Introduction to Insects and Diagnosing their Damage

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Facts about insects

- Over 3 million species (possibly over 7 million)
  50% plant feeders, 25% beneficial, 25% feed on decomposing organic matter
- Only 1% considered pests
- Size in U.S. ranges from 1 mm to over 3 inches, avg. 1/4 inch
- Color and appearance variable
- A few common structural features
- Classification very complex
- Divided into major groups called orders, then families
Identifying features

- Outer skeleton – **exoskeleton**
- **3 main body parts**: head, thorax, abdomen
- Most adults have 1 or 2 pair of wings on thorax
- Most have 3 pair of legs on thorax
- **Mouthparts**: chewing or sucking (variable)
- 1 pair of antennae
- 1 pair of compound eyes (if they have eyes), some also have ocelli (for light detection)
- **Cold-blooded** - body temperature depends on environment
External Anatomy of an Insect

Internal Anatomy of an Insect

Insect Wings: 2 pair on thorax (unless you are a fly)
Close-up of scales
Beetle Wings: elytra
Wing Venation

Vein

Cell
True Fly: 1 pair of wings, halteres
Insect Legs: 3 pair attached to thorax modified for lifestyle

- Tarsus
- Tibia
- Femur
- Trochanter
- Coxa
- Coxa
Tarsi a.k.a “Insect Feet”
Prolegs and crochets

Thoracic Legs

Prolegs
Grasshopper: jumping
Cockroach: running
Water Boatman: swimming
Compound Eyes
Internal Structure of the Compound Eye
Large eyes for hunting prey, dragonfly
Large eyes and ocelli for light detection, damselfly
Mouthparts: chewing, grasshopper, herbivore
Mouthparts: chewing, tiger beetle, carnivore
Piercing-sucking mouthparts: true bug

Sponging-lapping mouthparts: fly
Piercing-sucking: mosquito
Sucking: proboscis, coiled tube, moths and butterflies
Antennae: sensory for feel, smell and sometimes hearing

Filiform  Clubbed  Moniliform  Serrate
Plumose antennae: male midge
Feathery antennae: male moth, pick up scent of female moth
Metamorphosis

- Developmental process by which insects change and grow.
- 2 types: simple (gradual) and complete.
  - **Simple**: wings develop externally during immature stages and there is no “resting/pupal” stage preceding the last molt. (egg, nymph, adult)
  - **Complete**: the wings, if any, develop internally during the immature stages, and there is a “resting/pupal” state preceding the last molt. (egg, larva, pupa, adult)
Simple/Gradual Metamorphosis

Nymph

Egg

Adult
Katydid pulling out of last nymphal “skin”
Complete Metamorphosis
Monarch butterfly emerging from chrysalis
Monarch butterflies
Insect Relatives

- Various organisms are often confused with insects.
- Spiders, ticks, mites, millipedes, centipedes, sowbugs, etc.
- In general have more than 6 legs.
Spiders have 8 legs and 2 body regions: cephalothorax and abdomen. Some are active hunters and do not build webs. Others are passive hunters and build various types of webs. All spiders are predators.
Ticks: deer tick stages
Deer tick mouthparts
Spidermites: very tiny, may or may not produce webbing, general plant feeders
Eriophyiid mites: plant feeders, some produce galls, others cause russetting
2 pairs of legs per body segment
Feeds on decomposing organic matter

Millipede
1 pair of legs per body segment

Predator

Centipede
Sowbug
Integrated Pest Management
IPM = Common Sense

- Holistic approach to pest management.
- Understand all factors (and their interrelationships) influencing plant growth (soil, water, air, nutrients, insects, diseases, landscape design, weeds, animals, beneficial organisms, weather and cultural practices).
- Goal: manage pests and diseases at acceptable levels – not eliminate them.
- Prevent problems by choosing best plant for the site.
- Regular monitoring of landscape is critical to determining if action is required.
- Weak or poor quality plants are more susceptible to insects and diseases.
- IPM is not “organic”.
- Pesticides are used as a tool. Broad spectrum residual insecticides should be avoided.
- Least toxic solutions (physical, mechanical, biological controls) should always be tried first.
- Consider your landscape as part of the larger community ecosystem and manage it responsibly.
Identifying Insect feeding/damage/presence

