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**
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• **Abiotic**
  • Soil moisture extremes
  • Temperature extremes
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MAY PREDISPOSE TO BIOTIC!
The Second Step: 
Gather **accurate** and **complete** information

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

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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
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 whole tree 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 every 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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