused by *Agrobacterium tumefaciens*.

Galls form on all plant parts, caused by many pathogens.

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Over-development - more biotic causes

- Root knot nematodes - root galls
- Callus formation around cankers
- Tissue proliferation -some downy mildews and phytoplasmas
- Some insects and mites also cause galls.

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Used by permission of M. Williamson

Oedema of camellia, a physiological disorder

Over-development

- Abiotic causes
- Oedema
- Fasciation can be physiological or due to biotic causes.
- Some tree burls

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms and Signs

Photo: Paul Bertrand, University of Georgia, www.ipmimages.org

Target spot of tobacco, caused by *Thanatephorus cucumeris*.

Tissue Necrosis

- Fungal leaf spots
- Usually round, not vein-limited
- Elongated on narrow leaves or stems
- May have alternating zones of light and dark tissue
- Sporulation or mycelia may be evident

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms and Signs

Photo: Volcani Center Archives, Agricultural Research Organization, www.ipmimages.org

Bacterial leaf spot of sweet pepper caused by *Xanthomonas campestris* pv. *vesicatoria*

Tissue Necrosis

Bacterial leaf spots

- **Often dark and water-soaked**
- **Often vein-limited, giving angular shape**
- **Bacterial "flow" observed under microscope**

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms and Signs

Photo: Clemson University - USDA Cooperative Extension Slide Series, , www.ipmimages.org

Brown rot of peach, caused by *Monilinia fruticola*

Tissue Necrosis

Fruit rots

- **Firm or soft and watery**
- **Colors vary**
- **Fungal sporulation may be present**
- **Fungal and bacterial causes**

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Photo: Joseph O'Brien, USDA Forest Service, www.ipmimages.org

Sugar maple canker caused by *Nectria* spp.

Tissue Necrosis

Cankers = localized necrotic lesions

- **Sunken or swollen or both**
- **Mainly caused by fungi and bacteria**
- **Mechanical injury can cause**

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Photo: Robert L. Anderson, USDA Forest Service, www.ipmimages.org

Fire blight caused by *Erwinia amylovora*

Tissue Necrosis

Blight = rapid death or dieback.

- Also from coalescing leaf spots, e.g. early blight of tomato
- Mainly fungal and bacterial causes

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Photo: Edward L. Barnard, Florida Department of Agriculture and Consumer Services, www.ipmimages.org

Pitch canker of Virginia pine, caused by *Fusarium subglutinans*

Tissue Necrosis

Dieback - many causes

- Girdling cankers. Follow dieback to detect
- Dieback pathogens w/out cankers
- Root problems
- Mechanical, chemical or cold damage

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Used by permission of M. Williamson

Root rot of boxwood, caused by *Pythium* sp.

Tissue Necrosis

Root rots

- Root lesions
- Darkening and softening of roots
- Sloughing off of outer tissues
- Yellowing of foliage and stunting of plants
- Fungal and bacterial causes

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Photo: Clemson University - USDA Cooperative Extension Slide Series, www.ipmimages.org

Damping off of tobacco, caused by *Rhizoctonia* spp. and *Pythium* spp.

Tissue Necrosis

Damping off

- Rapid death of seedlings and cuttings
- Stem infected at soil line, seedling topples
- Spreads rapidly under crowded conditions
- Mainly fungal agents

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Used by permission of M.Williamson

Stem wilt of *Exacum* from INSV infection

Wilting

Biotic factors

- Root, crown or stem rots
- Vascular wilts
- Root crown or stem damage from insects or animals
- Mainly fungal and bacterial causes

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Used by permission of M. Williamson

Cold damage on azalea stem. Shoots wilt above damage.

Wilting

Abiotic factors

- Damage from weather extremes
- Dry or flooded soil
- Mechanical damage to roots, crown or stem

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Photo: David B. Langston, University of Georgia, www.ipmimages.org

Mosaic symptoms on cucumber due to a viral infection

Alteration of normal appearance

Mosaic

- Irregular patches of discolored tissue.
- Often with distortion
- Viruses mainly

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Photo: Dr. Backhaus, Biologische Bundesanstalt für Land- und Forstwirtschaft, www.ipmimages.org

Tomato spotted wilt virus (TSWV) on geranium leaf

Alteration of normal appearance

Ringspot

- On leaves and fruits.
- Distinct ring shaped lesions, often in concentric zones
- Viruses

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Used by permission of M. Williamson

Cotton damage by the herbicide 2,4-D

Alteration of normal appearance

Abiotic causes

- Chemical damage
- Nutritional deficiencies

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Used by permission of M. Williamson

Burford hollies yellowing due to root malfunction. Soil is poorly drained.

