# PEST LIBRARY INSECTS

TAYLOR'S

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# AMBROSIA BEETLES


Ambrosia beetles are beetles of the weevil subfamilies Scolytinae and Platypodinae (Coleoptera, Curculionidae), which live in nutritional symbiosis with ambrosia fungi and probably with bacteria. The beetles dig deep into tunnels in dead trees in which they grow fungal gardens, their only source of nutrition. After landing on a suitable tree, an ambrosia beetle digs a tunnel in which it launches spores of its fungal symbiont. The fungus goes into the plant's xylem tissue, absorbs it, and concentrates the nutrients on and near the surface of the beetle gallery. Most ambrosia beetles colonize xylem (sapwood and/or heartwood) of dying or recently dead trees. Species vary in their preference for different parts of trees, different stages of deterioration, as well as in the shape of their tunnels ("galleries"). However, the majority of ambrosia beetles are not specialized to any taxonomic group of hosts, unlike most phytophagous organisms which includes the closely related bark beetles.

Classification and Diversity

Until recently ambrosia beetles have been placed in independent families Scolytidae and Platypodidae, however, they are in fact some of the most highly-derived weevils. There are approximately 3,000 known beetle species using the ambrosia strategy.

Ambrosia beetles are an ecological guild, but not a phylogenetic clade. The ambrosia habit is an example of convergent development, as a number of groups evolved the same symbiotic relationship independently. The highest diversity of ambrosia beetles is found in the tropics. In the Paleotropical area, hundreds of species of Xyleborini as well as Platypodinae are the main agent starting dead wood decomposition. In the Neotropics, Platypodinae and Xyleborini are joined by the scolytine tribe Cortylini. In contrast with the diversity in the tropics, ambrosia beetle fauna in the temperate zone is rather limited. In the Nearctic region it is dominated by a few species from Cortylini, Xyleborini and Xyloterini. In the Palearctic ecozone, significant groups are Xyloterini and Xyleborini, joined by Scolytoplatypodini in the Far East.

The symbiotic relationship Beetles and their larvae graze on mycelium revealed on the gallery walls and on bodies called sporodochia, clusters of the fungus' spores. Most ambrosia beetle species don't consume the wood tissue; rather, the sawdust produced by the excavation is pushed out of the gallery. Following the larval and pupal stage, adult ambrosia beetles collect masses of fungal spores into their mycangia and leave the gallery to search for their own tree.

A couple dozen species of ambrosia fungi have been described, presently in the polyphyletic genera Ambrosiella, Raffaelea and Dryadomyces (all from Ophiostomatales, Ascomycetes). A lot more species are still to be uncovered. There is not a lot of information on the bionomy or specificity of ambrosia fungi. Ambrosia fungi are believed to be dependent on transport and inoculation supplied by their beetle symbionts, as they have not been found in any other habitat. All ambrosia fungi are possibly asexual and clonal.

Evolutionary Origin

During their evolution, most scolytid and platypodid weevils became progressively more or less dependent on fungi regularly co-habiting dead trees.

This evolution had various outcomes in different groups:

Some phloem-eating bark beetles (phloeophages) are probably employing aggressive phyto-pathogenic fungal associates to kill live trees.

Many of phloem-feeding bark beetles use phloem-infesting fungi as an addition to their diet. Some phloeophages became more or less dependent on such a mixed diet and evolved mycangia to transport their symbionts from maternal trees to newly infested trees. These beetles are called mycophloeophages.

Ambrosia beetles and ambrosia fungi are thus only one end of the spectrum of the weevil-fungus association, where both the beetle and the fungus became completely dependent on each other.

# ANTS

Ants are social insects of the family Formicidae and, in addition to the related wasps and bees, come from the order Hymenoptera. Ants evolved from wasp-like ancestors in the mid-Cretaceous period between 110 and 130 million years ago and diversified following the rise of flowering plants. Over 12,500 out of an estimated total of 22,000 species have been classified. One can easily identify them by their elbowed antennae and a distinctive node-like structure that creates a slender waist.

Ants create colonies that vary in size from a few dozen predatory individuals inhabiting small natural cavities to highly-organized colonies which may inhabit large territories and are composed of millions of individuals. These larger colonies consist mostly of sterile wingless females forming castes of "workers", "soldiers", or other specialized groups. Almost all ant colonies also have some fertile males called "drones" and one or more fertile females called "queens". The colonies are oftentimes referred to as superorganisms since the ants seem to operate as a unified entity, collectively working together to sustain the colony.

Ants have colonized nearly every landmass on Earth. Only Antarctica and a few remote or inhospitable islands lack indigenous ants. They thrive in most ecosystems and may form 15-25% of the terrestrial animal biomass. Their success in a lot of different environments has been credited to their social organization and their ability to modify habitats, tap resources, and protect themselves.

Their long co-evolution with other species has led to mimetic, commensal, parasitic, and mutualistic relationships.

