Identifying and Managing Insects in Urban Forests

PJ Liesch
UW Insect Diagnostic Lab
pliesch@wisc.edu
Twitter: @WiBugGuy
insectlab.russell.wisc.edu

Diagnostics: “Reading the Leaves”
- Clues on plant → pest ID
- “Working backwards” is a valuable skill, but can be challenging!
  - Damaging insects may be gone / hard to locate
  - May be 2+ insects present and need to determine pest

Anatomy Dictates Damage
- Insect anatomy dictates the type of damage caused to plants
- Mouthparts usually the structures involved
  - Sometimes other parts as well (e.g. ovipositor)
- Anatomy varies by type of insect (beetles, true bugs, etc.)
- Anatomy sometimes varies by stage of development
  - Ex. caterpillars vs moths/butterflies

Insect Mouthparts
- Insect mouths contain 4 basic parts:
  - Labrum
  - Mandibles
  - Maxillae
  - Labium
- These 4 basic parts have been modified through evolution for different functions

Insect Mouthparts: Types
- Chewing
  - Used to physically chew/cut off pieces of plant material
  - Signs: holes, notches, leaves gone entirely, etc.
  - Also used by borers and leafminers
- Key groups with chewing mouthparts:
  - Beetles
  - Caterpillars
  - Sawflies
  - Ants/bees/wasps
  - Grasshoppers
  - Walking Sticks
  - Earwigs
  - Etc.

- Piercing/Sucking
  - Used to drink liquids
  - Can’t chew holes if they wanted to!
  - Signs: discoloration, speckling, curling/distortion
- Key groups with sucking mouthparts:
  - True bugs: aphids, leafhoppers, plant bugs, scales, etc.
  - Adult moths/butterflies
  - Some bees/wasps
  - Mosquitoes
  - Mites such as spider mites

IPM of Midwest Landscape Plants
http://cues.cfans.umn.edu/old/ipmbook.htm

Chapter 4: Symptom Categories of Plant Damage

Insect Mouthparts
- Asymmetrical mouthparts
  - Initially scrape plant materials, then slurp up liquids
  - Signs: pale streaks/spots
- Key groups with rasping mouthparts:
  - Thrips

Anatomy
Insect Mouthparts: Types
Chewing
Piercing/Sucking
Rasping Sucking

Host Plant Specificity

- While some insects are broad generalists (e.g., Japanese beetle), there are many insects specialize on certain types of plants.
- Knowing the host plant can be an invaluable clue!

Main Insect Symptoms on Plants

1. Chewing on foliage, petioles, or twigs
2. Discoloration
3. Distortion of plant tissues
4. Dieback or dropping of plant parts
5. Other signs: droppings, cast skins, etc.

1) Chewing on Leaves, Needles, Petioles

- Defoliation
- Shot Holes
- Notched Margins
- Skeletonization

Defoliation

- Large portions of leaves or entire leaves eaten away

Top Suspects:
- Caterpillars: spongy moth, eastern tent caterpillar, forest tent caterpillar, euonymus caterpillar, fall webworm, and many others!
- Sawflies: elm sawfly, European pine sawfly, dogwood sawfly, dusky birch sawfly, etc.
- Others: beetles (such as May/June beetles), grasshoppers, walkingsticks, earwigs, slugs

Defoliating Caterpillars

Eastern Tent Caterpillar

Defoliating Sawflies

Elm Sawfly (Typical)

Mountain Ash Sawfly

European Pine Sawfly

"Charlie Brown" Damage

Defoliating Caterpillars

Many other caterpillar species can be found in the landscape
To narrow down: appearance, host plants, time of year

Redhumped Oakworm

Oak/beech in late summer

Whitemarked Tussock Moth

Many hardwood trees in early summer

Linden Looper

Linden and other hardwoods in spring

Cankerworms (several species)

Many hardwood trees

"Charlie Brown" Damage

European Pine Sawfly Larvae

Group of European Pine Sawfly Larvae
Other Conifer Sawflies
- Many other sawfly species are associated with conifers
- To narrow down: appearance, host plants, time of year

White Pine Sawfly
- White/red pines in summer

Redheaded Pine Sawfly
- Mugho/Jack pines; 2 generations per summer

Balsam Fir Sawfly
- Balsam and spruces in summer

Other Defoliators:

May/June Beetle

Slugs

Post-Oak Grasshopper

Shot Holes
- Small holes within foliage
- Top suspects:
  - Small caterpillars
  - Leaf beetles
  - General defoliators
  - Shot hole diseases

Notched Margins
- Small notches chewed out of edges of leaves
- Top suspects: weevils, small caterpillars, small sawflies

Notched Margins Examples
- Black Vine Weevil
- Strawberry Root Weevil
- Two Banded Japanese Weevil

Skeletonization
- Leaves have a lace-like appearance; damage may go partially or entirely through the leaf tissues
- Top suspects: some beetles, sawflies, and small caterpillars

Skeletonization Injury
- Japanese Beetle & Skeletonization Injury

Examples of Skeletonization
- Rose Chafers
- Oak Leaf Skeletonizer
- Imported Willow Leaf Beetle
- Elm Leaf Beetle
- Maple Trumpet Skeletonizer
### Examples of Skeletonization

- **Scarlet Oak Sawfly**
  - On oaks in summer
- **Pearslug Sawfly**
  - On rosaceous plants in late summer

### 2) Discoloration

- **Stippling/Speckling**
- **Leafmining**
- **Yellowing/Discoloration**

- Plant diseases can sometimes cause similar symptoms!

