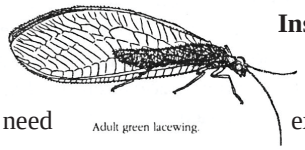
# Chapter 19.
# *Insects and Mites*

In this section you will learn the basic principles of insect and mite identification and control on horticultural plants. It does not contain all of the information you will need for identification and control of all pests. However, it will provide background knowledge on life cycles, types of damage, hosts, control techniques, and enough other general information about insects and mites to enable you to answer many of your customers' questions.



Adult green lacewing.

**Insects and mites exhibit an incredible range of sizes, shapes, colors and lifecycles.**

We strongly suggest that managers use an **Integrated Pest Management (IPM)** approach to deal with insect and mite pests. This approach involves starting with the correct identification of the species of insect or mite. Next, an understanding of the lifecycle and monitoring techniques is essential. Managers then need to evaluate and integrate practices from a selection of control tactics. Cultural (non-chemical) control methods such as those that maintain plant health, physical removal of infested plant parts or use of pest resistant plant material should be implemented first. An IPM approach also involves using biological control options where practical. Final solutions for control may involve selecting the proper pesticide and applying it at the correct time to kill the pest with minimal impact on beneficial organisms and the environment. Invasive species of insects, disease and weeds have added to the complexity of pest control. Many of these new invasive species may not have native biological control agents as an option. Control often involves bringing in new exotic predators and parasitoids to help suppress the pest damage. Additional information on IPM is covered in the IPM chapter of this manual.

## Classification

Insects and mites are in the same group (phylum Arthropoda) as crabs, shrimp, centipedes, sowbugs, spiders, and scorpions. These animals are characterized by segmented body parts, jointed appendages and a hard exoskeleton ("shell") which must be shed in order to grow.

**Insects (Class Hexapoda)** have six legs, three body regions (head, thorax and abdomen) and, in many groups, possess wings as adults. Some common examples are beetles, flies, wasps, true bugs, butterflies and moths.

**Mites (Class Arachnida)** although often referred to as insects, are not. Actually, they are more closely related to ticks, scorpions and spiders. Spider mites usually possess four pairs of legs. Some common examples are spruce spider mite, boxwood mite, and southern red mite. There is also a group of elongated plant feeding mites, called eriophyiid mites, with only two pairs of legs such as the pear blister mite and the hemlock rust mite.

Insects and mites exhibit an incredible range of sizes, shapes, colors and lifecycles. Conservative estimates claim there are over ten million distinct species, most unnamed. The vast majority (95%) are either beneficial or harmless. They act as pollinators for most fruits and vegetables. They provide food for birds and fish. Some insects and mites are either predators or parasites on other insects and mites. A relatively small number are harmful to the plants we grow. These are classified as pests. Insects and mites which attack plants may be very host specific (e.g. iris borer, boxwood psyllid and a limited number of scale insects). Some insects and mites attack a wide range of plants.(e.g. some spider mites, Japanese beetle and the cottony maple scale). Most common destructive insects and mites can be recognized and effectively kept below damaging levels if you have a basic knowledge of their host plants, life history, habits, damage, and appearance as well as an appropriate control strategy. A **host plant** is any plant that furnishes subsistence for a plant pest. In the literal sense, any plant that an insect or disease lives on is a host plant. In general usage, the term is used to describe a plant that is known to sustain a bad pest, such as cabbage plants, which are hosts to harlequin plant bugs.

**Most common destructive insects and mites can be recognized and effectively kept below damaging levels.**

Most of the typical insects that damage plants in landscapes and nurseries will produce 1-3 generations per year. Insects and plant - damaging mites, depending on the species, can overwinter as eggs, immatures, pupae or adults. Each species is different. Therefore, knowing the identification of the pest and its life cycle is critical for deciding when to make the most efficient control application, be it chemical or non-chemical control.

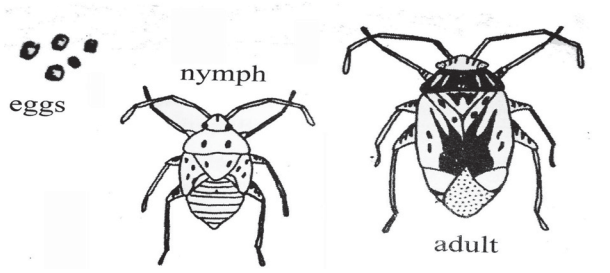
## Life Cycles and Growth Stages

All arthropods, including insects and mites, have exoskeletons that must be shed, as they grow in the immature life stages. Insects, mites and all other arthropods, such as crabs, go through several growth stages, shedding the exoskeleton to increase in size. Generally they emerge from eggs, pass through several juvenile stages (instars), and finally appear as adults. Most groups of insects mature in one of two ways: **gradual metamorphosis** and **complete metamorphosis**.

