Insect Pests of Ornamental Plants in the Home Landscape

Contents

Mississippi gardeners grow hundreds of different species of plants in their home landscapes, and most of these plants are subject to attack by one or more insect pests. Being able to identify and control these pests when needed is an important part of managing a home landscape. However, in many cases, it is possible to avoid, or at least reduce the potential of, having pest problems in the first place.

Gardeners accomplish this by being aware of the insect pests that are likely to occur on different species and varieties of plants and working proactively to minimize the potential for pest problems. This can be done by avoiding species or varieties of plants that are particularly prone to pest problems, keeping plants healthy and vigorous so they can defend themselves from pest attack, and avoiding actions, such as unnecessary insecticide sprays, that can trigger pest outbreaks. When pest problems do occur, insecticides can be important gardening tools but must be chosen and used with appropriate care and planning. See Extension Publication 2483 *Integrated Pest Management in the Home Landscape* for more information.

This publication provides you, as a home gardener, with information on the biology, management, and control of some of the insect pests most commonly encountered on landscape plants. Some pests, such as aphids, are addressed generically because the biology, management, and treatment of aphids is similar, regardless of the particular species of aphid and the plant on which it occurs. Other pests, such as hibiscus sawflies and lesser canna leafrollers, are discussed individually because they are so commonly encountered.

Although this publication does not specifically address all of the different species of insect pests that occur in Mississippi landscapes, smart gardeners often can adapt information to pest situations not specifically covered. For example, if you have problems with large numbers of aphids on daylilies and you determine there is a need for treatment, you can consult the section on aphids to see which insecticides are recommended and then check the insecticide label to be sure that particular insecticide is labeled for daylilies. Likewise, if green mapleworms are threatening to defoliate a prized maple tree, you can review the information on other caterpillar pests of deciduous landscape trees to gain some insight into possible management and treatment options.

The insecticides recommended for control of a particular pest are listed according to the active ingredient. This is necessary because a particular active ingredient may be sold under dozens of different brand names. Literally hundreds of different brand-name insecticide products are available for use in the home landscape, but these represent only a few dozen different active ingredients. Thus, when shopping for insecticides, it is important to know exactly which active ingredient you wish to buy. The section on Choosing and Purchasing Insecticides has more information on this and discusses most of the more common insecticides.

Within the list of insecticides recommended to control a particular pest, active ingredients that may be acceptable for use by organic gardeners are listed. Note, however, this does not necessarily mean that all brand name formulations containing that particular active ingredient are acceptable for organic gardening. Organic gardeners should read the product label carefully to be sure it conforms to their requirements.

When choosing insecticides, always read the label carefully to verify the insecticide is labeled for the intended use and for the particular plant being treated. For example, acephate is labeled to control caterpillars on many different landscape plants, but it will injure flowering crabapples, red maples, and several other species of trees. Also, although acephate is labeled to control fall webworms on most trees, it may not be used to control fall webworms on pecans because pecans are food-bearing trees.

Aphids

Aphids occur on most plants, but the most commonly attacked plants include crape myrtles, roses, and silver maples.

Crape myrtle aphids can build to heavy populations on susceptible varieties of crape myrtles, causing heavy accumulations of honeydew and sooty mold.

Description

Aphids are around 1/8 inch long. Many different species of aphids occur on ornamental plants. All are small, soft-bodied insects with piercing-sucking mouthparts. Depending on species, their color may vary from green, yellow, or black to pink or red. Some species, known as wooly aphids, are covered with white, cottony strands of wax. One of the more distinctive characteristics of aphids is the presence of two elongate, tailpipe-like structures known as cornicles that protrude from the end of the abdomens of most species.

Damage

Aphids cause damage by sucking plant sap and by transmitting plant diseases. Although individual aphids consume very little, aphids reproduce rapidly and can occur in extremely high numbers. Many species reproduce by parthenogenesis, which means that female aphids do not need to mate to reproduce. Many species can complete a generation in as few as 7 days. Feeding is often concentrated on young, expanding leaf and terminal tissue, and the physical damage caused by large numbers of piercing mouth parts can result in distorted plant growth. Aphids excrete large amounts of honeydew, or undigested plant sugars. This honeydew accumulates on leaves, causing them to be sticky. Honeydew also results in the growth of black sooty mold fungi. Although sooty mold does not damage the plant directly, heavy accumulations of sooty mold are unsightly and interfere with photosynthesis. Honeydew and sooty mold will also accumulate on vehicles and lawn furniture located under aphid-infested trees.

Common Species

The crape myrtle is the only host of the aphid bearing its name. The crape myrtle aphid occurs on the undersides of leaves and can build to extremely high numbers on susceptible varieties. The wooly alder aphid is a common species on silver maples. River birches are commonly infested with an aphid (no common name) that causes leaves to become distorted and reddened. The Asian wooly hackberry aphid is a relatively new, nonnative species that commonly occurs on sugarberry trees. These insects, which are covered with a white, cottony material, cause accumulations of sooty mold on infested trees. Oleander aphids commonly attack oleanders and butterfly weeds (*Asclepias*) planted in butterfly gardens. Yellow pecan aphids and black pecan aphids, two common pests of pecans, are discussed in a following section.

Management

Many insects prey on aphids, with lady beetles and lacewings being the most common. Parasitic wasps and fungal diseases also have a big impact on aphid populations. Natural biological control is the most important means of controlling aphids, and outbreaks are more likely when previous insecticide sprays have disrupted natural control. Certain varieties of crape myrtles, especially the "indica" varieties, are more likely to develop aphid problems than others. Consider susceptibility to aphids when selecting varieties of crape myrtles for planting. Heavy concentrations of aphids occurring on terminal growth of smaller plants often can be washed off with water sprayed from a garden hose.

Control

acephate, imidacloprid, malathion; *organic: azadirachtin, insecticidal soap, pyrethrins + canola oil*

Soil-drench treatments with imidacloprid can provide effective, long-term control of aphids, but such treatments are slow acting and must be applied before heavy infestations develop.

Whiteflies

Whiteflies are most commonly seen on gardenias, Ligustrum, Chinese privet, and hibiscus.

Silverleaf whiteflies. Note the numerous eggs and flattened, scale-like immatures, as well as the white-winged adults.

Description

Whiteflies are about 1/16 inch long and are related to aphids. Adult whiteflies are small, moth-like insects covered with a white, waxy powder. There are several different species, but all carry their white, powdery wings folded tent-like over their bodies. They are most commonly found on the undersides of leaves, but clouds of adults will fly around infested plants when disturbed.

Immature whiteflies are immobile, scale-like insects that feed on the undersides of leaves. They are flattened and oval-shaped and, depending on the species, may have waxy filaments protruding from their bodies. However, these traits are difficult to see without a hand lens.

Damage

Like aphids, whiteflies suck plant sap through piercing-sucking mouthparts. They are also similar to aphids in their tendency to build to high populations and their ability to produce large amounts of honeydew, which eventually results in sooty mold.

Common Species

Citrus whiteflies are commonly seen on gardenias (cape jasmine). Bandedwinged whiteflies can be identified by the two gray bands across each wing and occur primarily on hibiscus and other malvaceous plants. The silverleaf whitefly is an important pest of many vegetable and nursery crops and occasionally occurs on landscape plants. This species can be especially difficult to control.

Management

Avoid unnecessary insecticide treatments that can disrupt natural biological control.

Control

acetamiprid, azadirachtin, dinotefuran, imidacloprid; *organic: insecticidal soap, neem oil, horticultural oil*

Dinotefuran and imidacloprid are useful for controlling whiteflies when applied as a soil drench. Acetamiprid is one of the more effective foliar sprays for whiteflies. When attempting to control whiteflies with foliar sprays, apply at least two successive treatments 5 to 7 days apart.

Several other whitefly insecticides are labeled for application only by licensed commercial applicators. Because of the efficacy of these products and the difficultly of effectively controlling whiteflies, homeowners may wish to contract with commercial applicators for whitefly control in difficult situations.

Mealybugs

Mealybugs occur on gardenias and a few other landscape plants.

Madeira mealybugs. Note the small, yellow crawlers and the cottony egg sacs.

Description
Mealybugs are ⅛ to ⅓ inch long. They are soft-bodied, wingless insects that are related to aphids and whiteflies. One of the key characteristics of mealybugs is that their bodies are covered with a whitish or yellowish powdery wax material. The body is somewhat flattened and oval-shaped, and, depending on the species, there may be elongate, waxy filaments extending from the margins of the body. In most species, eggs are deposited in cottony egg sacs attached to the plant. Mealybugs are slow-moving insects.

The larvae of some species of lady beetles superficially resemble mealybugs. These lady beetle larvae are often found in association with infestations of aphids or mealybugs and are often mistaken for mealybugs. But these are predators that actively eat aphids and mealybugs. They move faster than mealybugs and have a distinct head.

Damage
Mealybugs are more commonly seen on plants grown indoors and in greenhouses, but they also occur on certain landscape plants and outdoor potted plants. Like aphids and whiteflies, mealybugs have piercing-sucking mouthparts and produce honeydew that supports the growth of sooty mold. Mealybugs often concentrate their feeding on young tissue in the terminals of plants, and heavy infestations can distort leaves and stems. The accumulations of wax, shed skins, and cottony egg sacs, combined with the resulting honeydew and sooty mold, are unsightly.

Management
Naturally occurring predators and parasites play a key role in keeping mealybug populations in check. On heavily infested plants, you can temporarily reduce populations by washing with a forceful water spray.

Control
acetamiprid, acephate, imidacloprid, dinotefuran; *organic: insecticidal soap, neem oil, horticultural oil, pyrethrins + canola oil*

Imidacloprid and dinotefuran control mealybugs when applied as a soil drench. Acetamiprid is one of the more effective foliar treatments. Multiple applications, applied at 7-day intervals, may be necessary when using foliar sprays.

Scale Insects

Scale insects occur on camellias, hollies, magnolias, euonymus, and many other plants.

Tulip tree scales are soft scales that occur on yellow poplar and magnolia trees and produce large amounts of honeydew.

Description
Scale insects are 1/16 to ½ inch long. They are unusual in that they are immobile for most of their lives and do not resemble other insects. Scale insects spend most of their lives underneath a hardened or soft waxy covering, with their mouthparts imbedded in the host plants. Newly hatched scale insects are insect-like and are known as crawlers. Scale crawlers quickly imbed their mouthparts into the plant and form the scale-like covering for which this group of insects is named. Scale insects are related to aphids, whiteflies, and mealybugs. There are two major groups of scale insects—armored scales and soft scales—and there are many different species within each of these groups.

Soft scales secrete a waxy covering that is firmly attached to their bodies. Soft scales produce large amounts of honeydew, which, in turn, can support the growth of sooty mold. In most cases, mature soft scales are usually much larger than armored scales, ranging in size from ⅛ to ½ inch across.

Common species of soft scales include **tulip tree scales**, which are commonly seen on yellow poplar trees, as well as on many of the small, deciduous magnolias and occasionally on southern magnolias; **pine tortoise scales**,

which occur on pines; and **Indian wax scales**, which occur on Indian hawthorns and many other shrubs. **Crape myrtle bark scales** are serious new pests of crape myrtles.

Armored scales secrete a waxy covering that is not attached to their bodies (although this is difficult to see without a microscope). Armored scales do not produce honeydew and are generally smaller—⅛ inch or less—and more flattened than soft scales.

Common armored scales include **tea scales**, important pests of camellias and hollies; **euonymus scales**, which occur on many species of euonymus; **white peach scales/ false oleander scales**, which occur on the leaves of magnolias and many other plants; and **San Jose scales**.

Damage
Depending on the species, scale insects may feed through the bark on twigs and limbs or on leaves. Heavy infestations of scale insects can be very damaging to plants, causing unthrifty growth, honeydew (in the case of soft scales), distorted growth, and even death of branches, limbs, or entire plants. Infestations of armored scales are easy to overlook because their coverings blend in with the bark.