Ant societies have division of labor, communication between individuals, and an ability to solve

complex problems. These parallels with human societies have long been an inspiration and subject of study.

Many human cultures make use of ants in cuisine, medication and rituals. Some species are valued in their role as biological pest control agents. However, they often destroy crops and infest buildings, bringing conflict with humans. Some species, such as the red imported fire ant, are regarded as invasive species, establishing themselves in areas where they are accidentally introduced.

# APHIDS

Aphids, also called the plant lice are among the most destructive insect pests on cultivated plants in temperate regions. The destruction they do to plants has made them enemies of farmers and gardeners all over the world, but from a zoological standpoint they are a very successful group of organisms. Their success is in part because some species are able to reproduce asexually.

Around 4,400 species of 10 families are known. In the past, many fewer families were recognized, as most species were included in the family Aphididae. About 250 species are serious pests for agriculture and forestry as well as an inconvenience for gardeners. They differ in length from 1 to 10 millimeters (0.04 to 0.39 in).

Plants showing aphid damage can have a range of signs and symptoms, such as reduced growth rates, mottled leaves, yellowing, stunted growth, curled leaves, browning, wilting, low yields and death. The removal of sap creates a lack of vigor in the plant, and aphid saliva is toxic to plants. Aphids often transmit disease-causing organisms like plant viruses to their hosts.

The green peach aphid, Myzus persicae, is a vector for more than 110 plant viruses. Cotton aphids (Aphis gossypii) frequently infect sugarcane, papaya and peanuts with viruses. Aphids helped in the spread of late blight (Phytophthora infestans) among potatoes in the Irish potato famine of the 1840s.

# AZALEA LACEBUG

Azalea lace bug, Stephanitis pyrioides, comes from a group of insects in the family Tingidae. The insects in this family typically inhabit and feed on the underside of leaves. They have thin lacy outgrowths on their thorax and have delicate lace-like forewings (Drake and Ruhoff 1965). At least 17 species of lace bugs destroy ornamental trees and shrubs in the United States.

Four species in the genus Stephanitis cause economic damage to plants in the heath family (Ericaceae) to which azaleas and rhododendrons belong. Of the four, the most destructive species associated with landscape plants is the azalea lace bug, Stephanitis pyrioides.

Infested azaleas develop stippled, bleached, silvery or chlorotic symptoms comparable to those caused by mites. The nursery industry considers the Azalea lace bug as a pest of major concern because of this aesthetic plant damage. Even in established landscape planting, azalea lace bugs can bring about considerable damage to foliage if not controlled early in the season when populations are low.

Native to Japan, the azalea lace bug spread around the world through the movement of its host species, azaleas. It occurs in most of the eastern United States including Florida. Available records show that it occurs in the states of Maryland, New York, Massachusetts, Virginia, Georgia, Alabama, Texas and California.

The adult lace bug is 3 x 1.5 mm (1/10 inch) long and cream-colored. The netted lacy wings, marked with black or brown patches, are held flat over the body with outer margins extending

beyond the body outline. Unless you look at it closely, the small size and transparent wings make it less apparent. When observed under a hand lens, a characteristic hood can be seen above the head.

# BAGWORM

The bagworm is a perennial insect pest of arborvitae, juniper, pine, spruce, and many other evergreen species. It attacks certain deciduous trees as well such as black locust, honeylocust, and sycamore. The bagworm is commonly found in southern regions of Pennsylvania. Infestations have recently been observed north of Interstate 80 in the state. The spread of the bagworm is slow-moving since adult females are not capable of flying. Their dispersal over large areas happens generally because of the movement of infested nursery stock and ornamental plants, or by ballooning (wind dispersal) of small bagworm larvae throughout early June. Bagworm larvae injure plants when they feed on needles and leaves. Young caterpillars feed on the upper epidermis of host plants, often leaving small holes in the foliage

Damage by mature larvae is especially destructive to evergreen plants. Trees including sycamore, willow, and other deciduous trees, usually refoliate following an episode of heavy defoliation. Unfortunately, bagworm infestations usually go unnoticed until damage is complete, and the large bags constructed by this pest are quite visible. Early detection of an infestation needs careful examination of host plants for the presence of small bagworms attached to the leaves or needles.

# BLACK VINE WEEVIL

The black vine weevil is a major pest in nurseries and developed landscape plantings. A native of Europe, this species was first reported in Connecticut in 1910. This key pest is the most harmful and widely distributed species of root weevils in the genus Otiorhynchus. Adults and larvae prefer rhododendron, Rhododendron spp., yew, Taxus spp., euonymus, Euonymus spp., and Japanese holly, Ilex crenata. Larvae likewise eat the roots of hemlock, Tsuga spp. This pest has been recorded on over 100 species of cultivated and wild plants. Some landscape pest managers call this insect the taxus weevil.