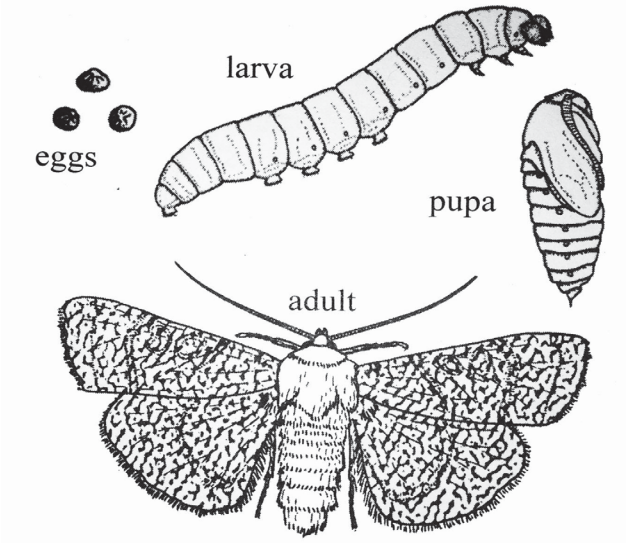
**Gradual Metamorphosis** occurs in most of the more primitive insects (that is, insects that developed early on in the evolutionary process). Typically, after the egg hatches, the insect goes through several nymphal instars and emerges as an adult after the last molt. Nymphs look much like adults except for not having fully developed wings, occupy the same habitat, and eat the same food. Control measures, if necessary, are similar for nymphs and adults. Examples are lace bugs, stink bugs, aphids, cockroaches, and grasshoppers. Most mites have a development similar to gradual metamorphosis of insects. Spider mites start as larvae with 3 pairs of legs, going into an eight legged protonymph stage followed by a deutonymph stage and then a sexually mature adult.

**Complete Metamorphosis** occurs in the more evolutionary advanced orders of insects. In this case, there are eggs, several larval instars, followed by a pupal stage, and then the adult. Larvae (grubs, maggots, caterpillars, etc.) and adults do not look alike, may live in different habitats and eat totally different foods. Examples are beetles, flies, and moths. Control measures, if necessary, will be different for the larval and adult life stages.

For example, the adult Japanese beetle feeds on foliage of plants in summer. The adults are controlled with foliar or basal plant drenching or injection applications of insecticides. The larval stage, a white grub, feeds on roots of grasses and is controlled with soil applications of insecticides in turfgrass areas or with beneficial nematodes. These turfgrass applications are made when the young larval forms are present in the root zone of the grass, usually in late summer to early fall. In the winter




**Gradual metamorphosis**




**Complete metamorphosis**

the larvae go deep in the soil where insecticides do not impact them. The larvae move up into the turfgrass root zone in spring, feeding for a while before pupating and emerging as adults, completing a one year life cycle.

Each insect or mite species varies in how long it remains in the immature form. For example, with two-spotted spider mites the female overwinters. The eggs laid in spring hatch and the larvae and nymphs develop in 20 -30 days, when temperatures are cool. As temperatures rise to 80- 90F then the development from eggs to larvae to nymphs to adults takes place in shorter periods of time, sometimes as short as 4- 5 days. In contrast, some insects with the longest immature stages include periodical cicadas which can have nymphal stages that last up to 17 years. The nymphs feed on tree roots for 17 years, and then emerge in spring, and molt to adults. Adults feed on trees, mate and reproduce. They lay their eggs in tree branches. The eggs hatch and the nymphs drop to the ground, burrow into the soil where they feed and develop, emerging again 17 years later.

Most of the typical insects that damage plants in landscapes and nurseries will produce 1-3 generations per year. Insects and plant - damaging mites, depending on the species, can overwinter as eggs, immatures, pupae or adults. Each species is different. Therefore, knowing the identification of the pest and its life cycle is critical for deciding when to make the most efficient control application, be it chemical or non-chemical control.