Management
Predators, such as lady beetles and small parasitic wasps, often keep scale populations in check. Outbreaks are more likely to occur when this naturally occurring biological control is disrupted by insecticide sprays; but outbreaks can also occur for other reasons, such as plant stress, absence of natural control agents, or individual plants that are inherently susceptible. Applications of pyrethroid insecticides are especially likely to flare scale outbreaks. Some homeowner mosquito treatments containing pyrethroids are labeled for application to shrubs to control resting adult mosquitoes, but gardeners should be aware that their use increases the potential for scale problems. Also, scale outbreaks tend to be more common in areas where there is an active mosquito-fogging program, particularly on plants that are nearest the application route.

In some cases, you can use pressurized water sprays, with a fine spray at approximately 30 PSI of pressure, to dislodge eggs and female scales from plants. Such treatments also help remove accumulations of sooty mold. This method is most effective against large soft scales, such as wax scales, infesting thick-leaved species such as hollies and Indian hawthorns. Apply these treatments before bud break, when only mature leaves are present. Tender leaves and buds can be injured with excessive water pressure. Hand removal can also be a helpful tool in reducing soft scale numbers on small or lightly infested plants.

Some plant species or varieties are more prone to having scale problems than others, and one way to avoid problems with scale insects is not using plants especially prone to scale infestations. Heavy outbreaks of scales are often naturally controlled, but this takes time. Such a cycle of scale outbreak followed by naturally subsiding populations is often seen with tulip tree scales on yellow poplars. However, heavy infestations of scales can kill or severely injure ornamental plants before natural control occurs.

Control
dinotefuran, imidacloprid, acephate, malathion, carbaryl; *organic: azadirachtin, neem oil, horticultural oil*

Scale insects can be very difficult to control. In cases where control of scale insects becomes necessary, there are three basic control options: horticultural oils, systemic insecticides, and crawler sprays.

Horticultural oils control scale insects and their eggs by suffocating them. Hence, oil sprays control only scale insects/eggs they contact directly, and getting adequate spray coverage is important when using oil sprays. Horticultural oils can be applied during the late winter, as dormant or delayed-dormant type sprays, as well as during the growing season. If used improperly, horticultural oils can injure plants, so be sure to read carefully and follow label directions. Because horticultural oils can be effective against all life stages of scale insects, they can be very useful tools for scale control. Examples of currently available horticultural oils include Hi-Yield Dormant Spray, Bonide All Seasons Horticultural & Dormant Spray Oil, Monterey Saf-T-Side, Fertilome Scalecide, Fertilome Dormant Spray & Summer Oil Spray, and Ortho's Volck Oil.

Because they constantly feed on plant sap, scale insects are susceptible to certain **systemic insecticides**. These are insecticides applied to the soil or injected into the trunk and taken up in the sap of the plant, where they are consumed by the scale insects.

Imidacloprid (Ferti-lome Tree and Shrub Systemic Insect Drench and Bonide Tree and Shrub Insect Control are two examples) is available for homeowner use as a soil drench to control infestations of soft scales. Note that this product is specifically labeled for use against soft scales (the group that produces honeydew) but is not labeled for control of armored

scales. This product can be a useful tool to control soft scales, especially when used in combination with other methods. Use rate depends on either height of shrub or cumulative trunk circumference. Keep in mind, however, that this product is slow acting, and it may take a month or more to begin seeing results. Apply this treatment according to label directions when plants are actively growing.

Dinotefuran is a soil-applied systemic insecticide that is especially useful against armored scales (the group that does not produce honeydew). Currently, dinotefuran is not available in small-package homeowner formulations, but there are commercial formulations that are not classified as restricted-use products and do not require special licensing to purchase (Safari 20 SG and Zylam are examples). Packages of such products can be costly and may contain more product than you need. However, in situations where a large number of plants require treatment, this may be the most cost-effective way to control armored scale infestations. Before purchasing such products, read a specimen label carefully to be sure you understand how to apply the product and how to determine the amount to use per plant. Then, count and measure the plants that require treatment, and make careful calculations to determine the amount of product needed. Be sure to read and follow label directions carefully. Measure carefully when mixing drench solutions; commercial formulations are concentrated. Use rate is based on inches of circumference around the main stem for trees, or on height in feet for shrubs. Dinotefuran is slow acting but can provide many months of residual control. Be sure to observe pollinator-protection requirements. Do not apply dinotefuran as a foliar spray to plants that are in bloom.

Crawler sprays are contact insecticide sprays that provide effective control of scale crawlers. Crawlers are soft-bodied and generally easy to kill with good coverage of a labeled insecticide. But such treatments are effective only if you apply them when scales are in the crawler stage. This can be difficult to do because eggs of different species of scales hatch at different times of the year. Two methods you can use to determine when crawlers first appear are frequently examining infested twigs with a magnifying lens and using double-stick tape wrapped around infested twigs. When properly timed, two or three successive sprays at 7- to 10-day intervals will kill most of the crawlers, breaking the life cycle of the scale insects on the infested plant. Timing crawler sprays is generally more difficult for soft scales, which have fewer generations per year than armored scales. Insecticides recommended to control scale crawlers include malathion or acephate.

Use a combination of methods

Because scale insects can be difficult to control, it is often necessary to use a combination of methods. On severely infested plants, one of the first steps is to prune out any severely damaged and/or infested limbs. This helps reduce the number of scales present and increases your ability to get adequate spray coverage. Getting thorough coverage is very important when attempting to control scales with insecticidal oils or crawler sprays. One problem with assessing progress with scale control is that dead scales look much like live scales, and dead scales may remain attached to the plant for quite a long time. With soft scales, you can often gauge progress by the presence of honeydew. As long as soft scales continue to produce honeydew, they are still alive. Because ants, such as fire ants and carpenter ants, actively tend and protect soft scales in exchange for the honeydew they produce, controlling ants can help control scales. Likewise, controlling scales can help control certain ant species.

Use a professional

Some scale insecticides are labeled for application only by licensed commercial applicators, and commercial applicators have the equipment necessary to effectively apply these products. Homeowners may wish to contract with commercial applicators for scale control in difficult situations.

Other scale control options

Two other options for scale control must be mentioned. One is the "do nothing" approach. In some cases, a plant may experience a heavy outbreak of scale insects that is eventually brought under control by naturally occurring parasites and predators. This often occurs with tulip tree scales on yellow poplars. But it takes time for the predators and parasites to find the scale infestation and control it. This is more likely to occur if the homeowner does nothing than if harsh chemical sprays are used. With this approach, there is the risk that the situation could get much worse, resulting in serious plant injury, before this natural control occurs.

Another option for dealing with scale insects is to replace the plant. This is a drastic step you should take only after careful assessment and consideration. Occasionally, a plant becomes so severely infested and damaged by scales that

this may be the best option. Obviously, when replacing such plants, you may want to choose a different species or variety of plant less prone to scale problems.

See Extension Publication 2938 *Crape Myrtle Bark Scale Identification and Control* for more detailed information on crape myrtle bark scales.

Thrips

Thrips occur on many plants but are most important on roses, tropical hibiscus, and laurels.

Adult thrips are less than 1/16 inch long. This photo shows adults of three species: tobacco thrips, flower thrips, and western flower thrips.

Description

Thrips are very small, elongate insects that are no more than 1/16 inch long when fully mature. Most adults have fringed wings they carry folded lengthwise over their bodies, but these are evident only when viewed through magnification. Immature thrips are usually light yellow to lemon-colored and are spindle-shaped.

Damage

Thrips can cause damage by feeding on leaves as well as by feeding on flowers. Their injury reduces the aesthetic value of the blooms of roses and other similar plants. Thrips also injure the foliage of certain plants, causing the leaves to have an unsightly, bleached appearance. A thrips feeds by punching plant cells with its needle-like mandible and sucking up the resulting plant juices. This results in silvery or bleached damaged areas. Because feeding is often concentrated on young, actively growing tissue, flowers and leaves are often crinkled or distorted as they continue to expand after being damaged. Thrips also transmit certain plant viruses.

Common Species

Western flower thrips and flower thrips commonly damage the blooms of roses, especially light-colored varieties, and blooms of other plants. Greenhouse thrips often cause serious damage to the foliage of Grecian laurel. Chilli thrips is a serious new, nonnative pest of roses and many other ornamental plants.

Control

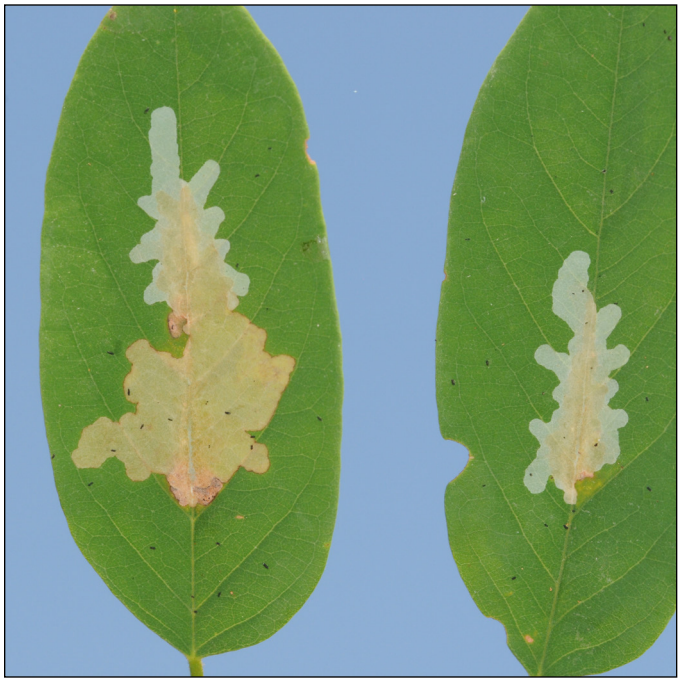
acephate, malathion, imidacloprid, bifenthrin, cyfluthrin, cyhalothrin, permethrin; *organic: azadirachtin, spinosad, insecticidal soap*

Soil-drench treatments of imidacloprid will help control foliage-feeding thrips, but thrips feeding in flowers are more difficult to control. During certain times of the year, large numbers of thrips migrate from maturing weeds and other hosts. Weekly sprays may be necessary to minimize damage to intensively managed roses during such periods of heavy migration.

See Extension Publication 2472 *Insect Pests of Roses* for additional information.

Leafminers

Leafminers occur most commonly on hollies, boxwoods, and azaleas; occasionally occur on other plants.



These blotch-type leaf mines were caused by larvae of the black locust leafminer. These tiny beetle larvae feed on the inner portions of the leaf, leaving the upper and lower epidermis intact.

Description
Leafminers are ¼ inch long or less. The term *leafminer* describes any insect that completes at least a portion of its life by living and feeding inside plant leaves. In most cases, the larvae feed on the leaf tissue between the upper and lower epidermis of the leaf. Depending on the feeding habits of the particular species, the mines may appear as irregularly shaped blotches or blisters or as winding tunnels. There are many different species of leafminers, representing several different groups of insects. Some of the most common leafminer species are flies, but some caterpillars live as leafminers for at least the early portion of their lives, and some species of sawflies and beetles are also leafminers.

Damage
Damage is caused by the larvae, which destroy leaf tissue by mining in the leaf, reducing leaf area and interfering with nutrient translocation. Extremely heavy infestations can result in enough loss of leaf area to adversely affect plant vigor and health. Fortunately, this is not common, and most leafminer infestations do not seriously affect plant health. However, even light leafminer infestations can cause plants to be unsightly, and damage to broadleaved evergreens may persist. This aesthetic injury is the primary damage leafminers cause.

Common Species
Holly leafminers are the larval stage of a small fly. Actually, several different species of leafminers attack hollies. Most have only one generation per year and overwinter as larvae or pupae within mines in the leaves. Adults emerge and lay eggs when new leaf growth is forming in the spring. Heavy infestations can result in severe aesthetic injury and leaf drop.

Boxwood leafminers are larvae of a small, gnat-like fly. The yellow to orange larvae overwinter inside the leaf mine, pupate in the spring, and emerge as adults in midspring.

Azalea leafminers are the larvae of a small moth. Newly hatched caterpillars feed as leafminers inside the leaves, causing blister-like mines, but older caterpillars exit the mines and feed as "leafrollers" or "leaftiers." Injury is concentrated on young leaves at the ends of stems. There are several generations per year, and heavy infestations can cause plants to be unsightly.