Injury caused by the larval stage feeding on the roots is highly destructive to plants. Feeding by larvae happen from mid-summer through autumn and in early spring. At first larvae feed on small tender roots, but in early spring, they transfer to the bark of large roots or the stem, often completely girdling them. Damage to roots may go unnoticed in container-grown plants in nurseries, but infested plants that are put in landscapes often die. Injury caused by adults is in the form of marginal notching of broadleaved evergreen foliage and other host plants. The marginal notching of the foliage seldom impacts plant health, even if it may be extensive.

# BRONZE BIRCH BORER

The bronze birch borer is a serious secondary pest of white, paper, and cut-leaf weeping birches. This native flat-headed borer will attack yellow, gray, and other species of birch. It has also been reported on beech.

The first sign that a tree is infested with borers is wilting and dying of the upper crown. Closer examination may show ridges (Image 2) and bumps on limbs and branches as well as "D"-shaped adult emergence holes in the bark. In some cases, the trunk may have parts with a rusty brown stain. This may be an indication that this species may be present. Removal of the bark where there are plenty of ridges will reveal irregular, winding, sawdust-packed tunnels called galleries that are created by larvae excavating plant material from between bark and wood. This pest usually first attacks 3/4-inch diameter branches in the crown of the tree. Girdling of the cambium by tunneling larvae interferes with movement of plant sap and nutrients that may result in partial or complete death of a branch or tree.

# CHILLI THRIPS

Chilli thrips destroys all the above ground parts of its host plants. It prefers young leaves, buds and fruits. Thrips eat by roughly rubbing (rasping) emerging and new plant parts. The rasping breaks plant tissue that oozes sap on which the insect feeds. Feeding may cause leaves to curl upward and become distorted appearing much like herbicide damage. Feeding also causes leaf, bud, and fruit tissue to become bronze in color. Newer leaves are generally shiny and older ones are frequently scarred from rasping. Infested plants become stunted and severe infestations can bring about total defoliation of the host. The symptoms may be confused for a fungal disease. This was particularly true with plumbago before chilli thrips was identified as the culprit responsible for blackened leaves and leafless stems. Despite severe damage on its many hosts, it can be quite difficult to collect more than a handful of chilli thrips even from many infested plants.

# CHINCH BUG

Chinch bugs are a complex of three various species within the Lygaeidae family. They have piercing-sucking mouthparts and they eat the sap of grass plants. They inhabit the thatch area of the turfgrass stand and prefer to feed on the lower leaf sheath and crown area of the plant. The chinch bug can be a major insect pest on home lawns all over the country. The hairy chinch bug (Blissus hirtus) is the most common species in the Northeast. The hairy chinch bug prefers bentgrasses, but will attack many other lawn grasses as well. The adult chinch bugs are about 3 to 5 mm (1/8 to 1/5 inch) in length and black with white markings on the wings. The wings rest flat over the back of the insect and there is a black spot between the wings. Adults may be long-winged or short-winged. There are five nymphal instars of chinch bus ranging in size from 1 to 3 mm (1/32 to 1/5 inch). The first two nymphal instars are red, with a white band across their abdomen, while the third and fourth instars are orange with wing pads just beginning to show up. The fifth instar is black with wing pads easily noticeable.

The chinch bug inserts its straw-like mouthparts into the plant tissue and sucks out the plant juices while injecting chemicals into the plant which clog the vascular system. The area around the feeding puncture generally turns yellow. Damaged areas first appear as small, irregular patches which grow larger as the insects spread. Chinch bugs are most destructive in open, sunny areas.

Chinch bugs spend the winter as adults in partially protected locations (under shrubs or around foundations of houses). As the weather warms in the spring, adults move into open areas, where females begin laying eggs. Fifteen to 20 eggs per day are deposited for two to three weeks. The eggs hatch in one to two weeks, and the nymphs start to suck the juices from host plants. It takes 30-90 days to reach adulthood. There are two generations per year, with a partial third generation in unusually warm summers. There is considerable overlap of generations, and all stages can be found during the summer.

# EASTERN TENT CATERPILLAR

The eastern tent caterpillar can be a major pest on cherry, plum, peach, pear, and a number of other deciduous shade trees. These caterpillars do not feed on evergreens. They usually pick the native black cherry (Prunus seratina) as a host, which commonly grows on roadsides and hedgerows. Nests of the eastern tent caterpillar are unsightly and the repeated defoliation they sometimes cause can bring about a decline of the host, predisposing it to damage from disease organisms and other insects. A single season's defoliation will rarely kill an otherwise healthy tree, as the feeding happens early enough in the season for the trees to grow new leaves.

Larvae vary in size from 10 mm (3/8 inch) upon hatching to 50 mm (2 inches) long when fully grown. The caterpillars are primarily brown and are thinly covered with light brown hairs. A white stripe on the back is bordered with reddish-brown stripes and a row of oval blue spots. The adult moths are brown with a wingspan of about 45 mm (1 3/4 inch). Two narrow, lighter-colored bands may be seen on the first pair of wings.