### Stippling / Speckling

- Foliage has a speckled appearance
- Can sometimes resemble sandpaper
- Caused by insects/mites with sucking mouthparts
- **Top suspects:**
  - Lacebugs
  - Plant Bugs
  - Leafhoppers
  - Thrips
  - Spider mites

### Stippling:

- **Rose Leafhopper**
- **Lace Bugs**
- **Ash Plant Bug**

### Leafmining

- Brownish patches within foliage
- May be linear, circular blotches, meandering
- Responsible insects are tiny: use chewing mouthparts to tunnel within the foliage
- Tend to be very host plant specific
- **Top suspects:**
  - Caterpillars
  - Flies
  - Sawflies
  - Beetles

### Leafminers

- **Elm Leafminer (Sawfly)**
- **Birch Leafminer (Sawfly)**
- **Locust Leafminer (Beetle)**

### Boxwood Leafminer (Gall Midge)

- Tiny (~1/8” long) yellow larvae live and feed within leaves of boxwood
- Adults active and laying eggs in June

### Thrips

- Thrive under hot/dry conditions
- Produce webbing when populations high
- **Top suspects:**
  - Lacebugs
  - Plant Bugs
  - Leafhoppers
  - Thrips
  - Spider mites
Needleminers

Yellowing / Discoloration

- General discoloration of plant tissues
- Can be a vague symptom; can resemble diseases, fertility issue, etc.
- Top suspects:
  - Aphids
  - Plant bugs
  - Mealybugs
  - Whiteflies
  - Leafhoppers
  - Certain mites

Yellowing on Grapes due to leafhopper feeding

Special Case: Four-Lined Plant Bug

Erineum Galls

3) Distortion

- Curling/Cupping
- Galls of leaves, twigs, flowers
- Plant diseases can sometimes cause similar symptoms!

Curling / Cupping

- Foliage distorted and curled
- Caused by insects with sucking mouthparts
- Diseases & herbicide injury can cause similar symptoms
- Top suspects:
  - Aphids
  - Plant Bugs
  - Leafhoppers
  - Psyllids

Curling/Cupping

Honey locust Plant Bug (Honey locust)

Boxwood Psyllid (Boxwood)

Curling/Cupping

Spiny Witchhazel Gall Aphid (Birch)

Leafflower Injury (Apple)

Snowball Aphids (Viburnum)

Curl Viburnum Leaves due to Aphids

Aphids

Potato Leaffopper & Plant Injury

Gall patches on Maple

Eriophyid Mite

Up-Close View of Erineum Gall

Honey locust Plant Bug (Honey locust)

Boxwood Psyllid (Boxwood)

Nymph

Adult

University of Wisconsin: Insect Diagnostic Lab
**Galls**
- Sever distortions of plant tissues in response to insects, mites, or certain diseases
- Can be caused by a wide range of insects/mites
- Mostly a cosmetic issue; treatment usually not feasible
- Tend to be very host-plant specific!

**Top suspects:**
- Wasps (tiny!)
- Aphids & relatives
- Gall midges
- Mites
- Others: Beetles, flies, etc.

**Wasp Galls**
- Hedgehog Gall (White Oak)
- Jumping Oak Gall (but & Swamp White Oak)
- Elm Cockle

**Aphid Galls**
- Aiptasia Gall (Elm)
- Gall Aphid

**Psyllids**
- Heckberry Psyllids

**Midge Galls**
- Maple Gall Midge
- Balsam Gall Midge

**Eriophyid Mite Galls**
- Ash Flower Gall Mite (Ash)
- Erineum Gall (Maple)
- Spindle Gall (Cherry)

**4) Dieback or Dropping**
- Shoot dieback
- Branch/Trunk Dieback
- Dropped plant parts

**Shoot Dieback**
- Tip of shoot dying
- May involve insect tunneling
  - Check for exit holes, frass, etc.
- Top suspects:
  - Caterpillars
  - Beetles

**European Pine Shoot Moth (Pine)**
Special Case: Damage Due to Oviposition
- Occasional egg laying (oviposition) injury can occur from insects such as treehoppers and tree crickets
- Oviposition scars can kill/stunt shoots, twigs & small branches

Dieback of Branches or Trunk
- Often indicates serious issues
- Check for signs of disease, technical injury, etc.
- Top suspects:
  - Borers
  - Scale insects
  - Other causes!