Citrus leafminers are a relatively new pest of citrus trees, which are often grown as landscape trees in the southern portion of the state. Citrus leafminers are the larvae of small moths. They cause long, winding mines in the leaves of many types of citrus trees, causing plants to be unsightly. Because this insect is newly introduced, it has few natural enemies, and infestations are often heavy. Because citrus trees are grown both as landscape plants and food crops, it is important to be sure any insecticides are specifically labeled for that use.

Locust leafminers are the larvae of small beetles. They cause irregular, blotch-shaped mines on black locust trees. In some portions of the country, this insect occurs in such high numbers that black locust trees may be severely defoliated by midsummer to early fall.

Management
Predators and parasites often keep leafminer populations in check, and outbreaks are more likely when biological control is disrupted by previous insecticide treatments. Hand-picking mined leaves can be an effective method of managing light infestations of leafminers. This is especially true for holly leaf miners, which overwinter inside the leaves. Picking and destroying infested leaves destroys the insects while also improving plant appearance. Light pruning can help control azalea leafminers, especially when combined with a foliar insecticide treatment. English boxwoods are less susceptible to boxwood leafminers than are other types of boxwoods.

Control
acephate, imidacloprid; *organic: spinosad*

Because the larvae live in a protected location inside the leaves, leafminers can be difficult to control. Systemic insecticides such as acephate or imidacloprid are normally most effective. Soil-drench applications of imidacloprid control some species of leafmining flies. Contact insecticide sprays must be applied during the time when adults are active and laying eggs. The objective is to control adults and establish an insecticide residue that controls newly hatched larvae as they are boring into the leaf. Several applications may be required to adequately cover the period of adult activity. Treatments containing the active ingredient spinosad are especially useful against leafmining caterpillars, such as azalea leafminers and citrus leafminers, and some formulations of spinosad are specifically labeled for use on home-grown citrus.

Leafhoppers

Leafhoppers are minor pests of most plants.

Sharpshooters are large leafhoppers (about ½ inch) that feed on twigs of crape myrtles and other plants, excreting large volumes of undigested plant sap.

Description

Leafhoppers are ⅛ to ½ inch long, active, long-bodied, somewhat wedge-shaped insects. They have piercing-sucking type mouthparts and readily run, hop, or fly when disturbed. There are many different species; most are green to yellow, but some species are brightly marked with yellow, red, or blue.

Common Species

Glassywinged sharpshooters are common on crape myrtles. This is an unusually large leafhopper (approximately ½ inch long) that forcibly excretes large amounts of liquid. Potato leafhoppers can cause leaf injury on red maples, while the redbud leafhopper is a common inhabitant of redbud trees.

Damage

Both adults and nymphs feed on the undersides of leaves and on tender stems, sucking the sap and causing leaves to become spotted or turn yellow or reddish and dry up. In other cases, leafhopper injury causes distortion of leaves and/or terminals. Leafhoppers can also transmit important plant diseases, such as aster yellows and Pierce's disease of grapes. The feeding of some species causes a toxic response in the plant, resulting in a burning effect that can cause leaf tips to wither and die. In most cases, leafhoppers are minor pests that seldom cause serious plant injury.

Control

bifenthrin, cyfluthrin, cyhalothrin, malathion, imidacloprid, permethrin; *organic: insecticidal soap, pyrethrins + canola oil*

It is rather uncommon for leafhopper populations to become heavy enough to require treatment. Apply foliar sprays as needed. Soil-drenches of imidacloprid provide some control but are rarely applied specifically to control leafhoppers.

Grasshoppers and Crickets

Grasshoppers and crickets are general feeders on the leaves of many plants.

Eastern lubber grasshoppers can damage many types of ornamental plants, including thick-leaved plants such as amaryllis and lilies.

Description

Grasshoppers and crickets can be ½ to 3 inches long. There are many different species of grasshoppers and crickets. They vary in size and color, but most are easily recognized by their hind legs, which are well developed for jumping.

Damage

Adults, as well as the immature nymphs, cause damage by eating leaves. Normally, the amount of defoliation these insects cause is negligible, but outbreaks occasionally occur and cause excessive defoliation. Potential for significant damage is greatest on small plants. In cases where grasshoppers are migrating from nearby fields, roadsides, or natural areas and feeding on ornamental plants, repeated insecticide treatments may be required.

Control
bifenthrin, cyfluthrin, acephate, malathion

Apply foliar sprays as needed to prevent excessive injury.

Spider Mites

Spider mites occur on roses, boxwoods, ornamental conifers, azaleas, camellias, and other plants.

Spider mites are potentially damaging pests of most ornamental plants.

Description
Spider mites are 1/32 inch or shorter. Although they are not insects, spider mites belong to a closely related group. Adult spider mites are so small that they are barely visible to the naked eye, but they can be readily observed through a 10x hand lens. Adults of most species are somewhat globular in shape and have eight legs. There are many different species, and color may vary from red to green or yellow. One of the more common species, the two-spotted spider mite, appears to have a dark spot on either side of its body.

Damage
Spider mites feed by sucking the fluid from plant cells. Adults and nymphs cause similar injury. Feeding by low numbers of mites is minor, but these pests have a very high reproductive potential and can complete a generation in as few as 7 days. Heavy infestations can cause severe injury and can even kill plants. Feeding by individual mites causes localized cell death, resulting in light-colored stippling. When mite populations are heavy, these individual feeding sites fuse, giving leaves a bleached or bronzed appearance. Severely injured leaves may curl and drop from the plant. At first, mite infestations are just on the undersides of leaves, but, under heavy infestations, the mites produce webbing (hence, the name spider mite) and occur on the tops of leaves and on other plant parts.

Common Species
The two-spotted spider mite is a common species on many ornamental plants, including roses. Southern red mites commonly occur on hollies, camellias, and azaleas. Boxwood mites are common on boxwoods. Spruce spider mites are pests of many ornamental conifers.

Management
Naturally occurring predatory mites and other predators often keep populations of plant-feeding mites in check. Outbreaks of spider mites often occur following insecticide treatments targeted against other pests because these treatments destroy the predatory mites. Avoid unnecessary insecticide treatments. Foliar applications of carbaryl, acephate, or pyrethroid insecticides tend to trigger mite outbreaks, and outbreaks are also more likely to occur on plants treated with imidacloprid. Outbreaks of some species of mites are favored by hot, dry weather, especially if accompanied by dusty conditions. Thus, keeping plants well watered during periods of drought helps reduce the potential for mite outbreaks. Washing foliage with a water spray can also be beneficial in controlling or preventing mites, but this should be done early in the day to avoid prolonging leaf wetness, which encourages plant diseases.

Control
insecticidal soap; *organic: neem oil, horticultural oil, pyrethrins + canola oil*

Unfortunately, there are no specific, highly effective miticides that are sold as homeowner formulations. Horticultural oils can provide very effective mite control when thorough spray coverage is achieved. When treating for mites, it is important to apply two or more successive treatments 4 to 5 days apart to effectively break the life cycle. Choose the product carefully. Using products that don't work or inadequate treatment intervals can intensify mite problems. For serious mite problems on high-value plants, consider contacting a licensed commercial applicator. These professionals have access to more effective miticides.

See Extension Publication 2472 *Insect Pests of Roses* for additional information.

Slugs and Snails

Slugs and snails attack hostas and other tender perennials, as well as many annual plants.

Slugs can damage tender, low-growing plants such as hostas and begonias.

Description

Slugs and snails can be ½ to more than 3 inches long. Slugs are more closely related to oysters and other mollusks than to insects. Their long, fleshy, slime-covered bodies are not jointed, and they have two movable "eye stalks" and another pair of sensory tentacles on their heads. Although similar, snails have shells, whereas slugs do not. Both slugs and snails move about on a layer of slime that dries to leave shiny trails. There are several species of slugs, some of which may be longer than 3 inches when mature. There are many different species of snails, as well. Through most of Mississippi, slugs are generally more common and more damaging than snails. These animals are active mostly at night and spend the day hiding under flowerpots, mulch, leaf litter, or in other protected sites.

Damage

Although snails and slugs often feed on decaying plant material, they also damage the leaves of tender perennials and annual bedding plants by feeding on them with their rasping-type mouthparts. Damage appears as long, narrow holes in the leaves and is often associated with the shiny trails. These pests also damage blooms, especially blooms growing near the ground. Keep in mind that these pests are rarely active during the day, but their shiny foraging trails can indicate their presence. Feeding is often concentrated on the emerging leaves of plants like hostas, which magnifies the overall impact of the injury. High populations often occur in situations where there is heavy mulch, leaf litter, or other organic matter and in densely planted beds. They thrive in conditions of constant moisture.

Management

Slugs thrive in moist, protected areas with heavy accumulations of decaying organic matter. Limit conditions favorable to slugs, such as excessive moisture, excessive organic matter/mulch, excessive leaf litter and other detritus, and items such as flower pots, rocks, and fallen limbs that provide daytime hiding places. Raking mulch away from the base of susceptible plants can also help reduce attacks. You can use copper or other types of barriers to protect especially sensitive or valuable plants. You can control slugs through diligent use of traps baited with beer or other attractive baits, such as moist dog food. Another nonchemical control option is to place inverted flower saucers, boards, or other attractive harborages in the flower bed, check them regularly, and physically remove and destroy any snails or slugs you find. These controls are more practical for small plantings.

Control

metaldehyde, iron phosphate

Slugs and snails can be controlled with baits specially formulated for this purpose, and many commercial brands are available for home use. For best results, combine baits with management efforts to make the area less attractive to slugs and snails. To prevent injury to developing leaves of hostas and other susceptible plants, it is important to begin control efforts early in the spring before plants begin to break dormancy or in the fall of the preceding year. Many species of slugs overwinter as adults and become active as temperatures warm in the spring. Baits are generally less effective when slugs are less active because of cool temperatures. Repeated bait applications are usually required to obtain and maintain control. Place baits near areas where the pests hide. Keep in mind that baits tend to lose their effectiveness when they become wet or if they are exposed to sunlight for prolonged periods. Because baits containing metaldehyde are toxic to pets and wildlife, be careful to use them properly. Baits containing iron phosphate are labeled for use around domestic animals.

Pillbugs

Pillbugs attack hostas and other tender perennials, as well as many annual plants.

Pillbugs primarily feed on decaying plant material but sometimes damage emerging leaves of hosta and other tender, low-growing plants.

Description

Pillbugs are about ¼ inch long. They are not insects but are land-dwelling crustaceans related to shrimp and crayfish. These animals have jointed bodies and seven pairs of legs and can roll into a ball when disturbed (hence, the name pillbug). Pillbugs prefer moist, protected environments with lots of decaying organic matter. Heavy populations often occur in heavily mulched flowerbeds or areas with heavy accumulations of leaf litter.

Damage

Although pillbugs feed mostly on decaying organic matter, they sometimes feed on the leaves of tender ornamental plants, such as hostas, and bedding plants. Damage often occurs as the leaves of dormant perennials are emerging through mulch and/or leaf litter.

Management

As with slugs, limiting mulch, leaf litter, and other detritus in flowerbeds can help limit pillbug numbers. Damage to emerging hostas and other tender perennials can also be limited by carefully raking mulch and leaf litter away from plants during emergence. This prevents the pillbugs from having a protected place to feed on the emerging foliage.

Control

spinosad or carbaryl baits; bifenthrin, permethrin, cyfluthrin

Baits containing spinosad or carbaryl help control pillbugs. These are usually sold as "bug and slug baits" and also contain active ingredients, such as metaldehyde or iron phosphate, that control slugs.

Liquid sprays or granular insecticides containing pyrethroid insecticides (active ingredients such as permethrin, bifenthrin, cyhalothrin, or cyfluthrin) can also be effective.

Pecan Phylloxera

Pecan phylloxera attack only pecans and hickories.

Pecan phylloxera are small, aphid-like insects that cause galls on leaves and twigs of pecans.

Although pecans produce edible nuts, they are also one of the more common trees in Mississippi landscapes. Pecan phylloxera is one of the most common insect pests of pecans. Because pecan trees are also food-bearing trees, it is important that you use only insecticides specifically labeled for application to pecans when it is necessary to treat them.