Egg masses of the eastern tent caterpillar may be found on smaller twigs of infested trees. The dark brown, shiny egg masses are about 20 mm (3/4 inch) long and 12 mm (1/2 inch) in diameter, and often encircle a twig. Larvae of the eastern tent caterpillar may be distinguished from those of the forest tent caterpillar, Malacosoma disstria, by the coloration pattern of the back. Forest tent caterpillars have a row of diamond-shaped white

spots alternated with small white dots along its back. Forest tent caterpillars, contrary to their name, do not build tents. In fact, they feed openly instead, often in large groups or clusters.

# EMERALD ASH BORER

Emerald ash borer (EAB), Agrilus planipennis Fairmaire, is an exotic beetle that was found in southeastern Michigan near Detroit in the summer of 2002. The adult beetles nibble on ash foliage but cause insignificant damage. The larvae (the immature stage) feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. Emerald ash borer probably arrived in the United States on solid wood packing material brought in by cargo ships or airplanes originating in its native Asia. Emerald ash borer is also established in Windsor, Ontario, was found in Ohio in 2003, northern Indiana in 2004, northern Illinois and Maryland in 2006, western Pennsylvania and West Virginia in 2007, Wisconsin, Missouri and Virginia in summer 2008, Minnesota, New York, Kentucky in the spring of 2009, Iowa in spring of 2010, and Tennessee in the summer of 2010. Emerald ash borer has killed tens of millions of ash trees in southeastern Michigan alone, with tens of millions more lost in Illinois, Indiana, Kentucky, Minnesota, Missouri, New York, Ohio, Ontario, Pennsylvania, Tennessee, Quebec, Virginia, West Virginia, and Wisconsin.

# FALL WEBWORM

The fall webworm is a widely distributed native pest of shade trees and shrubs and is seen from late summer through early fall. It feeds on almost 90 species of deciduous trees commonly attacking hickory, walnut, birch, cherry, and crabapple. This species acts similarly to the eastern tent caterpillar, but the fall webworm makes its nest over the end of the branch rather than at tree crotches. The large conspicuous webs contain caterpillars, dead partially-eaten leaves, and fecal droppings.

The larval stage of this pest skeletonizes and consumes leaves inside the protection of a tent-like web that they enlarge as they need more food and grow. They may sometimes defoliate a tree, but rarely kill it. On shade trees webs usually occur on occasional branches. They may not injure the tree appreciably, but they decrease its ornamental value.

# FUNGUS GNAT

Fungus gnats (Bradysia species) - also known as dark-winged fungus gnats, are tiny, mosquito-like insects often found in homes and offices, typically around houseplants. They are considered a problem when there is a large group, but the adults are harmless insects that do not bite. Fungus gnat larvae develop in the growing medium of houseplants and are thought of as minor pests of houseplants.

Adults are 1/8-inch-long, delicate, black flies with long legs and antennae. There is a unique "Y-shaped" pattern on the forewings. The larvae are wormlike and translucent, with a black head capsule, and inhabit the growing medium of houseplants.

Fungus gnats are tiny, delicate bodied flies that commonly develop in the growing medium of houseplants. Larvae of fungus gnats feed on algae, fungi and plant roots in growing medium. Adults do not bite or feed.

Fungus gnats can be controlled by allowing the growing medium to dry between watering. You may also use some insecticides and biological control agents to control fungus gnat larvae in growing media.

Fungus gnat larvae usually are found in the top 2 to 3 inches of the growing medium, depending on moisture level. They primarily feed on fungi, algae and decaying plant matter. However, the larvae will

feed on plant roots and leaves resting on the growing medium surface. Larvae develop rapidly and are fully grown in two to three weeks. They then pupate in or on the growing medium.

# GREEN JUNE BEETLE

Adult beetles are ¾ to 1 inch long. The adult's upper body is velvety green to dull brown with vertical stripes of green with yellow-orange margins on the hardened front wing. The underside of the body is shiny metallic green or gold. Adults also have a unique, small, flat horn on the head (Fig. 2). Green June beetle grubs are 3/8 (first instar) to 1½ inches long with a white stubby body and short legs. The grubs have an unusual habit of crawling on their backs rather than relying on their small legs, which are extended upward as they move across surfaces. Ridges found on the top surface of the grub's body are covered with short, stiff hairs that assist them in moving on the surface of the grass.

Home lawns in select areas of the Mid-Atlantic often suffer from the severe and extensive injury brought about by green June beetle grubs. Green June beetle is otherwise called the fig-eater because of its fondness of ripe figs and other thin-skinned fruit. Researchers have stated that this insect is a native pest with a wide distribution from Connecticut and southeastern New York to Florida and westward into Texas, Oklahoma, and Kansas. Over the past three decades, the green June beetle has received very little attention, except when the big adults were active fliers in July, especially since their buzzing sound during flight is similar to that of bumble bees.

# JAPANESE BEETLE

Japanese beetles are one of the most common pests in Northeast gardens. They were accidentally introduced with infested irises from Japan for the 1916 World's Fair. The adults feed on more than 300 different plants, "skeletonizing" the leaves and leaving only midribs and other veins. When populations are high, they may defoliate plants. The larvae (grubs) feed on roots and can kill large areas of turf.

