

## Guess Who Came to Dinner?

### Diagnosis of Leaf Injuries Based on Feeding Patterns, Symptoms and the "Leavings"

**The Problem** - Insects or mites have been feeding on your garden plants, but have left the scene. What happened?

**The Solution** - Look for clues that were left behind

Sources of clues include:

*Changes in plant appearance based on how the insect fed on the plant*

*Various "leavings" produced by feeding insects: "cast skins", waste products, secreted products (silk, waxes)*

**Background Information #1** How do various insects feed? Do they chew on solids, or do they suck fluids

## Insects that Chew Plants

**The basic features of chewing mouthparts:**

**Mandibles** (1 pair), designed to cut and tear - the business part of the chewing mouthpart

**Maxillae** (1 pair), for help in manipulating food and packed with cells for taste and touch

**Labrum**, a small flap at the front that covers the mandibles

**Labium**, a flap at the back of the mouthparts that helps hold food and has sense organs

Insects that use chewing mouthparts:

Grasshoppers, crickets

Earwigs

Beetle adults and larvae

Larvae of moths and butterflies (caterpillars)

Larvae of sawflies

Feeding patterns on leaves by chewing insects

Many have a generalized feeding pattern, with nothing distinctive

Most caterpillars, some beetle larvae, sawfly larvae, grasshoppers, earwigs

Some are "picky feeders" that produce a distinctive feeding pattern

**Leaf notching** (angular notches confined to margins) - typical of **root weevils**

The curious case of leafcutter bees

Leaves smoothly cut along leaf margin

Leaves *not eaten*, but collected for *constructing nest cells*

**Shotholes** (small holes confined to the interior of the leaf) - typical of **flea beetles** and **adults of many other leaf beetles**

**Skeletonizing** (chewing largely avoids main veins) - typical of many **leaf beetle larvae, Mexican bean beetle larvae, slug sawfly larvae, and Japanese beetle adults**

Slugs

Different way of chewing - rasping of the leaf surface

Tongue-like *radula* with hundreds of teeth-like *denticles*

**Slime trails!**

Earwigs vs. Slugs

*Try night surveys to really understand what is happening!*

**Background Information #2** Do insects produce any distinctive waste products that can be used for diagnosis?

Insects that have chewing mouthparts and produce solid/semisolid waste (**frass**)

Insects that suck fluids produce various liquid waste (**honeydew, tar spots**)

Frass produced by caterpillars – ridged, often hexagonal pellets

Frass produced by grasshoppers – elongate, similar to small rodent droppings

Frass produced by beetles – often thin, elongate; often watery and may smear easily

**Background Information #3a** Do insects secrete any distinctive materials?

**Silk** – Mostly produced by Lepidoptera/caterpillars

Used to tie leaves/create shelters/tents

Production of cocoon (insects other than some moths make cocoons)

Also used by spiders (creation of shelters, webs for prey capture, protection of eggs)

**Leafminers**

Larvae develop within a leaf/needle – “mine” the leaf tissues

Diagnosis: Can you tease apart the top and bottom layers of the leaves?

Habit of many kinds of insects – some caterpillars, sawfly larvae, fly larvae, beetle larvae

Often described by mine pattern:

Serpentine (often by fly larvae, some caterpillars)

Blotch

Tentiform (distinctive of one kind of caterpillar)

### **Insects and Mites that feed on plant fluids (some kind of piercing-sucking mouthparts)**

Order Hemiptera (true bugs, aphids, scale insects, leafhoppers, etc.)

Order Thysanoptera (thrips)

Order Acari (mites)

**Background Information #4** Do insects or mites leave behind "cast skins" after molting, egg shells?

Rarely observed with chewing insects - they are consumed

Frequently found with insects/mites that suck fluid

**Background Information #3b** Do insects secrete any distinctive materials?

**Wax** – Produced by insects that feed on the fluids of the phloem (some Hemiptera)

Wax may cover the body (powdery cover, long thin strands)

Wax may cover the egg sac

Wax as an excreted product – produced by certain psyllids

Potato/tomato psyllid – waste in form of waxy pellets resembling granulated salt or sugar

The basic features of **piercing-sucking mouthparts (Hemiptera)**:

**Mandibles** (1 pair), extremely elongated and designed to drill into plants

**Maxillae** (1 pair), extremely elongated and interlock to produce a food canal (for liquids coming out) and a salivary canal (for saliva going into plant)

The mandibles and maxillae form a **stylet bundle**

**Labrum**, a small, usually inconspicuous flap at the front

**Labium**, extremely elongated and forms the structure that supports the stylet bundle

A **proboscis** or "beak" is produced

*Hemipteran feeding habit - Lacerate-flush*

Found among many true bugs (e.g., squash bug, plant bugs)

Involves massive destruction of cells during feeding

*Hemipteran feeding habit - Consume cells of the mesophyll*

Found mostly among some leafhoppers, lace bugs, armored scales

Leaf spotting produced - **stippling**

Associated waste product - **tar spots**

**Thrips (Thysanoptera) a different kind of *piercing-sucking mouthpart***

The basic features of thrips mouthparts:

Mandibles (1 only), *functions as a spike to penetrate leaf surface*

Maxillae (1 pair), extremely elongated and *pierce underlying cells to release cell fluids*

Labrum, Labium, form a cone through which the fluids are pulled into the mouth

Feeding type - **puncture, poke and suck** (not rasping!!)

Light patches on leaves where cell contents emptied (**stippling**)

Associated waste product - **small dark tar spots**

**Spider Mites - a very different kind of *piercing-sucking mouthpart***

The basic features of spider mite mouthparts:

**Chelicerae** (pair), *functions to break the surface cells to release cell fluids*

Feeding type - "**rototill and suck**"

Light flecking on leaves where cell contents emptied (**stippling**)

May progress to generalized yellowing, bronzing on some plants

Associated waste product - **small dark tar spots**

*Hemipteran feeding habit - Consume fluids of xylem*

Found mostly among some leafhoppers (sharpshooters) and spittlebugs

No visible effect on plant

*Hemipteran feeding habit* - **Consume fluids of phloem**

Habit of aphids, soft scales, mealybugs, psyllids (some), leafhoppers (some)

Precision drilling to phloem, often with little/no cell death

Associated waste product - **honeydew**

**Honeydew!**

Shiny, sticky sweet fluid

Supports growth of sooty mold fungi

Used as food by many insects (bees, wasps, flies)

Whitney Cranshaw  
Department of Agricultural Biology  
Colorado State University  
Fort Collins, CO 80523

[whitney.cranshaw@colostate.edu](mailto:whitney.cranshaw@colostate.edu)