Description

Pecan phylloxera are small, yellow insects that look very much like aphids. They are seldom seen because they are encased inside the galls that they cause to form on stems and nuts. The pea- to marble-sized, knot-like galls these insects cause make them easy to identify.

Damage
Pecan phylloxera overwinter as eggs in cracks and crevices on limbs and branches. Egg-hatching coincides with leaf bud break in the spring, and the young nymphs immediately crawl to the developing leaf buds and begin feeding. Their feeding affects the growth of the leaf tissue, causing the formation of the hollow, knotty galls that encase the feeding nymphs. These galls cause severe deformation of developing twigs and nuts. On heavily infested trees, more than 70 percent of the new terminal tissue can be affected, resulting in trees that are unsightly and unproductive. Fortunately, outbreaks of pecan phylloxera are somewhat cyclic, and trees may experience heavy infestations for a year or so, followed by several years of low populations.

Management
Avoid planting pecans in the home landscape. If you do plant pecans, avoid the high-maintenance varieties normally grown in commercial pecan orchards. Instead, plant varieties such as Candy, Elliott, Farley, Jenkins, or Syrup Mill that tend to perform better in unmanaged landscape situations. Although they generally produce smaller nuts, these varieties exhibit phylloxera- and/or disease-resistance or exhibit other traits desirable for unmanaged trees. Be aware that these varieties may be difficult to locate, but, if you wish to plant pecan trees in your home landscape, it is worth the effort to locate these or similar varieties.

Control
imidacloprid

You can control pecan phylloxera with well-timed foliar sprays of imidacloprid, but you must use a commercial formulation that is labeled for foliar application to pecans. Such products can sometimes be purchased in relatively small volumes (pints or quarts). However, few homeowners have the power-spray equipment needed to treat large pecan trees. In most cases, you should hire a licensed commercial applicator to treat large trees. If you work with a commercial applicator, be sure to discuss proper spray timing; sprays that are applied too late will not be effective.

Always be aware of the potential for drift onto neighboring properties and other nontarget sites, and take appropriate precautions to avoid drift-related problems. In many urban settings, the potential for problems from spray drift may be so great that you won't want to make such treatments.

If you attempt treatment, proper timing is critical. Treatments will not be effective after the protective gall forms around the insect. To be effective, treatments must be applied as soon as leaf buds begin to break in the spring and before there is more than 1 inch of new leaf growth. If the tree was severely infested the previous year, apply a second application about 10 days after the first.

Getting good spray coverage is also an important consideration when treating for pecan phylloxera. Depending on tree size, 10 to 20 gallons of finished spray are normally required to adequately treat one tree. When treating pecans, be sure the insecticide you use is specifically labeled for use on pecans.

Pecan Aphids

Pecan aphids attack only pecans.

Pecans are included in this publication because they are often grown in the home landscape. Because they produce an edible crop, be sure to use only insecticides specifically labeled for pecans.

Description
Two species of aphids commonly occur on pecans. Their common names provide good general descriptions. Yellow aphids are small, yellow aphids that occur on the undersides of pecan leaflets. Yellow aphids can build to high populations, with numbers exceeding 50 to 100 aphids per compound leaf. Black aphids are small, black aphids that also occur on the undersides of leaflets, but they are much less numerous than yellow aphids. Black aphids are easily identified by the angular, yellow lesions that their feeding causes on pecan leaflets. Often, you can see an aphid feeding in such an area.

Damage
Yellow aphids cause damage by sucking plant sap and producing honeydew. The loss of sap and other associated damage can adversely affect vigor and nut production, and this is an important consideration for commercial producers. But for homeowners, honeydew and the resulting accumulations of sooty mold are often considered to be the more important injury. This is especially true for pecan trees growing over patios or parking areas. Although outbreaks can occur in late spring to early summer, heavy infestations of yellow aphids occur most commonly in late August through October.

Although they are much less abundant than yellow aphids, black aphids can cause more damage to the vigor and yield potential of pecans. This is because they inject toxic saliva that results in angular shaped, yellow lesions. These lesions

eventually turn brown, and leaflets and entire compound leaves will be shed from the tree prematurely. Because they are much less numerous than yellow aphids, black aphids do not usually cause large amounts of honeydew.

Management
Avoid planting pecans in the home landscape, or at least avoid planting pecans near patio and parking areas where you don't want accumulations of honeydew and sooty mold on automobiles or lawn furniture. If you plant pecans, avoid planting high-maintenance varieties. Instead, plant varieties such as Candy, Elliott, Farley, Jenkins, or Syrup Mill that tend to perform better in unmanaged landscapes. Although they generally produce smaller nuts, these varieties resist or tolerate insects and/or disease or have other traits desirable for unmanaged trees. Be aware that these varieties may be difficult to find, but if you want to plant pecan trees in the home landscape, it is worth the effort to find them or similar varieties. Avoid spraying pecan trees with insecticides. Because many foliar insecticide sprays destroy predators and parasites that help keep aphid numbers in check, using them can cause aphid outbreaks.

Control
imidacloprid

There are no insecticide sprays recommended to control aphids on pecan trees in the home landscape. Applying foliar insecticide sprays to pecan trees often increases aphid populations. The soil-applied systemic insecticide imidacloprid is labeled for use on homegrown pecans to control aphids. Because this product is applied as a drench to the soil around the tree and because it works systemically, it is less likely to disrupt natural control. Although control is often erratic, because of varying soil and weather conditions, it is the only useful treatment available to homeowners, and it is relatively easy to apply.

Homeowners who choose to use the imidacloprid drench treatment should read the label carefully to be sure they are applying the proper rate. The product is sold in 1-quart bottles, and the use rate is based on the number of inches around the tree at breast height. It may take more than 1 quart of product to treat one tree. For example, a tree that has a diameter of 12 inches has a circumference of nearly 38 inches. It would take 38 fluid ounces of product to treat a tree of this size. Because it takes a long time for this systemic insecticide to be taken up and moved through the plant, you must apply it well before you expect a pest problem.

Lace Bugs

Lace bugs attack azaleas, lantanas, pyracantha, rhododendrons, sycamores, oaks, and a few other plants.

Azalea lace bug adults. Note the lace-like wings and the dark fecal deposits on the leaf.

Description
Adult lace bugs vary in color from brown to light gray, depending on species. They are about ⅛ inch long and have lace-like wings. In most species, the wings are enlarged and have net-like veins. Nymphs may be black to gray and are usually covered with spines.

Damage
Adults and nymphs cause damage by sucking sap from the undersides of leaves. Damaged leaves have a stippled appearance, which is often mistaken for spider mite injury. Heavily damaged leaves may look bleached out before eventually turning brown. Dark spots of shiny, shellac-like fecal material on the undersides of leaves are a sure sign of lace bug infestation and may be present even when insects are not obvious. Azalea, lantana, and pyracantha species are the most likely to require treatment. Although lace bugs are common on sycamores and some oaks, infestations are seldom severe enough to cause serious injury.

Common Species
Azalea lace bugs are the most common insect pest of azaleas. Heavy infestations can cause foliage to appear bleached out and unsightly. Because of the evergreen nature of azaleas, damage will remain for quite a while after

insects are controlled. Lantana lace bug is a common pest of lantanas. Heavy infestations cause bleaching and browning of leaf margins and eventually cause death of entire leaves. Lace bug injury on lantanas is often mistaken for drought stress, disease, spider mite feeding, or chemical injury. You must look closely to see the small insects on the undersides of the leaves.

Management
Lace bugs have several natural enemies. Check susceptible plants regularly to detect infestations before serious injury occurs. Azaleas planted in full sun are more susceptible to attack than those planted in filtered shade. Some varieties of azaleas exhibit resistance.

Control
acephate, malathion, imidacloprid, bifenthrin, cyfluthrin, cyhalothrin, permethrin; *organic: neem oil, horticultural oil, pyrethrins + canola oil*

Soil-drench treatments of imidacloprid applied in fall or spring help control lace bugs. Foliar insecticide sprays are the quickest way to eliminate heavy infestations. Foliar insecticides that provide systemic activity, such as acephate or imidacloprid, are most effective. Direct insecticide sprays to the undersides of leaves for best control, especially with nonsystemics.

Azalea Caterpillars

Azalea caterpillars primarily attack azaleas, especially the "indica" varieties. They sometimes attack blueberries.

Azalea caterpillars often assume this C-shaped posture when alarmed.

Description
Mature caterpillars are approximately 2 inches long. This large, strikingly marked caterpillar is an occasional pest of azaleas throughout the South. Newly hatched azalea caterpillars are yellow with longitudinal reddish stripes, but their appearance changes markedly as they grow. Older caterpillars are black checkered with yellow or white, with reddish-orange heads and legs. These caterpillars often rest with their heads and tails raised into the air, creating a broad U-shape.

Damage
The moths deposit their eggs in masses of up to 100 eggs. Newly hatched larvae feed together on the undersides of leaves, causing leaf skeletonization. As larvae grow, they spread out and feed individually, causing progressively greater amounts of defoliation. Heavy infestations can cause total defoliation of entire plantings of azaleas. As with most caterpillars, 80 to 90 percent of the total leaf area that a single caterpillar will eat during its life is eaten during the last 3 to 4 days before pupation. This is why severe defoliation can seem so sudden. Plants that appear perfectly fine on Sunday afternoon can be totally defoliated by Wednesday afternoon. Infestations are most common on the large-leafed "indica" varieties.

Management
Be alert for early signs of defoliation injury to azaleas: leaf skeletonization caused by young caterpillars. Infestations are most common in late summer and early fall. Early detection and control of young larvae can prevent serious defoliation injury.

Control
permethrin, bifenthrin, acephate, cyfluthrin, cyhalothrin; *organic: Bts, spinosad*

Azalea caterpillars can be controlled with foliar sprays containing these active ingredients. When treating for azalea caterpillars, you should also consider the potential for lace bug problems, and, if necessary, choose a treatment such as acephate or cyfluthrin + imidacloprid that controls both pests. Use Bt products only against small larvae not threatening to cause immediate defoliation.

Eastern Tent Caterpillars

Eastern tent caterpillars occur primarily on black cherries but also attack apples, crabapples, and occasionally other trees.

Eastern tent caterpillars build angular-shaped webs in the crotches of black cherry tree limbs in the spring.

Description

Mature caterpillars are about 2 inches long. Eastern tent caterpillars are easy to identify by the silken tents they build in the crotches and limb forks of black cherry trees in early spring. The tents normally have an overall angular shape because of their location. Because few, if any, leaves are enclosed within the tent, the caterpillars must leave the tent, usually at night, to feed on nearby leaves. The background color of the body is black, etched with fine gold or yellow markings, but a distinct white line runs down the center of the back, and a row of irregular blue spots and markings run down either side. The head is black, and the body is sparsely covered with long, fine, tan-colored hairs. Mature larvae wander about on the ground in search of a place to pupate. Eggs are laid in dark-colored, somewhat slick, spindle-shaped masses around the smaller twigs. This is the overwintering stage.

Damage

Heavy infestations can cause significant, or even complete, defoliation, but there is only one generation per year, and trees can recover with little long-term injury. Protect young, newly established trees from excessive defoliation.

Pregnant mares abort as a result of accidentally consuming eastern tent caterpillars wandering about on the grass in search of pupation sites. This phenomena cost Kentucky thoroughbred breeders more than $300 million in lost foals in 2001, when eastern tent caterpillars were unusually abundant. Although this situation has not been documented in Mississippi, cautious horse breeders may wish to avoid pasturing pregnant mares near infested wild cherry trees in the spring.

Management

Most years, the damage eastern tent caterpillars cause is not significant, and no control is necessary. Removing and destroying tents and the caterpillars in them can provide control on smaller trees. You can use a hook fashioned from a clothes hanger and taped to a long pole to remove tents from larger trees (be careful around power lines).