Adults are approximately 10 mm (3/8 inch) long, with a metallic green midsection and head. The wing covers are coppery brown, and tufts of white hairs line the sides of the abdomen.

The life cycle is completed in one year, with ten months spent as a grub in the soil and two months as an adult. Females lay eggs in soil, usually in turf, during the summer (primarily in July). Grubs feed on roots close to the soil surfaces until cold weather arrives, then move to about 15 cm (6 inches) below the surface of the soil where they hibernate for the winter. Once spring comes, the grubs move nearer the surface and resume feeding. They pupate in May and June, emerging in early July as adults. Roses, fruit trees, beans, tomatoes, and corn are among the favorite foods of the adult Japanese beetle. Adults feed during the day, especially in warm weather and on plants in full sun. They chew on the flowers and the leaves, which soon wilt and drop. Large populations can completely defoliate a plant.

There are several similar species, such as Oriental and Asiatic garden beetles, which also eat landscape plants. Oriental and Asiatic garden beetles feed mostly during the night on flowers but cause little damage as adults (the larvae can seriously damage roots, particularly of grasses).

# LACE BUG

Lace bugs are common pests of azalea, rhododendron, sycamore, broad-leaved evergreens and a lot of deciduous trees and shrubs. The adults have highly-ornamented wings and a hood-like structure covering the head. Its surface is entirely covered with veins that look like lace.

Adult lace bugs are about 3 to 6 mm (1/8 to 1/4 inch) long with a netlike pattern on the wings, which are dotted with brown and black. The immature stages, or nymphs, are similar except they are smaller and often have spines. The eggs, although small, are easily distinguished by their elongate and cylindrical shape. They resemble small, black smoke stacks connected to the undersides of the leaf.

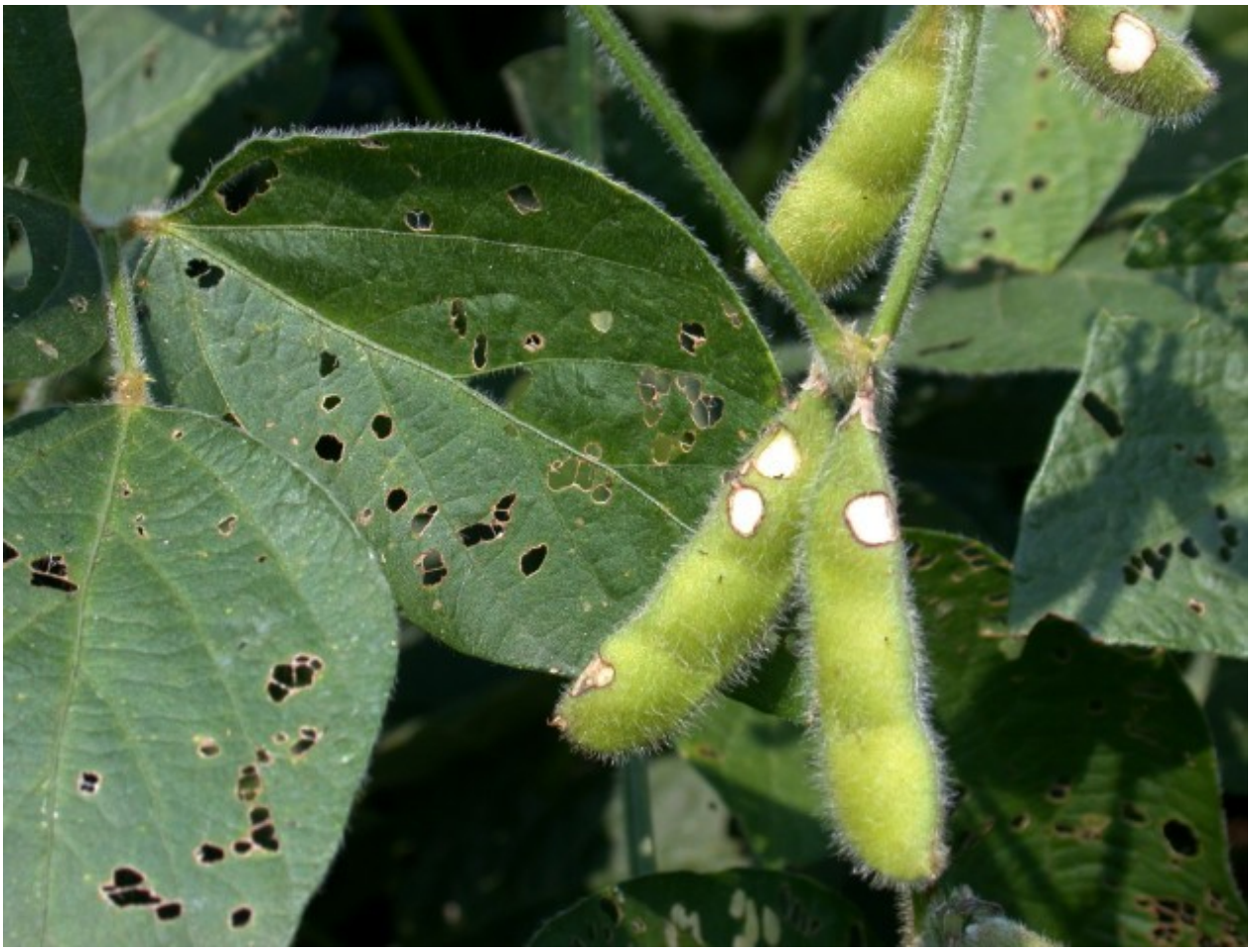
Lace bugs can be classified into two groups - those that attack deciduous trees and shrubs and those that attack evergreen shrubs. Lace bugs which attack deciduous plants spend the winter in the adult stage by hibernating on the plant under bark or near the plant in leaf litter. Lace bugs which attack evergreens spend the winter in the egg stage attached to the leaves. The hawthorn lace bug is one species which attacks deciduous plants. The adults hibernate under loose bark of their host plants as well as among leaf litter. They become active in early to mid-May and return to the new leaves. The females soon begin to lay eggs along the larger veins on the lower leaf surface. The females may lay eggs for a considerable time, often extending into June. The eggs hatch in a couple of weeks, and the nymphs