**Feeding Methods and Damage**

Plant-feeding mites are divided into three major groups or families: **spider mites** (Tetranchynid mites), **rust mites** (Eriophyid mite) and **broad mites** (Tarsonemid mites). All of the mite families have sharp, needle-like mouthparts called chelicerae used for piercing individual plant cells. When **spider mites** feed on plant foliage, the mite wounds the plant cell and removes the cell contents, causing a fine **stippling** damage. Stippling looks like thousands of tiny dots on the foliage and often appears silvery at first. The damage then turns white and, finally as the cell oxidizes, turns bronze to brown in color. Spider mites also have a silk gland. Silk is emitted from the mouthpart and is placed on parts of the plant. This silk is used to aid the travel of mites between plant parts. This silking can be used in IPM monitoring to detect spider mite activity.

**Broad mites** do not produce silk from their mouthparts and the lack of silk makes detection more difficult. These mites are small and cryptic, feeding in leaf folds and flower buds. They inject a plant hormone that causes new tip growth to harden and become distorted. These mites are tiny and must be identified under 30 - 40 X magnification. Detection involves peeling back young folded, newly emerging leaves.

**Rust mites** damage plant foliage by piercing it and some species (ex. pear blister mite) cause cells to bubble up and harden, looking like rust. Other rust mites cause their host to "off color" such as hemlock rust mite.

**Insects with piercing sucking mouthparts** have strawlike mouthparts called **stylets**. The stylets are used to pierce foliage, plant stems and flowers. The feeding insect often injects enyzmes that break down plant cells, allowing the insect to draw up the liquid plant parts. Some insects with stylet mouthparts include aphids, scales, lace bugs, leafhoppers, and whiteflies. If an insect with stylet mouthparts feeds on newly developing leaves or plant parts, the leaves often become distorted, gnarled and stunted. On fully expanded or mature leaves, there is often chlorotic stippling or streaking. These external symptoms can be used in diagnosing of causal agents of plant damage in IPM monitoring.

Sometimes the damage done by insects with stylet mouthparts, such as scale insects, is not noticeable at first glance. Infested plants gradually become weakened over a period of time, eventually looking unhealthy, thin and poor in vigor. New growth and leaf size are reduced and occasionally branch die-back may result.

Several species of insects with stylet mouthparts such as leafhoppers, plant bugs and some aphids are **vectors** of bacterial and viral diseases. When they feed on bacterial or virus infected plants, they often carry the disease to healthy plants. Their feeding injury may be minor compared to the damaging virus or bacteria they introduce into a plant system. The virus or bacteria may ultimately cause the plant to die.

Certain sucking insects, notably aphids and soft scales, excrete large amounts of waste called **honeydew.** This sugary, sticky honeydew coats foliage and bark of trees and shrubs, cars, and sidewalks, providing a site for the growth of a fungus. This fungus is referred to as **black sooty mold.** It blocks light from leaf surfaces, thus reducing plant vigor, and generally makes the plant unattractive. Ants and yellow jackets are attracted to the honeydew as a food source. Their presence may be your first indication that sucking insects are feeding.

borer (late instar stage) (photo: S. Gill)

**Insects with chewing mouthparts** have external mandibles. They consume leaves, roots and in some species, chew under the bark of the trunk or branches, acting as a borer. The larvae (grubs and caterpillars) of many other destructive insects cause injury by chewing plant tissue. Insects can be grouped by the damage they cause. For example, **defoliators** consume leaf foliage. **Leafminers** feed between leaf surfaces, leaving distinctive trails, such as the boxwood leafminer or holly leafminer. **Plant borers** are insects that bore into trunks, roots, rhizomes or tubers. Examples would be the dogwood borer and iris borer. **Leaf skeletonizers** generally chew between leaf veins, consuming the soft tissue of the leaf. Examples would be the Japanese beetle and hibiscus sawfly. **Tip** and **shoot borers** such as the maple tip borer, lay eggs in the tip growth of maples and their larvae cause dieback of the tip growth.

There are also some eriophyid mites, flies and gall wasps which cause unusual swelling of plant tissue, referred to as **leaf or stem galls**. These pests insert plant growth regulating chemicals into plant parts. The chemicals cause cell tissue to distort into structures that are used to house the larvae of the damaging insect.