Control

permethrin, cyfluthrin, cyhalothrin; *organic: Bts, spinosad*

In cases where treatment is necessary to control heavy infestations, or to protect small, susceptible trees, apply foliar insecticide sprays. Often, you can treat small, recently planted trees with a hand sprayer. You can use hose-end sprayers designed for treating trees and shrubs for trees up to 20 to 25 feet tall, but few homeowners have the power-spray equipment needed to treat large trees. Treatment of large trees usually must be performed by licensed commercial applicators. Always be aware of the potential for drift onto neighboring properties and other nontarget sites, and take appropriate precautions to avoid drift-related problems. In many urban settings the potential for problems from spray drift may be so great that you won't want to make such treatments.

Forest Tent Caterpillars

Forest tent caterpillars occur on various oaks, sweetgums, black tupelos, maples, elms, and other hardwood species.

Forest tent caterpillars do not build tents. Note the blue stripe and white, keyhole-shaped spots along the back.

Description

Mature caterpillars are about 2 inches long. Forest tent caterpillars are closely related to eastern tent caterpillars, which they resemble. Like eastern tent caterpillars, the background color of the body is black, etched with gold or yellow markings, and the caterpillars are sparsely covered with long, tan hairs. Forest tent caterpillars have a row of white, keyhole-shaped spots down the center of the back, rather than the solid white line seen in eastern tent caterpillars, and a nearly continuous slate blue line down either side of the body. Despite their name, forest tent caterpillars do not build tents. Instead, they form silken mats on the trunk and larger limbs. There is only one generation per year, and this insect overwinters in the egg stage. Eggs are deposited in dark-colored, somewhat slick masses that encircle smaller twigs. Eggs hatch in early spring as leaves begin to develop.

Damage

Occasionally, forest tent caterpillars occur in outbreak numbers and cause widespread defoliation of forest and landscape hardwoods. During non-outbreak years, individual trees can suffer heavy defoliation. Although this injury is unsightly, trees normally produce a second flush of leaf growth, and hardwood trees usually recover from one defoliation with little long-term adverse effect. But repeated defoliation can reduce tree growth rate.

Management

Protect trees that suffer severe defoliation from further stress, such as a second defoliation or drought stress, for the rest of the season.

Control

permethrin, cyfluthrin, cyhalothrin; *organic: Bts, spinosad*

In cases where insecticides are needed to control heavy infestations or to protect small, susceptible trees, apply a foliar insecticide. Often, you can treat small, recently planted trees with a hand sprayer. You can use hose-end sprayers designed for treating trees and shrubs on trees up to 20 to 25 feet tall, but few homeowners have the power-spray equipment needed to treat large trees. Treatment of large trees usually must be performed by licensed commercial applicators. Always be aware of the potential for drift onto neighboring properties and other nontarget sites, and take appropriate precautions to avoid drift-related problems. In many urban settings, the potential for problems from spray drift may be so great that you won't want to make such treatments.

Fall Webworms

Fall webworms primarily attack pecans and persimmons; they occasionally attack other trees, such as Bradford pears.

Fall webworms are important pests of pecans in the home landscape, and heavy infestations can cause severe, and even total, defoliation. Although pecans are commonly grown in the landscape, they are considered a food crop, so you must be careful when selecting insecticides.

Fall webworms build tents around the ends of branches of pecan and persimmon trees and feed on the leaves enclosed within.

Description
Mature larvae are about 1¼ inch long. This caterpillar makes conspicuous webs that enclose the ends of branches. Many dozens of caterpillars occur and feed within one web. The webbing protects the caterpillars from birds, insects, and parasites. The caterpillars themselves may be redheaded with light-colored spots or black-headed with dark spots. Regardless of head color, the caterpillars will be sparsely covered with long, light-colored hairs. Although there are two generations per year, these caterpillars are much more common in late summer and fall.

Damage
The webs this insect makes are unsightly, especially when heavy outbreaks result in dozens, or even hundreds, of webs per tree. This caterpillar causes defoliation by feeding on the leaves enclosed within the web, and heavy infestations can result in total defoliation of susceptible trees. In the absence of other stress, trees normally survive and recover from one-time complete defoliation. But pecans that are severely defoliated may suffer from poorly filled nuts in the year of the defoliation and reduced nut load the following year. Heavy infestations of fall webworms occur more routinely in the southern portion of the state.

Management
The "do nothing" approach is the most commonly used option for managing fall webworms. Avoid planting susceptible species (pecans and persimmons). When only a few webs are present on small- to medium-sized trees, you can remove them by using a hook made from a coat hanger and taped to the end of a long pole (be careful around power lines). Destroying the web this way also exposes the caterpillars to predation and parasitism.

Control
permethrin, cyfluthrin, cyhalothrin; *organic: Bts, spinosad*

Control webworms with contact insecticide sprays that penetrate the webbing. Often, you can treat small, recently planted trees with a hand sprayer. You can use hose-end sprayers designed for treating trees and shrubs to treat trees up to 20 to 25 feet tall, but few homeowners have the power-spray equipment needed to treat large trees. Treatment of large trees usually must be performed by licensed commercial applicators. Always be aware of the potential for drift onto neighboring properties and other nontarget sites, and take appropriate precautions to avoid drift-related problems. In many urban settings, the potential for problems from spray drift may be so great that you won't want to make such treatments. When treating pecans, be sure the insecticide is specifically labeled for pecans (some formulations of carbaryl and malathion are labeled for use on pecans).

Walnut Caterpillars

Walnut caterpillars occur on walnut, hickory, and pecan trees.

Walnut caterpillars occasionally defoliate individual limbs or areas of pecan and walnut trees. Older caterpillars are dark-colored, as seen here, but younger caterpillars are reddish with thin, white, longitudinal stripes.

Description
Although they are gregarious and feed together as a group, walnut caterpillars do not build webs. They have the unusual habit of clustering in masses on the trunk of the infested tree when it is time for them to molt or shed their skin. After molting, the caterpillars move back into the crown of the tree to resume feeding, leaving a mass of shed skins stuck to the trunk of the tree. These masses of shed skins may remain on the tree for some time after the caterpillars have completed their development and crawled to the ground to pupate. The caterpillars are red with white stripes down their sides when young, and black or dark-colored when fully mature. Caterpillars of both colors are sparsely covered with long, white hairs. When they are disturbed, the caterpillars tend to arch their heads and tail ends, creating a wide U-shape. There are two generations per year.

Damage
These caterpillars feed together in large groups, causing localized defoliation within the crown of the tree. Often, all of the leaves on one branch will be eaten, leaving only the larger mid-veins, while leaves of adjacent branches are undamaged. Such localized defoliation seldom causes serious long-term injury.

Management
When masses of caterpillars move to the trunk of the tree to molt, they are often near the ground where you can reach them and physically destroy them, or you can spray them directly with labeled contact insecticides.

Control
permethrin, cyfluthrin, cyhalothrin; *organic: Bts, spinosad*

If infestations are heavy enough to threaten severe defoliation, you can control caterpillars with foliar insecticide sprays. Small, recently planted trees can often be treated with a hand sprayer. Hose-end sprayers designed for treating trees and shrubs can be used to treat trees up to 20 to 25 feet tall, but few homeowners have the power-spray equipment needed to treat large trees. Treatment of large trees usually must be performed by licensed commercial applicators. Always be aware of the potential for drift onto neighboring properties and other nontarget sites, and take appropriate precautions to avoid drift-related problems. In many urban settings, the potential for problems from spray drift may be so great that you won't want to make such treatments. When treating pecans, be sure the insecticide you are using is specifically labeled for pecans. Some formulations of carbaryl and malathion are labeled for use on pecans.

Bagworms

Bagworms most commonly attack arborvitae, junipers, cedars, and other needle-bearing evergreens but also occasionally occur on broadleaf trees and shrubs.

Bagworms are damaging pests of needle-bearing evergreen trees, such as junipers, cedars, and arborvitae.

Description
Bagworms are about 1¼ inch long. You can easily recognize this insect by the tapering gray to tan silk bags it produces and attaches to its host plant. Some of the needles or leaves of the plant are usually woven into the bag. If the bags contain caterpillars, they are not firmly attached to the plant, but when the insects pupate, they use strong silk to attach the bag to the plant. Adult females are wingless and never leave the bag. Eggs are deposited inside the bag, and this is how this pest overwinters. In the spring, newly hatched larvae either remain on the original plant or spread to other plants by ballooning on a silken parachute.

Damage
Damage is the result of defoliation caused by the feeding caterpillars. When only a few caterpillars are present, defoliation is negligible, but heavy infestations can result in complete or severe defoliation of individual plants. Defoliated plants covered with bags are unsightly.

Management
Because of this insect's limited mobility, infestations are often localized, and hand-picking before eggs hatch in the spring can effectively control low infestations on small plants. It is easier to remove bags of larvae than pupal cases or egg cases, which are attached to the plant with strong silk. These often have to be cut away with scissors or pruning shears.

Control
chlorantraniliprole; *organic: Bts, spinosad*

You can control this pest with foliar insecticide sprays, but choose your treatment carefully. Spider mite populations sometimes increase after applications of carbaryl or pyrethroid insecticides (permethrin, cyfluthrin, and cyhalothrin). Spinosad and Bt products are less likely to flare mites. Treat small, recently planted trees with a hand sprayer, or use a hose-end sprayer designed to treat trees and shrubs up to 20 to 25 feet tall. Treat in mid-April through early June to control newly hatched caterpillars before they cause much damage. Treatments applied in late summer or fall, after caterpillars have pupated, will not be effective.

Lesser Canna Leafrollers

Lesser canna leafrollers attack cannas.

Lesser canna leafroller caterpillars feed within the whorls of cannas, preventing them from unrolling properly.

Description
Mature larvae are about ¾ inch long. This caterpillar is the most important insect pest of cannas. You can easily identify it by the damage it causes—leaves fail to unroll properly and exhibit a "rat-tailed" appearance. The caterpillars, which are found inside these rolled leaves, have skin that is somewhat translucent and covered with light-colored spots. The larvae look green because you can see the gut contents through the skin. The naked brown pupae are also found inside the rolled leaves. You may see the moths, which are light tan with faint wavy lines of darker brown, resting on the foliage with their wings spread and their antennae folded back along the sides of the body.

Damage
Young larvae begin by feeding as leaf miners, creating small, frass-filled tunnels within the leaf. As the caterpillars grow larger, they leave the leaf mines and bind the young, unrolled leaves with silk, preventing them from unrolling properly. They then complete their development within the protected area of this leaf roll, where they feed on the upper surface of the leaf but leave the lower, translucent epidermis intact, creating a windowpane effect. As many as 10 or more caterpillars may feed inside a single leaf roll. Leaves that do manage to unroll often have mines where young larvae fed, windowpaned defoliated areas, and rows of holes across the leaf blade. Heavily infested plantings produce few blooms and are unsightly.

Management
Some gardeners avoid planting cannas because of this pest. Some varieties of cannas are less susceptible than others. These insects overwinter as partly grown larvae and pupae in the whorls and debris of the previous year's foliage. Removing and destroying old stalks and debris in or before late winter can aid greatly in controlling this pest, especially if there are no nearby plantings where old stalks and debris are allowed to remain through the winter. Check cannas regularly for early signs of infestation. If you detect infestations, prune and destroy infested stalks and apply a foliar insecticide.

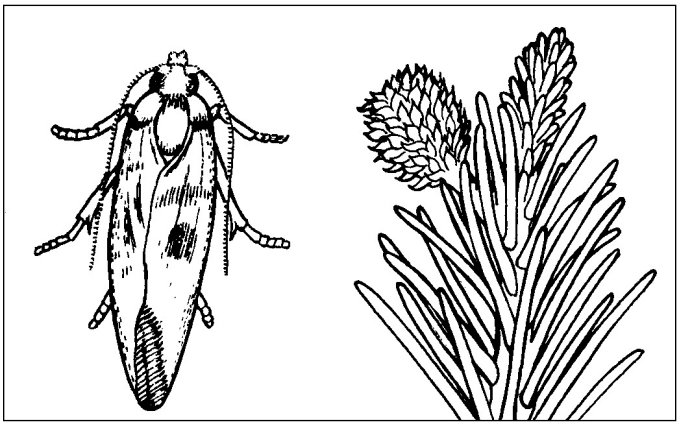
Control
acephate, bifenthrin, cyfluthrin, cyhalothrin, permethrin; *organic: spinosad*

Control this insect with foliar insecticide sprays. Many effective treatments are available in pre-mixed, ready-to-use formulations, and this can be a quick and convenient way to treat small plantings. Because there are several generations per year, it may take several treatments, applied at intervals

throughout the summer, to maintain control. Be sure to direct sprays into the unrolled leaf whorls. Because canna leaves are slick and waxy, it is helpful to add a "sticker" to the insecticide spray. Insecticides that have systemic activity, such as acephate, are often most effective.