gather together and feed. Each nymph sheds its skin (molts) five times before they reach the adult stage. Growth to the adult stage usually takes three to four weeks. Peak numbers of this pest are usually present in July. Only one generation occurs per year. Related species of lace bugs such as the oak, sycamore and hackberry lace bugs have two and occasionally three generations in a summer.

The azalea lace bug is an example of a lace bug which attacks evergreens. The azalea lace bug spends the winter in the egg stage. The eggs are partially inserted into the leaf tissues along the midvein and are covered with the resin-like excrement of the female. The nymphs hatch in the spring, usually mid-May. They feed in small groups on the under surface of leaves and molt five times before becoming adults. The adults mate and lay eggs for a second generation by mid to late July. Often there is a third generation in the late summer and early fall. The andromeda and rhododendron lace bugs have similar life cycles.

The damage caused by lace bugs is first noticed as yellow spots on the upper leaf surfaces of affected plants. Lace bugs actually feed on the undersides of leaves with their piercing-sucking mouthparts, but because they kill surrounding cells as they feed, they cause the yellow spots to appear on the upper sides of the leaves. The first yellow spots that appear are very similar to mite damage, but the spots made by lace bugs are much larger. When feeding damage becomes too much, the leaves take on a gray blotched appearance or can turn completely brown. As lace bugs feed, they produce brown varnish-like droppings that spot the underside of the leaves. These droppings further distinguish lace bug damage from mite damage. When large numbers of lace bugs are present, cast skins can be found attached to the leaves.

# LEAF BEETLE



The lily leaf beetle adult is a striking bug with a bright scarlet body as well as black legs, head, antennae, and undersurface. The adults are 6 to 9 mm (1/4 to 3/8 inch) long, and they will squeak if they are squeezed gently--a defense mechanism to deter predators. Adults and older larvae feed on leaves, stems, buds, and flowers of the host plant. Adults deposit their eggs on the underside of leaves in an irregular line. The reddish/orange eggs take from 7-10 days to hatch under normal circumstances. Females lay up to 450 eggs, usually over two growing seasons. Larvae look like slugs with swollen orange, brown, yellowish or even greenish bodies and black heads. Larvae tend to do more damage than adults. Larvae are distinctive and repulsive in that they secrete and carry their excrement on their backs. Younger larvae feed for 16-24 days, primarily on the underside of leaves.

Larvae enter the soil to pupate; pupae are florescent orange. New adults emerge in 16-22 days and feed until fall. They do not mate or lay eggs until they emerge the following spring in late March through June. Lily leaf beetles spend the winter in the soil or plant debris in the garden or woods, oftentimes a distance away from the host plants. Adults prefer environments that are shaded, protected, cool, and moist.

# LEAF HOPPER

Leafhopper adults are elongated, wedge-shaped and somewhat triangular in cross-section. They jump and fly off readily. Depending on species, they range in size from 1/8 to 1/2-inch and their bodies are colored yellow, green, gray or they may be marked with color patterns. Nymphs look similar to adults but are wingless. They can run very fast, occasionally sideways, and hop. Very common and various species feed (with sucking mouth parts) on the juices of a wide variety of plants; occasionally injuring plants and transmitting plant diseases; medically harmless although adult leafhoppers are capable of biting, temporarily producing pain.