- What type of damage is present?
- Determine if damage is from insect or related organism.
- Culprit may not be obvious.
- Identify host plant or product, narrows possibilities.
- Are there signs of insect infestation such as frass, wax, cast skins, tents, sooty mold, sawdust, etc.
- Is the damage significant?
- Is treatment necessary and is it worth treating?
- Identification of pest important to determine treatment
Chewing mouthparts: grasshopper, herbivore
Important pests to control in the landscape

Gypsy Moth

Bagworm
Eastern tent caterpillar, webbing, gregarious, early - before gypsy moth, rose family hosts

Prune out egg masses in the winter
Fall webworm produces webbing on many woody plants, especially shade trees later in summer and into fall.
Pine sawfly: resembles caterpillar, gregarious, adult is a wasp, cannot use B.t.
Other Sawflies

Slug Sawfly on Red Oak

Dogwood Sawfly
Japanese **beetle**: classic damage is skeletonizing, hosts include rose, linden and grape.
**Viburnum leaf beetle, *Pyrrhalta viburni,*

- Look for it on *Viburnum* species, especially arrowwood viburnum, European cranberrybush viburnum and mapleleaf viburnum
- Adults look a lot like Elm leaf beetle
  - Keep an eye out and report it using our MAEDN app from the Iphone store or Google Play. Just search on MAEDN and it will come up.
Common Weevils in the Landscape

Two-Banded Japanese Weevils

Black Vine Weevil
Leafmining: insect feeds between leaf surfaces: caterpillars, fly maggots, sawfly larvae, beetles

Holly Leafminer - fly

Birch Leafminer - sawfly

Locust Leafminer - beetle

Tupelo Leafminer - caterpillar
Damage from Sucking Insects

Piercing-sucking mouthparts: causes small spots or stipples. Size of mouthparts determines the size of the spots.
Two-spot spider mite

Two-spot spider mite and eggs

Mite damage on hops, very fine stippling
Spruce Spider Mite

Spruce mite damage on Alberta spruce, fine stippling on needles, pattern

Close up of spruce spider mite – attacks needled evergreens, prefers cool weather

Spruce spider mite eggs – notice red color
Slightly larger stippling: piercing-sucking mouthparts, lace bug damage

Underside of leaves: chrysanthemum lace bugs and fecal spots on goldenrod
Coarse stippling: leafhoppers and 4-lined plant bug

4-lined plant bug also causes necrotic areas in leaf resembling leaf spots
Brown marmorated stink bug
Kudzu Bug: another invasive bug

Adult: size of a pea

Bugs massing on house

- Arrived in Georgia in 2009
- Currently in Maryland and spreading rapidly
- Feed on all legumes
- Prefer kudzu and soybeans
- This infestation is originally from Japan and likely entered US in Atlanta

Bugs on soybean leaf
Spotted Lanternfly, *Lycorma delicatula*

- Native, to Southeast Asia
- Adults 1 inch long and very colorful
- Adults and nymphs feed by sucking sap from stems and leaves
- Adults lay eggs on smooth non-host surfaces
- Attacks many hosts including grapes, apple, pines stone fruits, and Tree of Heaven
- Currently in Berks, Bucks, Chester, & Montgomery counties, PA
Check trees, especially Ailanthus for egg masses. They may be deposited in protected areas like under loose bark.
Scale Insects

- Damage may appear as yellowing, off-color and eventual dieback. Often stress pests (on plants stressed due to drought, etc.).

- **Soft Scales**: can be fairly large, resemble bumps on bark, feed on phloem vessels, produce honeydew, sooty mold may be present.