Nantucket Pine Tip Moths

Nantucket pine tip moths attack most pines, including Virginia pines and Scots pines, but not longleaf or eastern white pines; they seldom attack slash pines.



Description

Adult moths are small and seldom seen; they are about ⅓ inch long and are brick-red mottled with gray. Larvae, which are about ⅓ inch long when mature, are small, yellow caterpillars with dark heads and cervical shields. The small, shiny, brown pupae are often found inside infested terminals.

Damage

Damage is caused by the larvae, which bore into tips of new growth, causing deformity or death of infested tips. This results in excessive branching and uneven growth on older trees. Attacks to newly planted trees can result in crooked or malformed trunks. Trees less than 10 feet tall are most susceptible. This insect has several generations per year. Emergence of the first generation can occur as early as late February, especially in the southern portion of the state.

Management

Monitor susceptible species of pines and protect them from excessive tip moth damage during the first 3 to 5 years after planting. You can use pheromone traps to monitor for presence of adult moths, but insecticide treatments are required to provide control when damaging insect numbers are present.

Control

imidacloprid (drench), acephate, bifenthrin, permethrin, cyfluthrin

Soil-drench applications of imidacloprid will help control pine tip moths. This is one of the few caterpillar pests that imidacloprid controls. Treatments should be applied in early winter. When properly timed, foliar insecticide treatments control newly hatched larvae and prevent infestation. Several applications per year may be required to properly protect newly planted, susceptible trees.

Sawflies

Sawflies attack pines, ashes, river birches, and various other plants.

Redheaded pine sawflies occasionally defoliate young pine trees in home and commercial landscapes.

Description

Adult sawflies are wasp-like insects, but their biology is very different from the paper wasps with which most people are familiar. During the larval stage, most sawflies feed on the leaves of plants and resemble caterpillars. In fact, sawfly larvae look so much like caterpillars that many people are surprised to learn they are not caterpillars. Sawfly larvae can be distinguished from caterpillars by the fact that they have more than five pairs of prolegs on their abdomens and by the presence of a distinct eyespot on their heads.

Damage

The larvae cause damage by eating the leaves or needles of infested plants, occasionally resulting in severe defoliation. Sawfly populations are very cyclic and sporadic, but heavy infestations occasionally occur on pines, ashes, river birches, and other plants.

Common Species
There are many different species of sawflies. Following are some of the most common.

Redheaded pine sawfly: The larvae of this insect are covered with rows of distinct shiny, black spots on a background of light yellow to green. As the name suggests, the head capsule is reddish, and there is a black eyespot on each side of the head. Outbreaks of redheaded pine sawflies occasionally occur on young pines. Infestations are most common on pines less than 15 feet tall. There are two to three generations per year.

Dusky birch sawfly: This insect is an occasional defoliator of river birch trees. It looks somewhat like the redheaded pine sawfly, having rows of shiny, black spots on a green to yellow background, but it has a dark-colored head capsule. Larvae often rest with the end of their abdomens raised away from the leaf surface in a characteristic S-shaped pose.

Hibiscus sawfly: This is an important pest of certain types of ornamental hibiscus. It is discussed in more detail in the following section.

Control
permethrin, bifenthrin, cyfluthrin, cyhalothrin, malathion; *organic: spinosad*

When you detect them in time, you can control sawfly infestations with sprays of foliar insecticides. Small, recently planted trees can often be treated with a hand sprayer. Hose-end sprayers designed for treating trees and shrubs can be used to treat trees up to 20 to 25 feet tall, but few homeowners have the power-spray equipment needed to treat large trees. Treatment of large trees usually must be performed by licensed commercial applicators. Always be aware of the potential for drift onto neighboring properties and other nontarget sites, and take appropriate precautions to avoid drift-related problems. In many urban settings, the potential for problems from spray drift may be so great that you won't want to make such treatments.

Hibiscus Sawflies

Hibiscus sawflies attack hibiscus, particularly the large-flowered moscheutos varieties.

Heavy, lace-like defoliation on the leaves of large-flowered hibiscus/rose mallow plants is usually caused by hibiscus sawfly larvae.

Description
Hibiscus sawflies are the most important insect pest of the large-flowered moscheutos-type hibiscus. The larvae are small, green, caterpillar-like insects that are only about ¼ inch long when fully mature. They have black heads and rows of short, raised, spike-like projections along their backs. They feed on the underside of the leaf. Larvae are so small and inconspicuous that the casual observer often overlooks them. Adults are small, wasp-like insects, about ¼ inch long. The body and head are black, but the thorax is reddish-orange. Eggs are inserted into the leaf tissue near the tip or edge.

Damage
These insects cause heavy defoliation injury to susceptible varieties of hibiscus. Untreated infestations can result in complete defoliation, leaving only the lacy leaf veins. There are several generations per year, and defoliation can occur throughout the growing season.

Management
Native varieties such as grandiflorus and aculeatus are less susceptible to this pest, and many new hybrids exhibit resistance. Check susceptible varieties often throughout the growing season, and treat as soon you detect sawflies.

Check for small larvae on the undersides of leaves, for the black and red adults, or for egg-laying wounds on leaves.

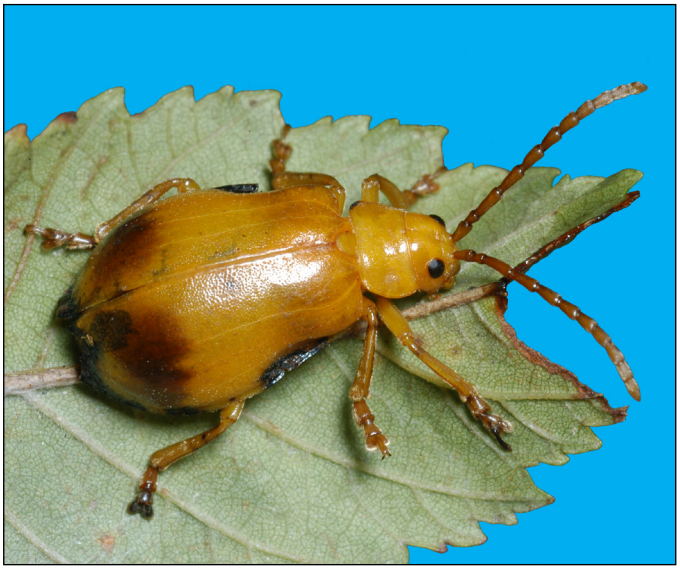
Control
acephate, permethrin, bifenthrin, cyfluthrin, cyhalothrin, malathion, imidacloprid (drench), spinosad

Hibiscus sawflies are easily controlled with foliar insecticide treatments. Because there are several generations per year, several treatments are usually required to provide season-long protection. Many effective treatments are available in pre-mixed, ready-to-use formulations, which makes applying treatments quick and convenient. Systemic insecticides, such as acephate, usually provide longer-lasting control. Soil-drench applications of imidacloprid help control hibiscus sawflies.

Leaf-Feeding Beetles

Leaf-feeding beetles are most commonly found on elms, crape myrtles, willows, and cottonwoods.

Several different species of leaf-feeding beetles occur on landscape plants. These belong to the family of beetles known as Chrysomelidae. This is an unusual group of beetles in that, in many species, both the larvae and adults feed on leaves.



Larger elm leaf beetles are infrequent defoliators of elm trees.

Description
The adults are small beetles approximately ¼ inch long. Coloration depends on species. Some are colorfully marked; others are metallic blue. Larvae range from black to tan or yellow with black spots or stripes.

Damage
For most species, damage is caused by both adults and larvae, which feed on the leaves and cause defoliation. Damaged leaves often have an unsightly skeletonized appearance because of browned, uneaten leaf veins and cross veins.

Common Species
A few of the most commonly encountered species of leaf-feeding beetles are briefly discussed below.

Elm leaf beetle: Adults are yellow with longitudinal black stripes. Larvae are also yellow with dark stripes down each side. Both adults and larvae feed on leaves, and the yellow eggs are deposited in clusters on the undersides of leaves. It attacks all species of elms but is more common on some species than others.

Larger elm leaf beetle: Larger elm leaf beetles occasionally cause dramatic browning and net-like defoliation of elms in woods and home landscapes. The half-inch-long adults are yellow with darker spots at the rear of the body and sometimes at the base of the wings. The large, leaf-feeding larvae are yellow-brown and are sometimes seen crawling on the ground after they leave the tree in search of a place to pupate.

Cottonwood leaf beetle: Adults are yellow with striking long, black marks. Smaller larvae are dark-colored, but larger larvae are gray with black spots. Both adults and larvae feed on leaves, causing skeletonizing defoliation. This insect is found on eastern cottonwoods as well as willows and other species of poplar. There are also several closely related species.

Altica foliacea: This flea beetle has no common name but is sometimes referred to as the "crape myrtle flea beetle." The adults are small, shiny, blue-green metallic-colored insects that jump when disturbed. Adults and larvae feed on weed hosts, occasionally building to high numbers. High numbers of adults can occur on crape myrtles in midsummer, causing damage by injuring the leaves. They are most commonly found in nurseries or on recently planted trees.

Control
bifenthrin, cyfluthrin, imidacloprid, cyhalothrin, permethrin, malathion; *organic: spinosad*

Leaf beetle populations are often kept in check by predators and parasites. When outbreak populations occur, foliar

insecticide sprays are required to minimize damage. Repeated applications may be required to control heavy or persistent infestations. Although not generally effective against beetles, spinosad is active against the larval stage of some leaf-feeding beetles.

Yellow Poplar Weevils

Yellow poplar weevils attack magnolia, yellow poplar, and sassafras trees.

Description

Adults are small (about ⅛ inch long), stout-bodied, gray weevils. The larvae are white, legless grubs that feed inside leaf mines.

Damage

Infestations of concern most commonly occur on southern magnolias. Adults cause damage by feeding on buds and tender new leaves. Damage is often magnified as leaves expand, resulting in small holes in the leaves. Damage to fully expanded leaves results in numerous brown feeding spots, usually concentrated near the tips of the leaves. Larvae feed as leafminers in large, puffy, blotch-shaped mines at the tips of leaves. Several larvae may occur within one leaf mine. Although infestations are rarely so severe as to adversely affect tree health, heavily infested trees are unsightly. Because of the longevity of magnolia leaves, damage may be evident even when insects are no longer present.

Management

Because this insect overwinters in leaf litter of host trees, raking leaf litter in the fall or early winter can reduce overwintering populations.

Control

Little information is available on controlling this pest, and no insecticides are labeled specifically for yellow poplar weevils. Soil drenches of imidacloprid have shown some promise. Foliar insecticide sprays can be used to control overwintering adults in the spring, as soon as they begin feeding on buds and young leaves, with the objective of controlling the adults before they have a chance to begin laying eggs. Products such as carbaryl, permethrin, or cyfluthrin + imidacloprid should control adult weevils, but timing of sprays is critical, and multiple treatments will be required.

May Beetles

May beetles attack various hardwood trees.

These insects occasionally cause mysterious defoliation of young hardwood trees planted in landscapes.

There are many species of May beetles. All are robust, brown-colored beetles that fly at night.

Description

May beetles are the adult stage of white grubs, which can be important pests of turf grass. They are robust, heavy-bodied, brown to tan beetles about ½ inch long. These beetles are active primarily at night.

Damage

Young oaks and other hardwoods occasionally sustain mysterious defoliation injury that appears to have occurred overnight, yet no insect pests can be found on the tree. Damaged leaves may be totally consumed, leaving only the petiole and midvein. This type of injury is caused by adult May beetles, which occasionally congregate on individual trees in large numbers during late spring. The beetles feed heavily during the night but leave the tree to seek shelter during the day. This injury is rather uncommon and most often occurs on newly planted trees less than 15 feet tall.