# LEAF MINER

Leaf miners are usually the larvae of flies, moths, or beetles that feed or "mine" between the upper and lower epidermal leaf surfaces. The larvae tunnel through the leaf creating a narrow, whitish colored serpentine (winding) mine or blotch (blister) type mine. The tunnel is clear, except for the trail of black fecal material that larvae leaves behind as they feed. Female flies puncture or "stipple" leaves with their ovipositors to deposit eggs in the leaf tissue or to feed on sap. Many ornamental plants are attacked by leafminers, but azalea, bougainvillaea, ixora, hollies, chrysanthemum, lantana, oak, and boxwood are some of the preferred hosts. Leaf miner damage is quite apparent, but healthy plants should be able to tolerate considerable injury before losing vigor or yield. However, during heavy infestations, plants appear bleached or faded and their aesthetic value decreases. In some cases, the leaves turn yellow and drop, due in part to the entry of pathogenic fungi and bacteria into old mines. The following are examples of some common leaf miner species, but a lot more species exist.

# MEALYBUG

Mealybugs are insects in the family Pseudococcidae, unarmored scale insects found in moist, warm climates. They are considered pests because they feed on plant juices of greenhouse plants, house plants and subtropical trees and also acts as a vector for a couple of plant diseases. Mealybugs are sexually dimorphic which means the sexes have distinct morphological differences. Females are nymphal, exhibit reduced morphology, and are wingless. Although unlike many female scale insects, they often retain legs and can move. The females do not change completely and are likely to be neotenic (exhibiting nymphal characteristics).

Males are winged and do change completely during their lives. Since mealybugs (as well as all other Hemiptera) are hemimetabolous insects, they do not undergo complete metamorphosis in the true sense of the word, i.e. there are no clear larval, pupal and adult stages, and the wings do not develop internally. However, male mealybugs do show a radical change during their life cycle, changing from wingless, ovoid nymphs to "wasp-like" flying adults.

# MITES

Spider mites are common pest problems on numerous plants around yards and gardens throughout the United States. Injury is caused as they feed, bruising the cells with their small, whip-like mouthparts and ingesting the sap. Damaged areas usually appear marked with a lot of tiny, light flecks, giving the plant a somewhat speckled look. Following severe infestations, leaves become discolored, producing an unthrifty gray or bronze look to the plant. Leaves and needles may eventually become scorched and drop prematurely. Spider mites frequently kill plants or cause serious stress to them. Spider mites (Family: Tetranychidae) are classified as a type of arachnid, relatives of insects that also includes spiders, ticks, daddy-longlegs and scorpions. Spider mites are small and often difficult to see with the unaided eye. Their colors range from red and brown to yellow and green, depending on the species of spider mite and seasonal changes in their appearance.

Many spider mites produce webbing, particularly when they occur in high populations. This webbing gives the mites and their eggs some protection from natural enemies and environmental fluctuations. This webbing is often confused with the webbing produced by spiders, as well as fluff made by cottonwoods.

# MOLE CRICKET

The mole crickets compose family Gryllotalpidae, of thick-bodied insects about 3-5 centimeters (1.2-2.0 in) long, with big, beady eyes and shovel-like forelimbs highly developed for burrowing and swimming. They also have the ability to fly: the adult mole cricket may fly as far as 8 kilometers (5.0 mi) during mating season, is active most of the year, and spends the winter in hibernation. Younger insects can have shorter wings, and their appearance varies by species, with some that look like grasshoppers or very large ants or dark-colored "termites"; when wings are short.

Mole crickets are omnivores, feeding on larvae, worms, roots, and grasses. Common predators of mole crickets include birds, rats, skunks, armadillos, raccoons and foxes. Mole crickets are relatively common, but because they are nocturnal and spend nearly all their lives underground in extensive tunnel systems, they are rarely seen. Mole crickets amplify their song by chirping in a burrow that they've carefully sculpted into the shape of a double exponential horn, which acts as a megaphone. They live in agricultural fields, lawns and golf courses. They may be found in every continent with the exception of Antarctica and are commonly considered pests.

# SCALE

Scale insects are tiny, immobile insects with no visible legs or antennae, pressed tightly against the plant on which they are feeding. Many are common and serious pests of trees, shrubs and indoor plants. Scale insects feed on plant sap. They have long, threadlike mouthparts (stylets) which are six to eight times longer than the insect itself. Scale feeding slowly reduces plant vigor; heavily infested plants grow poorly and may suffer dieback of twigs and branches. An infested host is sometimes so weakened that it dies. Scales often discharge a sticky honeydew which is attractive to wasps and ants and which supports the growth of black sooty molds.

# SOD WEBWORM

Here are several species of caterpillars called sod webworms that can be majorly harmful pests of U.S. lawns. They may also become important pests of grass covered parks, cemeteries, golf courses. They have even been noted to cause damage in small grain crops such as corn, wheat and oats. Damage to grass is caused by the feeding of the larval or "worm" stage. The adult moth does not cause damage to turf, other plants or clothing. The damage brought about by sod webworms may be noticed in early spring. The damage appears as small dead patches of grass among the normally growing grass. The summer generation may cause general turf thinning or even irregular dead patches in late June into early August. Sod webworms prefer sunny areas and the larvae are often found on south facing, steep slopes and banks, where it is hot and dry. Heavily shaded turf is rarely attacked by the larvae.