**In Maryland more than 150 species of scale insects are known to occur, most of which attack woody plants. New exotic species of invasive scale continue to move into Maryland and other states with the shipment of infested plant material.**

Not all insects cause damage to plants. Adult moths, butterflies, adult sawflies, and true flies utilize pollen or nectar as a food source and do not injure plants by feeding.

**Insects and Mites on Ornamentals**

The following discussion reviews some of the major pest groups. Pests of interior plants, greenhouse-grown plants, and exterior woody and herbaceous plants are discussed separately. More comprehensive and specific information can be obtained from books such as "Pests and Diseases of Herbaceous Perennials – the Biological Approach" by Gill, Cloyd, Baker, Clement and Dutky. "Insects and Beneficials of the Greenhouse" by Gill and Sanderson, "Garden Insects of North America" by Cranshaw, "Insects That Feed on Trees and Shrubs" by Johnson and Lyon, and Extension manuals such as #359 "Total Plant Management of Herbaceous Perennials" and #363 "Total Plant Management of Greenhouse Crops". Several websites such as http://extension.umd.edu/ipm will help identify insect and disease activity in Maryland and best control tactics. The two afore mentioned manuals and fact sheets on specific insects can be found on this website.

**Interior Plants and Greenhouse-Grown Plants**

Pests of plants used for interiorscapes are often shipped in from tropical parts of the world. Most of these pest species are not winter hardy in our climate in Maryland and only exist in heated buildings and greenhouses. There is an ever increasing number of new invasive species being introduced into tropical areas so the list of pest showing up on interior plants continues to grow. These tropical plant pests can thrive in greenhouse production facilities, at the retail outlet, or on the customer's plants in the home or office. Damage from these pests can be severe, or become severe, if plants with light infestations are not treated. Infested plants should not be sold or used as stock plants for propagation. Part of your IPM effort should involve inspecting plant material brought in from tropical parts of the world for the presence of insect, mite and disease pests. It is a good idea to isolate new shipments of plants in an observation area for a couple of weeks to make sure the pests do not spread to other plants in the interiorscape or greenhouse.

**The website www.extension.umd.edu/ipm will help identify insect and disease activity in Maryland and best control tactics.**

**Mites**

spider mites and damage on spruce needle (photo: S. Gill)

Several different species of mites can damage interiorscape plants and greenhouse crops. Many of these mites are extremely small and require a hand lens or microscope to be seen. Damage may be the first noticeable sign of an infestation. **Spider mites** insert needle-like mouthparts into plant cells of foliage. The resulting damage causes a distinct stippling. Heavy infestations will stunt plant growth and render a plant unmarketable. One of the most common spider mites is the two-spotted spider mite.

Spider mites prefer dry conditions and bright, possibly hot locations in the landscape or greenhouse. Susceptible plants growing in areas of high light and high temperatures tend to have spider mite outbreaks. Hanging baskets in the upper canopy of the greenhouse are likely places for spider mite populations. Plants growing on the south or west side of a greenhouse, or in front of a hot window may build spider mite populations rapidly. Damage appears as a "stippling" (thousands of tiny yellow dots) on the foliage and the plant may have yellowing foliage.

*Monitoring for spider mites*

Examine plants prone to spider mites such as lemon balm, verbena, dracaena spikes, potted sunflowers, New Guinea impatiens, and poinsettia. Place a white paper on a clip board and place this under foliage of plants to be examined. Tap the foliage sharply to dislodge mites onto the paper. Examine the mites using a 10 – 20 x magnifier.

*Solutions for spider mite control*

- **Cultural (non-chemical) control: Don't put mite sensitive plants in hot dry sites** such as southern or western exposures. In addition, do not over-fertilize with high nitrogen fertilizer. Spider mites do not thrive in high moisture environments. Dousing foliage with water will help suppress populations. Make sure to let foliage dry out after this water dousing to reduce chances of inducing foliar disease problems. Jet streams of water can be used to dislodge mites, but this would have to be done on a regular interval to be effective.

- **Biological control: Predatory mites** can be purchased from biological supply companies found on the web. (Refer to the IPM chapter of this manual for a list of web sites.)Predatory mites are fast moving, teardrop shaped mites in the family Phytoseiidae. *Phytoseiulus persimilis* controls two-spotted spider mites and works best when used in high relative humidity greenhouses. *Neoseiulus californicus* controls several spider mite