Management

Attacks by May beetles are sporadic and difficult to predict. Young trees near outdoor lights that are left on overnight seem to be most susceptible to attack. Where feasible,

turning off overnight lights located near young, susceptible trees during May and early June may reduce the probability of attack.

Control
permethrin, bifenthrin, cyfluthrin, zeta-cypermethrin

Although May beetles are susceptible to foliar insecticide treatments, timing of control is difficult because of the unpredictable nature of attack. Foliar sprays may provide some short-term residual control and may help in certain high-risk situations.

Japanese Beetles

Japanese beetles attack the foliage and/or blooms of many ornamental plants.

The Japanese beetle has progressively expanded its range over the eastern United States since it was introduced in the early 1900s. It has recently become a serious pest of roses and other susceptible plants in North Mississippi and continues to expand its range.

Adult Japanese beetles cause damage by feeding on leaves and blooms of many ornamental plants. They can be especially important pests of roses.

Description
Adult Japanese beetles are about ½ inch long, shiny, metallic green with metallic bronze wings and rows of white, fuzzy spots toward the end of the abdomen. This makes them fairly easy to recognize, although some other native scarab beetles are also metallic green. Larvae are "white grubs" that are about 1 inch long when fully mature. They feed on the roots of grasses in commercial turf, as well as in pastures, roadsides, and unmanaged areas.

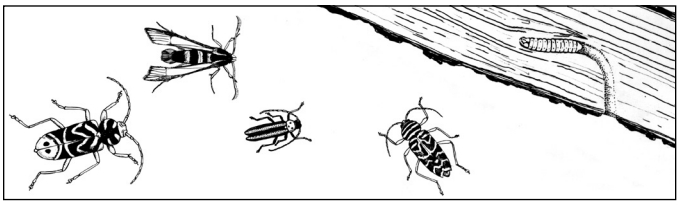
Damage
Damage is caused by the adults, which feed on the foliage and/or blooms of many different species of ornamental plants. This includes many trees, woody shrubs, herbaceous perennials, and annual plants. Leaf-feeding results in skeletonizing defoliation, with the severity of damage being related to the number of beetles present. Japanese beetles are also highly attracted to the blooms of many plants, especially large, light-colored blooms. They feed on the anthers and petals, causing unsightly damage. White or yellow roses are favorite targets and often sustain heavy damage in areas where Japanese beetles are common.

Management
In areas where Japanese beetles are abundant, gardeners may choose to avoid growing species or varieties of plants that are especially susceptible. Be careful in making this determination because susceptibility can vary greatly within a group of plants. For example, Japanese maples are quite susceptible, while red maples are seldom attacked. Likewise, some varieties of crape myrtles are relatively resistant to attack, while others are highly susceptible. Light-flowered varieties of roses are more likely to be attacked than are varieties with darker-colored blooms. Biological treatments, such as the milky spore disease bacteria and Japanese beetle traps, are sold commercially, but their effectiveness is not supported by results from controlled experiments. Because larvae can also develop in pastures and wastelands, controlling larvae in commercial turf may not help prevent attack of landscape plants by large numbers of adults.

Control
bifenthrin, permethrin, cyhalothrin, cyfluthrin, zeta-cypermethrin, chlorantraniliprole; *organic: azadirachtin*

Adult Japanese beetles can be controlled with foliar sprays, and foliar sprays may also provide short-term residual protection. Repeated treatments will be necessary to protect susceptible plants adequately where this pest is abundant. Repeated applications of products containing azadirachtin—a natural product derived from neem seed—also repel Japanese beetles. Be sure to observe pollinator protection cautions when treating plants that are in bloom.

Wood-Boring Insects



Close examination of a dead or dying tree almost always reveals wood-boring insects, but this does not necessarily mean insects are the primary cause of the tree's distress. Hundreds of different species of insects are attracted to dead or dying trees, and many families of beetles and moths specialize as wood-borers. In most cases, infestations of wood-boring insects are the result, not the cause, of a tree's distress. Many species of wood-borers attack only dead wood, and many others can successfully initiate an attack on trees that are stressed and in decline. Relatively few species can successfully attack healthy trees. Some of these are discussed specifically in the following sections. Even these species are most likely to attack trees that are stressed or injured.

Healthy, vigorously growing trees defend themselves from attack by wood-boring insects in many ways. Tight, healthy outer bark provides a physical barrier to insect entry. Pines and other species produce large amounts of resin that can "pitch-out," or entomb, attacking insects. Invading larvae can be crushed or walled off by rapid, vigorous growth. Healthy trees also produce many chemical defenses. However, stressed or injured trees produce characteristic odors that are highly attractive to wood-boring insects, signaling that the tree is susceptible to attack.

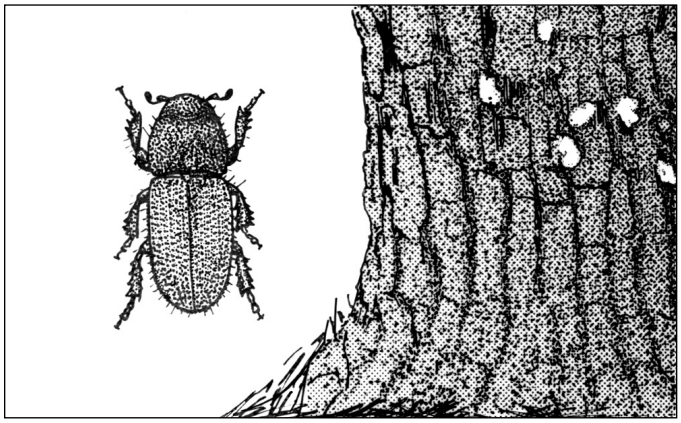
The most important thing you can do to protect landscape trees from wood-boring insects is to maintain tree health by avoiding injury or stress. Following are some of the key points to keep in mind.

- Choose planting sites carefully, and match the site to the species you are planting.
- Use trunk wraps to protect newly planted trees.
- Avoid tight guy wires or trunk wraps that can injure bark (be sure to remove trunk wraps).
- Use mulch or trunk guards to prevent injury from string trimmers or mowers.
- Avoid using too much mulch, and do not pile mulch against base of trunk.
- Avoid physical injury to trunk or bark.
- Prune properly and at the right time of year.
- Avoid injury to roots and trunk during construction operations.
- Avoid compacting soil over roots.
- Keep trees adequately watered during periods of drought.
- Provide adequate nutrition, but avoid overfertilization.
- Avoid chemical or herbicide injury.

The following sections provide additional information about some of the more important species of wood-borers that will attack healthy, or relatively healthy, landscape trees in Mississippi.

Black Turpentine Beetles

Black turpentine beetles damage only pines.



Description

Adult black turpentine beetles are ¼ to ⅓ inch long. These barrel- or cylinder-shaped beetles are reddish-brown to black. The larvae are small, legless, white grubs.

Damage

This insect bores through the outer bark of pine trees and lays its eggs in the inner bark, or cambium layer. The developing larvae feed as a group, creating pocket-like galleries in the inner bark. Multiple attacks can effectively girdle the tree, resulting in death. Popcorn-sized masses of dried resin, known as pitch tubes, on the outer bark often mark the site of an attack. These pitch tubes often contain reddish-brown boring dust. Attacks by black turpentine beetles are normally restricted to the lower 6 to 10 feet of the trunk. Trees suffering injury or stress are most susceptible to attack. Large, overmature, and, thus, high-value trees, are generally more susceptible than young trees. Attacks are most common from May through September.

Management

Avoid injury or stress to trees. Trees that have been physically injured are more likely to be attacked. Stressed trees are less able to defend themselves by producing resin. Avoid situations that cause soil compaction, root injury,

or drought. Keep trees well-watered during periods of drought. Remove dead and dying trees, as well as stumps, as quickly as possible to prevent beetles from breeding in these and then moving to nearby healthy trees.

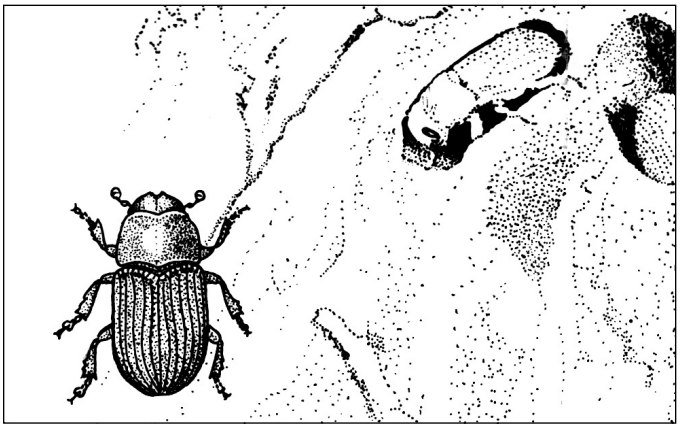
Control
permethrin

When infestations of black turpentine beetles are evident on nearby trees or stumps, it may help to apply preventive insecticide treatments to the trunks of high-value trees. Trunk sprays containing permethrin can help protect trees, and several brands are labeled for homeowners. Be sure to choose a permethrin product that specifically lists use on pine trees to control borers and allows adequate rates of permethrin (0.5% concentration in finished spray). You may need to repeat sprays several times during the summer for adequate protection.

Onyx Pro (bifenthrin) is not labeled for use by homeowners but may be applied in the home landscape by licensed commercial applicators. Because this treatment provides longer residual activity, it may be worth hiring a commercial applicator to treat high-value trees during periods of high beetle populations.

Southern Pine Beetles

Southern pine beetles damage only pines.



Description
Southern pine beetle adults are about ⅛ inch long. They are smaller than black turpentine beetles but are similarly shaped. They are cylindrical and reddish-brown to dark-colored. The larvae are small, legless grubs.

Damage
Like black turpentine beetles, this insect bores through the outer bark of pine trees and lays its eggs in the inner bark, or cambium layer. The beetles eat winding, S-shaped galleries in the cambium. Adult beetles inoculate infested trees with a fungal disease, which hastens tree death, and larvae also feed in the cambium, girdling this life-supporting tissue.

Trees defend themselves by producing extra resin where the adult beetle tries to bore into the tree. Healthy, unstressed trees can often successfully pitch-out attacking beetles. Because of fungal disease and the girdling of the cambium caused by the winding feeding tunnels, successful invasion by only a few beetles usually kills the tree. Southern pine beetles normally focus their attacks on the main tree trunk, from chest height to where the lower limbs are attached. Trees suffering injury or stress are most susceptible to attack.

Management
Keeping landscape trees well watered during drought is the most important thing you can do to help reduce the probability of bark beetle attack. Avoid injury or stress to trees. Trees that have been physically injured are more likely to be attacked. Avoid situations that cause soil compaction, root injury, or drought. Remove dead and dying trees, as well as stumps, as quickly as possible to prevent beetles from breeding in these and then moving to nearby healthy trees.

Control
permethrin

When infestations of southern pine beetles are active in nearby trees, it may help to apply preventive insecticide treatments to high-value trees. To be effective, though, such treatments must thoroughly cover the trunk from its base to where the first lower limbs are attached. Few homeowners have the necessary equipment to treat larger trees properly. Trunk sprays containing permethrin can help protect trees, and several brands are labeled for use by homeowners. Be sure to choose a permethrin product that specifically lists use on pine trees to control borers and allows adequate rates of permethrin (0.5% concentration in finished spray). You may need to repeat sprays several times in the summer to get adequate protection.

Onyx Pro (bifenthrin) is not labeled for use by homeowners but may be applied in the home landscape by licensed

commercial applicators. Because this treatment provides longer residual activity, it may be worth hiring a commercial applicator to treat high-value trees during periods of high beetle populations.

Ips Beetles

Pines are the most common trees attacked by Ips beetles, but some species also attack certain hardwoods.

Description

Adult beetles are so small (about ⅛ inch long) that they are rarely seen. There are several species, all of which have a distinctive indention at the end of the abdomen that is bordered by two rows of small spines. The larvae are small, legless grubs.