The most serious damage usually shows up in July and August when the temperature is hot and the grass is not growing vigorously. In fact, most sod webworm damage is mistaken for heat and drought stress. Sod webworm-damaged lawns may recover slowly, without irrigation and light fertilizations. These thin turf areas allow weeds to establish in the lawn making it unsightly. Sod webworms appear to feed on all the common turfgrass used throughout the U.S. However, common Kentucky bluegrass, perennial ryegrass and fine fescues are the ones showing damage the most. Improved perennial ryegrasses with endophytes are highly resistant to sod webworms.

Likewise, tall fescue, though often attacked, usually outgrows the damage. Bent grasses on golf courses are commonly affected.

# WHITE GRUB

White grubs are immature scarab beetles. They hatch from eggs laid in the soil, have three larval instars, and also pupate in the soil. The third instar is often the most destructive and may be seen in the soil the longest. The adults are rarely turf pests, but some may feed on tree leaves or make mounds in the soil. White grubs may have one or more generations each year in the Mid-Atlantic. When white grubs feed on grass roots, the grass gradually thins, yellows, and dies. This makes the grass feel soft and spongy. Scattered, irregular, brown patches of grass appear, which become larger over time. The root injury reduces the turf's ability to take up water and nutrients and withstand drought stress. Heavily infested grass pulls up easily.

Furthermore, white grubs attract moles, raccoons, armadillos, and birds, which can make an already damaged area appear worse. However, these animals may be interested in earthworms or other insects besides grubs. Large numbers of dark-colored, parasitic wasps with yellowish to white stripes on their abdomens that hover over the lawn on sunny days in the summer or fall may also be a sign of infestation. Sample the area to confirm that a white grub problem really exists. Proper monitoring and identification can prevent turf loss and costly renovation. To check for a grub infestation, get a shovel, sift through the top 3 inches of soil, roots, and thatch. Look for creamy-white, C-shaped beetle larvae, with tan to rusty-brown heads and six legs. Larvae that look like grubs but lack legs are probably billbugs. Mature grubs vary in length from ¼ to 2 inches, depending on species and age. The pattern of hairs, or raster), on the tip of the grubs abdomen helps in larval identification. However, adults are needed

for an accurate species identification. After examining the soil, replace the grass and water it. It is quite common to find an occasional grub and is not cause for alarm. Healthy turf can usually outgrow the root loss caused by a couple of grubs. Damage thresholds vary depending on the grub species and quality of the turf.

# WHITE PINE WEEVIL

The white pine weevil, Pissodes strobe, is considered the most destructive insect pest of eastern white pine in Pennsylvania with either forked or deformed trees brought about by repeated infestations. Trees become vulnerable to injury when they reach a height of about three feet, and trees exposed to direct sunlight are more likely affected. Adults are 1/4" long reddish-brown weevils with white patches on the end of their wing covers. Like most weevils, the adult has a long snout-like beak from which knobbed antennae arise. Larvae, living beneath the bark, are white, legless, with a unique brown head. They are 5/16" long when mature.

The first sign of infestation by this pest is glistening droplets of resin on terminal leaders in late March and April. This is brought about by punctures made by adults in the process of feeding and cutting egg-laying sites. Larvae do the most damage as they tunnel downward in the leader, causing the shoot to wilt and ultimately die. Repeated infestations in successive years creates a deformed or forked tree.

# WOOLLY ADELGID

The hemlock woolly adelgid is a small aphid-like insect that feeds on several species of hemlock (Tsuga spp.) in Asia, its homeland, and in North America where it was introduced. To date, populations of this pest in eastern North American forests have been unmanageable (although new biological control programs offer promise). However, hemlocks growing in nurseries and landscapes can be controlled through an integrated pest management (IPM) approach. This is important because hemlock is a unique and versatile landscape species for which there is no good substitute. An IPM approach for A. tsugae on ornamental hemlocks includes carefully monitoring for the presence of the adelgid, carrying out different cultural practices to enhance tree vigor and to discourage pest invasion, using mechanical and chemical control measures as needed to decrease adelgid populations, and promote biological control by encouraging the activity of natural enemies.

A fully-grown adult of the hemlock woolly adelgid is approximately the size of a period on this printed page. However, this insect is easily recognized during most of the year by the presence of a dry, white woolly substance on the young twigs. This "wool" is associated with all stages of the adelgid, but it is most abundant and visible during spring when egg masses are present. An egg mass looks a lot like the tip of a cotton swab, although somewhat smaller. Adelges tsugae injures eastern and Carolina hemlock by sucking sap and probably also by injecting a toxic saliva while feeding. This causes the needles on infested branches to desiccate, turn a grayish-green color, and then drop from the tree typically within a few months. Most buds are also killed, so little new growth is produced on infested branches.