Diagnosing Plant Problems: Insects and Other Arthropods
Insect Diagnosis

• Focuses on classic, morphology based taxonomy

• Often requires an expert taxonomist for species-level identification

• Limited resources for diagnosticians

• Quality of sample submitted is important!
How an insect is identified

First Detectors (County Extension Agents, Crop Consultants)

Extension Diagnostic Specialists (at Land Grant Universities)

Taxonomic Specialists (usually federal, state, or university employees)

Species Identification Confirmed
Symptoms vs. Signs

Photo credit: Green ash damage by ash borer - James Solomon, USDA, www.forestryimages.com, #3067035
Signs and symptoms of arthropod damage

- **Feeding damage**
  - Leaf mining
  - Defoliation
  - Boring
  - Root feeding
  - Galling
  - Die back

- **Discoloration**
  - Stippling and chlorosis
  - Bronzing and browning
  - Black coating or sooty mold

- **Insect Signs**
  - Frass
  - Webbing
  - Egg masses
Signs and symptoms of arthropod damage

• Feeding damage
  — Leaf mining
    • Leaf mining is produced by insects such as flies, moths, wasps, and beetles
    • The “mining” is a result of the feeding activity of the insect
    • The insect feeds in between the layers of plant tissues creating the mine
    • The mines will grow wider as the larval insect grows in size
    • Some mines look serpentine, while others look irregular, or blotchy
Signs and symptoms of arthropod damage

• Feeding damage
  — Leaf mining

Leaf blotch miner moth
Aspen leafminer

Signs and symptoms of arthropod damage

- Feeding damage
  - Leaf defoliation
    - Leaf defoliation can occur with grasshoppers, beetles, some wasps, and the juvenile forms of flies, butterflies, and moths
  - Skeletonizing the leaf
    - Happens when the veins or the “skeleton” of the leaf is left behind
  - Chewing the leaf
    - Circular bite marks can be seen on the leaves, especially along the edges.
Signs and symptoms of arthropod damage

- Feeding damage
  - Leaf defoliation

Leaves chewed by the dogwood sawfly

Feeding damage by yellownecked caterpillars

Oak skeletonizer
Signs and symptoms of arthropod damage

- Feeding damage
  - Boring
    - Boring insects usually live in the woody tissues of the plant such as the twig, stem, or trunk
      - Can be found in non-woody vegetation as well
    - Boring insects include beetles and moths
    - Boring can destroy the vascular tissues of the plant
    - Some beetles bring fungal spores into the woody part of the plant to feed their young. These fungal spores can be pathogenic to the plant
    - The juveniles of boring insects can usually attain a large size
Signs and symptoms of arthropod damage

- Feeding damage
  - Boring

Signs and symptoms of arthropod damage

• Feeding damage
  — Root feeding
    • Some insects feed in or on the roots of a plant
    • Root feeders may include types of ants, beetles, flies, and moths
    • Because they are underground, they are harder to monitor until you see the damage they create
Signs and symptoms of arthropod damage

• Feeding damage
  — Root feeding

Damage caused by carrot weevil

Damage from western corn rootworm (left) and nondamaged roots (right)

Photo credit: Damage caused by carrot weevil - Whitney Cranshaw, Colorado State University, www.bugwood.org, #1243117; Western corn rootworm - Richard C. Edwards, Purdue University, www.bugwood.org, 30725088
Signs and symptoms of arthropod damage

• Feeding damage
  — Gall formation
    • Can occur in buds, leaves, stems, flowers, or roots
      — Where they grow and what they look like can indicate which arthropod created them
    • Can also be produced by bacteria and fungi
      — Crown gall bacterium causes galls on roots, crowns, and stems
      — Fungi can also form large galls that superficially resemble the crown gall bacterium
Signs and symptoms of arthropod damage

- Feeding damage
  - Gall formation

Maple bladdergall mite

Oak galls produced by wasps

Oak bullet gall produced by cynipid wasps

Signs and symptoms of arthropod damage

• Check to see if the gall was caused by an arthropod
  — Closely examine the gall
  — Cut it open and look for exit holes, frass, empty larval chambers, etc.
  — If possible, rear insects to adult stage
Signs and symptoms of arthropod damage

- Feeding damage
  - Dieback of the plant

Dieback due to emerald ash borer infestation

Dieback due to blue spruce engraver infestation

Signs and symptoms of arthropod damage

- Discoloration
  - Stippling and chlorosis

Photo credit: Top left - Whitney Cranshaw, Colorado State University, www.bugwood.org, #5369739; Bottom left - Whitney Cranshaw, Colorado State University, www.bugwood.orgm, #5369740; Right - Jason Sharman, Vitaltree, www.bugwood.org, #5454780
Signs and symptoms of arthropod damage

- Discoloration
  - Bronzing and browning
Signs and symptoms of arthropod damage

• Discoloration
  – Black coating or Sooty mold
    • Sooty mold grows on the honeydew left behind by certain insects (mealy bugs, whiteflies, scales, etc.)
    • Honeydew is a sugary waste product secreted by certain plant juice feeding insects.
    • Sooty mold is a fungus that covers the parts of the plant where the honeydew is secreted.
Signs and symptoms of arthropod damage

- Discoloration
  - Sooty mold

Photo credit: Left - Joseph O’Brien, USDA Forest Service, www.bugwood.org, #1427010; Right – Stephanie Stocks, Department of Entomology and Nematology, University of Florida
Signs and symptoms of arthropod damage

- Insect Signs
  - Frass, webbing, and egg masses

Photo credit: Left – frass tubes from ambrosia beetles, Michael Flores, University of Florida; Center – webbing from spider mites, University of Florida; Right – Egg mass of sod web worm, Nastaran Tofangsazi, University of Florida.
Groups of arthropods likely to cause plant damage

- Numerous caterpillars (Order Lepidoptera)
  - Such as armyworms and cutworms
- Beetles (Order Coleoptera)
  - Numerous leaf-feeding and wood-boring pests
- Sawflies (Order Hymenoptera)
- Various flies (Order Diptera)
- Various insects with piercing-sucking mouthparts including scales, mealybugs, whiteflies, aphids, psyllids, hoppers, and other members of the Order Hemiptera.
- Spider Mites
Beneficials vs. Pests

- Know the difference between beneficial arthropods and pests.

Predatory stink bug feeding on an armyworm

Predatory beetle – the lady bird beetle

Predatory wasp – an ichneumonid

Predatory mites – Phytoseiulus persimilis

Questions?

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• NPDN website
  – www.npdn.org

• First Detector Training Website:
  – www.firstdetector.org
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- Cooperative Agriculture Pest Survey Program (CAPS)
- National Plant board and State Departments of Agriculture
- Extension Disaster Education Network (EDEN)
- Center for Invasive Species and Ecosystem Health (Bugwood)
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