- **Armored scales**: flat, waxy, feed on phloem cells, do not produce honeydew, sooty mold will not be present.
Armored Scale: off-color, yellowing on Mugo pine near sidewalk: pine needle scale stress pests, feed on phloem cells, no honeydew

Elongate hemlock scale: waxy, flattened, no honeydew, can cause needle drop, dieback
Examples of Common Soft Scales

Indian wax scale on quince: honeydew and sooty mold

Cottony camellia scale on holly.
Signs of sap tappers

Sooty mold on sweetbox from cottony taxus scale

Tulip poplar leaf: cast skins from aphids and honeydew
Other Sap feeding insects

Aphids: feeding can cause distortion of new terminal tissue, resembles virus symptoms

Whitefly adult and nymphs

Mealybugs: produce honeydew, cause yellowing and dieback
Borers

- May be beetle larvae, caterpillars or wood wasp larvae.

- **Beetles** will pack sawdust (frass in the tunnels. Holes are exit holes only and will be round, D-shaped or oval. Sap or pitch will be present on conifers under attack.

- **Caterpillars** will push frass out of the tunnels through holes in the bark. Holes are round. Sap may be present on some trees.

- **Wood wasp** larvae pack sawdust and exit holes are round.

- **Damage** will appear as yellowing of foliage, wilting (sometimes) and dieback.
Abiotic vs. Insect Damage

Pine, yellow all over, no pattern, no insects or mites, root rot, trauma to root system, drought, etc.

Dieback from top-down on pine: stress pests, bark beetles
Symptoms of borer damage

Wilting and dieback of rhododendron branches: check closely for canker, mechanical damage and borers.

Yellowing of Nanking cherry: eventual dieback and death from peach tree borer.
**Ambrosia Beetles:** tiny beetles that bore into the heartwood of trees. They are generally associated with dying trees but some species attack healthy trees and shrubs.
Emerald Ash Borer (EAB) is an aggressive exotic wood boring beetle native to East Asia that attacks stressed and healthy ash trees, frequently causing death within three years of infestation.
Asian Longhorned Beetle: (ALB) is a very serious exotic pest that was introduced in solid wood packing material from China.

Adult: 1-1 ½”

Exit hole 3/8” or larger
Japanese Cedar Longhorned Beetle attacks Arborvitae, Cryptomeria, False cypress, Leyland Cypress, and in eastern redcedar (North Carolina). Other listed hosts include Chamaecyparis, Thujopsis, Juniper, Monterey cypress, firs, and pine. Damage appears as dead branches as small as a pencil to main trunks.

Adults ~ 3/8in

Larva in gallery

Exit holes 4 x 2 mm

Damage to trunk
Clearwing borers

Peach tree borer larva: all clearwing borer larvae look

Adult of peach tree borer: clear-wing moth

Adult lilac borer
Peach Tree Borer Damage

Base of cherry laurel with frass and peach tree borer larva

Sap on trunk of cherry tree from peach tree borers, can’t use nematodes for control
Sirex Wood Wasp

ADULT READY TO EMERGE

ADULT WASP

LARVAE IN LOG
Gall: abnormal growth of plant tissues caused by the stimulus of an animal or another plant. Caused by diseases, insects such as wasps, midges, adelgids, aphids, psyllids, caterpillars, and mites.
Beneficial Insects, Mites & Nematodes

- **Predators** consume their prey.
- **Parasitoids** (parasites) live on or in their host.
- **Ectoparasites** develop on the outside of the host.
- **Endoparasites** develop inside the host.
Praying Mantid

Egg mass – overwintering stage
Ladybird beetle
Green lacewing
Ground beetle
Tiger beetle
Dragonfly and damselfly
Minute pirate bug: predator of thrips
Syrphid fly: predator of aphids
Aphid parasite and mummies
Parasitized hornworm larva, parasite cocoons on the surface of the caterpillar
Beneficial wasps
Scoliid wasp: parasite of white grubs

Clement, UMD
Cicada killer wasp with cicada
Tachinid fly laying eggs on caterpillar
Predatory mites
Spiders
- All predators
- Active hunters
- Passive hunters

Jumping

Orb Weaver

Wolf Spider
Beneficial nematodes