Borers
- Can either be primary or secondary borers
- Important clues: host plant, size of holes, presence of frass, part of plant (twigs, branches, trunk, etc.)

Special Case: Sapsucker Injury
- Can resemble borer activity
- Holes regular in size, often in linear or grid-like pattern
- Typically tolerated by trees; occasionally problematic

Dropped Plant Parts
- Dropped plant parts
- Top suspects:
  - Boring insects
  - Squirrels

Managing Insect Pests: Approaches

Factors to Consider in Pest Management
- Cost ($): immediate & long-term
- Time / resource / worker availability?
- Type & value of plant
- Size & number of plants?
- How large of an area?
- Site factors
- Environmental impacts of management
- Overall feasibility
- Other factors…

Cultural Practices
- Manipulation of the local environment to prevent pest problems or reduce the amount of damage; planning & decision making
  - Proper plants & planting
  - Variety selection (disease/pest resistance)
  - Incorporating diversity into the Urban Forest
  - Watering & Fertility
  - Tolerance

Physical (Mechanical) Control:
- Physical activities performed to help prevent or reduce pests
  - Physical weed control
  - Hand-control of insects (picking/squishing)
  - Water-blasting
  - Barriers/row cover
  - Traps
### Biological Control:
- Use of natural enemies to reduce pest levels
- Predators
- Parasites
- Pathogens

**I.e., Relying on Mother Nature to help out!**

- How to get more natural enemies:
  1. Augmentation biological control: adding beneficials (direct)
  2. Conservation biological control: create habitat to encourage beneficials (indirect)

- It's important to recognize beneficial insects to help reduce chemical inputs
  - i.e., don't spray a pesticide if the "cavalry" has arrived!

### Biological Control Resource:
- Comprehensive resource on biological control (110 pages)
- Available as a free pdf; hard copies $12

[bit.ly/3zGsLrN](bit.ly/3zGsLrN)

### Chemical Control
- Use of chemical pesticides to reduce pest levels
  - This can include:
    - Biorational pesticides
    - Conventional pesticides

Each pesticide is different:
- Pest(s) it works against (e.g., many or few)
- How long they work for
- How often they can be applied
- Impacts on beneficials...

### Insecticidal Soaps & Horticultural Oils
- Soaps: chemically similar to dish soaps
- Oils: either mineral oil-based or plant oil-based

**How they work:** by direct contact: cell membrane disruptor & suffocant

- Residual: short residual activity
- Other: phytotoxicity possible

**Best against:** soft-bodied pests (aphids, caterpillars, spider mites, etc.) on smaller plants (small trees & shrubs); also eggs (oils) [spongy moth]

### Spinosad
- Based on naturally-occurring bacterium; usually organic

**How it works:** affects nicotinic receptors in insect nerves

- Residual: some residual activity (several days)

**Best against:** chewing-type insects (caterpillars, beetles, thrips, leafminers)

### Synthetic Pyrethroids
- Synthetic versions of natural pyrethrins
- Most widely used group of insecticides

**Examples include:** bifenthrin, deltamethrin, lambda-cyhalothrin

- **How it works:** affects sodium channels in insect nerves

- Residual: medium (often 1-2 weeks; sometimes longer)

**Best against:** most "exposed" pests; very broad spectrum of activity
  - Can be hard on beneficials!

### Organophosphates
- Based on WWII-era nerve gases
- Some have systemic activity (acephate & bidrin)

**How it works:** affects activity of acetylcholine in nerves

- Can act cumulatively (risks to humans/mammals)

- Residual: medium (often 1+ weeks)

**Best against:** many "exposed" pests; very broad spectrum of activity; also useful as fast-moving systemics in some cases (acephate)
  - Can be hard on beneficials!

### Neonicotinoids
- Mimic natural insecticidal properties of nicotine

**How it works:** affects nicotinic receptors in insect nerves

- Residual: long (weeks-foliar; months-systemic)

**Best against:** semi-selective & depends on AI; beetles, sucking insects, caterpillars (sometimes)
  - Can be hard on beneficials!—**Highly toxic to bees/pollinators**

### Bacillus thuringiensis
- Based on naturally-occurring bacterium; labelled for organic use
  - Bacillus thuringiensis kurstaki (caterpillars)
  - Bacillus thuringiensis galleriae (some beetles, e.g., Japanese beetle)

**How it works:** disrupts insect midgut

- Residual: short (often a week or so)

**Best against:** very specific for each Bt strain; caterpillars and certain beetles
Questions?

PJ Liesch
UW Insect Diagnostic Lab
pliesch@wisc.edu
Twitter: @WiBugGuy

insectlab.russell.wisc.edu