Step-by-Step Guide to Field Diagnostics

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Causal Agents of Disorders

- Biotic
  - Fungi
  - Bacteria
  - Viruses
  - Phytoplasma
  - Nematodes
  - Insects & Mites
- Abiotic
  - Soil moisture extremes
  - Temperature extremes
  - Salts
  - Air pollution
  - Wind, light effects
  - Mechanical damage
  - Pesticide damage

Diagnosing Disorders

- The ***process*** of determining the cause of an abnormality
- Diagnosis is a ***team*** effort
  - Grower/Consultant/Manager
  - Farm Advisor/Extension Agent
  - Diagnostic Clinic
- Conclusions are derived from ***critical evaluation of the trees and the environment***
  - Requires a blend of good observational skills, science, and experience

Diagnostic Advice

- Don't jump to conclusions
  - Keep an open mind
- Be a detective: observe, question, gather clues
- Evaluate the whole plant, the whole orchard, and the areas around the problem area
- When possible…
  - Dig up and look at roots
  - Cut open stems, branches, fruits, etc.

The First Step: Spot the Problem

- Diagnosis begins with the ***observation*** that there is a problem with the tree(s)
  - Know the healthy/normal appearance (cultivar diffs)
  - Symptoms
- This means you need to ***physically*** be in your orchard on a regular basis.

Symptoms

Symptoms usually develop because the causal agent:

- Produces (or induces the plant to produce) enzymes, toxins, or growth regulator imbalances
- Interferes with specific cellular functions
  - The particular symptom develops based on whatever plant process(es) are affected

The Difficulties with Symptoms

- Change over time (progression)
- Vary with severity/virulence of the stressor/pathogen
- Vary due to age or stage of the tree
- Vary due to environmental conditions during and after infection

Symptoms are often insufficient for diagnosis

Symptoms are Complex!

- Symptoms are not always specific to causal agents
- Causal agents often affect more than one plant process at a time leading to complex symptomology
- Plants may be affected by more than one causal agent (abiotic and biotic) at a time
  - adds to complex symptomology

Symptoms are often insufficient for diagnosis

Abiotic disorders may predispose the tree to biotic disorders!

- **Biotic**
  - Fungi
  - Bacteria
  - Viruses
  - Phytoplasma
  - Nematodes
  - Insects & Mites
- **Abiotic**
  - Soil moisture extremes
  - Temperature extremes
  - Salts
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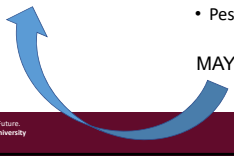
  - Mechanical damage
  - Pesticide damage



MAY PREDISPOSE TO BIOTIC!

The Second Step:
Gather *accurate* and *complete* information

- Situation of the Orchard
- History of the Disorder
- Spatial Variability
- Symptom Expression

Critical Information Needs

- Situation of the Orchard
  - Cultivar and rootstock
  - Age and production history
  - Soil textures
  - Cultural practices:
  - Weather conditions before and during symptom development
  - Historic land use of orchard site
  - Land use in adjacent properties
  - Soil and water analyses
  - Leaf tissue nutrient analyses

Critical Information Needs

- History of the Disorder in the Orchard:
  - When the problem began. Or when symptoms were first noticed.
  - Whether it is a chronic problem
  - Whether the symptoms are spreading (within tree or to other plants in the orchard)

Critical Information Needs

- Spatial Variability of the Disorder in the Orchard:
  - Percentage of orchard affected
  - Pattern of symptoms in orchard
    - Scattered
    - Clumped
    - Random
  - Other plants in orchard affected

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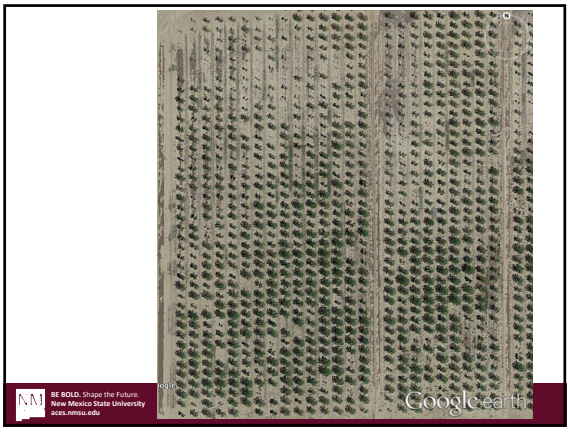

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Critical Information Needs

Symptom expression

- The plant parts affected
- Top-down or bottom-up in canopy
- Where is PRIMARY site of injury?
- The progression in severity on plant over time

Evaluating Leaf Symptoms

- Uniformity or patterns?
  - Leaf and plant
  - Size of spots
- Margin (borders)?
  - Thickness
  - Color
- Spread or growth?
  - Edge definition
  - Merging of spots
- Fruiting bodies?

The Third Step:
Collect Specimens

- Important for accurate diagnosis
- All specimens should be fresh, kept refrigerated
- Submit samples showing all stages of problem
- In some cases it may be best to collect the <u>whole tree</u> if possible

Sampling:
Include samples from all affected organs

- Do not destroy signs or symptoms
- Roots: Remove soil, include tissue above and below visible lesions
- Stem and leaf: Include tissue above and below visible lesions
- Flower, fruit, seed: Collect the entire organ

Sampling Techniques:
Handling and Packing

- Identify/label correctly <u>every</u> specimen
- Package delicate material in a sturdy box
- Do not add water or wet paper towels
- Ship immediately overnight and early in the week

Thank You!

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