Alteration of normal appearance

Yellowing

- Often nutritional, cultural or environmental
- Root malfunction – biotic or abiotic
- Nematode infestation
- "Yellows" phytoplasma diseases

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms

Be aware of symptom variability.

- May have more than one problem.
- More than one pathogen may be involved.
- Pathogens have varying levels of virulence.
- Environmental conditions can affect symptom expression.
- Host genetics and physiology can effect symptom expression.

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptom variability due to multiple pathogens

Used by permission of S. Scott

Peach seedlings infected by single or multiple viruses show symptom variability.

- Peach seedling on left infected with both *Prune dwarf virus* (PDV) and *Prunus necrotic ringspot virus* (PNRSV)
- Seedling in middle infected with PDV alone
- Seedling on right infected with PNRSV alone

MODULE 4 – Diagnosing plant problems: Plant Diseases

Signs

Photo: USDA Forest Service Archives, USDA Forest Service, www.ipmimages.org

White mycelia of *Armillaria* sp. on tree trunk affected by Armillaria root and stem rot.

Fungal signs

- Evidence of pathogen on tissue.
- Spores, mycelia or fruiting bodies.
- Use hand lens or knife for field detection.

MODULE 4 – Diagnosing plant problems: Plant Diseases

Signs

Photo: Central Science Laboratory, Harpenden Archives, British Crown, www.ipmimages.org

White rust of chrysanthemum, fruiting bodies of *Puccinia horiana*

Fungal signs

Fruiting bodies

- Shape of fruiting body aids in fungal identification.
- Tissue location may help differentiate between species.

MODULE 4 – Diagnosing plant problems: Plant Diseases

Signs

Used by permission of M. Williamson

***Oidium* sp. causing powdery mildew on *Viburnum suspensum*.**

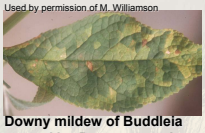
Fungal signs

- Powdery mildew fungi form mycelia and spores on tissue surface.
- Powdery material rubs off.
- Leaves often distorted, discolored
- Dark, round fruiting bodies form in fall.

MODULE 4 – Diagnosing plant problems: Plant Diseases

Symptoms and Signs

Used by permission of M. Williamson



Downy mildew of Buddleia caused by ***Peronospora harotii.***

Used by permission of M. Williamson

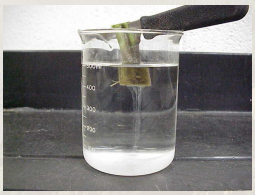
Downy mildew of veronica, caused by ***Peronospora sordida***

Downy mildews often produce angular leaf spots.

Downy mildews develop sporulation on leaf undersides only.

MODULE 4 – Diagnosing plant problems: Plant Diseases

Signs



Used by permission of M. Williamson

Bacterial streaming from tomato infected by *Ralstonia solanacearum.*

Bacterial signs

- **"Streaming" from freshly cut stem in water.**
- **"Stringing" from cut stems pushed together, then pulled apart.**
- **Bacteria "flow" observed from tissue mount on compound microscope.**
- **Bacterial ooze can be observed on-site with some diseases.**

MODULE 4 – Diagnosing plant problems: Plant Diseases

The section on SIGNS & SYMPTOMS was adopted from part of NPDN publication No.0013 authored by Williamson, Riley & Maloy (2006, updated 2008).
This educational unit was adapted from "Plant Disease Diagnosis" by M. B. Riley, M. R. Williamson and O. Maloy. In: *The Plant Health Instructor*. DOI:10.1094/PHI-I-2002-1021-01
(Used by permission of the American Phytopathological Society)

- *Publication Number: 0013*
- *Publication Date: December 2006*

Workshop assignments

Verbal and/or written

- Goals
  - Collecting information
    - Description of plant : type, condition, etc
    - Growing location
    - How plant is situated.
    - Any signs and/or symptoms

Workshop assignment

Photography

- Goals
  - Description of location/issue with images
  - Exercise: show issue with ONE image.

End of

Collecting and Documenting Evidence workshop Part 1.