Damage

The Ips beetle is one of the more common pests of landscape pines. Attacks by Ips beetles are normally focused on the trunk and large limbs located in the upper, or crown, area of the tree. If the tree is already stressed before attack, reddish boring dust can be found in bark crevices. Attacks to trees that are relatively healthy may result in resin flowing from bore holes and even the formation of small pitch tubes, similar to those caused by southern pine beetles. Adult beetles bore through the outer bark and excavate galleries in the inner bark, or cambium layer. The larvae construct their own feeding galleries that branch out from the initial "egg gallery." When the larvae mature and emerge from the tree as adult beetles, they leave numerous small, round emergence holes that cause the bark to look as though it has been riddled with birdshot.

Management

Keep trees well watered during drought. Avoid injury or stress to trees. Trees that have been physically injured are more likely to be attacked. Stressed trees are less able to defend themselves. Avoid situations that cause soil compaction, root injury, or drought. Remove dead and dying trees, as well as stumps, as quickly as possible to prevent beetles from breeding in these and then moving to nearby healthy trees. Ips beetles also breed in freshly cut pine logs and pulpwood, as well as freshly trimmed limbs. Promptly removing or burning such material reduces the potential for attack.

Control

Keeping trees well watered during drought is the most important thing homeowners can do to help reduce the probability of bark beetle attack. Because Ips beetle attacks are concentrated in the crown area, preventive insecticide treatments are difficult to use effectively.

Granulate Ambrosia Beetles

Granulate ambrosia beetles (*Xylosandrus crassiusculus*) attack and kill many species of ornamental hardwoods, including Bradford pears, crape myrtles, ornamental cherries, maples, magnolias, sweet gums, and pecans.

Densely compacted columns of frass protruding from the bark of a tree are usually a sign of infestation by granulate ambrosia beetle.

Description

Adult granulate ambrosia beetles are about 1/10 inch long. This small beetle is reddish-brown, stout, and cylinder-shaped. It has a somewhat humpbacked appearance, and its head points downward. When trees are first being attacked, curved, toothpick-sized columns of tightly packed frass, extending up to 3 inches long, often extrude from the bore holes. These columns of frass are somewhat characteristic of this species and are eventually broken off by wind and rain, leaving only birdshot-sized, frass-packed entrance holes. This is a relatively recent invading pest that seems to be increasing in importance.

Damage
Although granulate ambrosia beetles readily attack dead or dying trees, they are a particular threat to young, recently established trees. Such trees are still under stress from planting. Attacks are more common on trees fewer than 3 inches in diameter, and attacks to young saplings are most likely to occur in the very early spring, at or slightly before bud break. Attacks may occur later in the year, as well. Invading beetles inoculate trees with a fungal disease, which serves as food for the larvae. While some trees may survive localized attacks, trees with numerous frass columns or bore holes around the main trunk do not survive.

Management
Promptly cut and destroy heavily infested trees to reduce potential for spread to uninfested trees. Avoid injury or stress, which increase the potential for attack.

Control
permethrin

Trunk sprays containing permethrin can help protect trees, and several brands are labeled for homeowner use. Be sure to choose a permethrin product that specifically lists control of borers and allows use of adequate rates of permethrin (0.5% concentration in finished spray). Trunk sprays applied in late winter may help prevent attacks to susceptible, high-value trees.

Onyx Pro (bifenthrin) is not labeled for use by homeowners but may be applied in the home landscape by licensed commercial applicators. Because this treatment provides longer residual activity, it may be worth hiring a commercial applicator to treat susceptible, high-value trees during periods of high beetle populations.

Soil-applied systemics like imidacloprid or dinotefuran will not control granulate ambrosia beetles.

Flatheaded Appletree Borers

Flatheaded appletree borers attack many different species of hardwood trees.

Flatheaded appletree borers belong to a group of beetles known as shorthorn beetles.

Description
Adult flatheaded appletree borers are about ½ inch long; larvae are about 1 inch long. Adults are somewhat oval-shaped, short-horned beetles and are metallic gray. The larvae are legless, white, segmented, and worm-like. They have small, dark-colored heads, and the three white segments immediately behind the head are enlarged and flattened.

Damage
Although this insect is most attracted to trees that are stressed or injured, it will also attack relatively healthy trees, especially young trees just being established. The larvae damage the tree by boring in bark, cambium, and wood. It takes only one or two larvae to kill or seriously injure a young sapling. There is only one generation per year, but egg-laying may occur throughout much of the growing season.

Management
Healthy, vigorous trees that are protected from bark injury are less susceptible to attack. Cultural practices that prevent sunscald and bark damage and encourage vigor make trees less susceptible and help trees grow out of the susceptible

stage faster. This can include things like proper planting depth, proper mulching, and proper use of trunk wraps or trunk shading to prevent sunscald/southwest injury during the first winter or two. Remove wraps each spring. Keep trees adequately watered and use mulch, but not too deep, and not piled against the trunk.

Control
imidacloprid, dinotefuran, bifenthrin, permethrin

Soil-applied systemic insecticides, such as imidacloprid (e.g., Merit 2F or BioAdvanced Tree & Shrub Insect Control) or dinotefuran (e.g., Zylam), can provide effective preventive control, but such treatments must be applied in early spring, shortly after budbreak, or in the previous fall to have time to move into the tree before eggs hatch. Read labels carefully; treatment rates are given as amount of product per inch of trunk diameter or circumference. These systemic treatments work by killing young larvae after they have bored through the bark and have begun to feed. Trunk sprays of insecticides such as bifenthrin (e.g., Onyx Pro) or permethrin (e.g., Hy-Yield 38 Plus) are less effective options that must be applied shortly before egg-laying begins. These treatments work by killing eggs and newly hatched larvae before they bore into the tree.

Dogwood Borers

Dogwood borers attack many species of hardwoods, but dogwoods are the most commonly damaged landscape species.

Description
Adults are small (less than ½ inch long), day-flying, wasp-like moths that are blue/black with yellow bands around the abdomen. The wings are mostly clear with black tips and markings. Fully mature larvae are slightly over ½ inch long and are cream-colored with reddish-brown heads.

Damage
Eggs are deposited on the outer bark, and newly hatched larvae enter the tree through wounds and small cracks in the bark. The larvae cause damage by boring in the inner bark layer of the tree. Loose, scaling bark or swollen, knotty areas on the trunk indicate infestation. Heavily infested trees may suffer from limb or crown dieback and poor growth.

Management
Keeping trees healthy and vigorous and avoiding injury and stress are the most important means of preventing infestation. Choose planting sites carefully. Trees planted in full sun are more susceptible to attack than trees planted in partial shade. On trees that are exposed to full sun, avoid pruning lower limbs to allow more shading of the trunk. Although no cultivars of dogwood are resistant to this pest, some types (such as Korean dogwood) are less susceptible.

Control
permethrin, chlorantraniliprole

You can use trunk sprays of permethrin to partially protect heavily infested or high-value trees. Sprays will not control larvae that have already bored into the tree. The objective is to have a residue of insecticide on the bark to control newly hatched larvae before they bore under the bark. Sprays must be applied several times during the growing season to obtain season-long control. Egg-laying moths may occur from spring through September, but heaviest populations occur later in the season. Acelepryn (18.4% chlorantraniliprole) is an alternative trunk spray treatment that can be effective when applied only twice per season. Acelepryn is more costly but is a better option for protecting high-value or heavily infested trees. Soil-applied systemics like imidacloprid or dinotefuran will not control dogwood borers.

Ash Borers

Ash borers are day-flying moths that are similar to dogwood borers. They are also known as lilac borers, but in the Deep South, they focus on ash trees. As with dogwood borers, it is the caterpillars that cause damage—by boring

Ash borers are day-flying moths that are similar to dogwood borers. Empty pupal cases protruding from the bark are a sign of recent moth emergence.

into young shoots or by chewing and mining in the inner bark and sapwood. Because of the similarity in common names, and the fact that both bore in ash trees, the two borers and their damage can be confused. Ash borer is a native moth pest. Emerald ash borer is a nonnative beetle.

Description
Adults are day-flying moths that resemble red wasps in size, shape, and color. Mature larvae are approximately 1 inch long with cream-colored bodies and brown head capsules.

Damage
Larvae cause damage by boring in inner bark and sapwood, resulting in cracked, scaly bark; sunken lesions on trunks and limbs; dieback of severely damaged limbs; and poor tree growth. Larvae also cause damage by boring into and killing developing shoots, which can result in forked trunks when central leaders die. There is only one generation per year. Mature caterpillars pupate within their galleries and emerge as moths in spring to early summer, usually leaving their empty pupal shells behind, partly protruding from the bark. These empty pupal skins are a sure sign of attack by ash borer or the closely related banded ash clearwing borer, which emerges in the fall and causes similar damage.

Management
Ash borers are more likely to attack trees that are stressed or injured. Trees growing in or near parking lots, where most of the soil is covered with asphalt or concrete, are especially prone to attack. Avoid planting trees in situations where root growth will be restricted and soil is subject to compaction. Keep trees properly watered and avoid bark injury or soil compaction in the root zone.

Control
chlorantraniliprole

Apply chlorantraniliprole (Acelepryn) to trunks and lower limbs in the spring, or as soon as you observe newly emerged pupal cases protruding from the bark. Follow directions for applying as a trunk spray for clearwing moths using a mid-label or higher rate. For best control of heavy infestations, apply a second treatment in 3 to 4 weeks. Soil-applied systemics like imidacloprid or dinotefuran will not control ash borers.

Emerald Ash Borers

As of July 2021, emerald ash borers have not yet been detected in Mississippi, but they are present in all neighboring states and could appear here at any time. This is a serious pest of ash trees that has already killed most ash trees in the eastern United States. Effective treatments are available for protecting high-value landscape trees from emerald ash borers, but these treatments must be applied preventively.

Adult emerald ash borers are strikingly colored, but are only about 1/3 inch long. Adults are often not noticed until nearby ash trees have already been seriously damaged. (Pennsylvania Department of Conservation and Natural Resources–Forestry, Bugwood.org)

Description
Adults are about ⅓ inch long; mature larvae are 1 to 1¼ inch long. Adults are small, peg-shaped, metallic-green beetles. The larvae, which live beneath the outer bark, have slender, white, segmented bodies, with many of the segments appearing bell-shaped. Infestations are usually first detected by observation of damage symptoms, including dieback of limbs in the crown of the tree; splitting of bark; presence of small, D-shaped emergence holes (about ⅛ inch in diameter); new growth sprouting from the lower trunk of the tree; and woodpecker feeding. There is only one generation per year. Adults lay eggs in bark crevices in the spring, and larvae feed beneath the outer bark through the summer and fall, overwinter, and emerge as adults the following year.

Damage

Emerald ash borers attack only ash trees. Damage is caused by the larvae, which bore in the cambium, or inner bark, girdling tree limbs and trunks. Damage usually progresses down from the crown of the tree. Trees are usually killed after 3 to 5 years of infestation. Experience in other states indicates that trees that have lost more than half of their canopy due to crown dieback usually cannot be saved. Mortality of untreated trees is around 99 percent.

Management

Preventing initial introduction is the first line of defense. Avoid transporting firewood or ash logs into the state. Trees that become infested with emerald ash borers, and that will not be treated, should be immediately cut and destroyed in order to prevent emergence and spread of adult beetles. Avoid using ash trees in new landscape plantings. Choose alternative species that are not susceptible to emerald ash borers.

Control

Primary reference for information on emerald ash borer treatment options: Herms D.A., McCullough D.G., Smitley D.R., Sadof C., Williamson R.C., and Nixon P.L. 2009. *Insecticide options for protecting ash trees from emerald ash borer.* North Central IPM Center Bulletin. 12 pp.

To protect high-value landscape ash trees, be alert for reports of the presence of emerald ash borer infestations within 15 to 30 miles of your location, and begin preventive insecticide treatments promptly. Depending on choice of treatment, plan on treating yearly or every second year for as long as you want to protect the tree. Optimum treatment timing also depends on choice of insecticide and method of application; timing ranges from early to late spring (around March 1 through mid-May), with slow-acting, soil-applied treatments needing to be applied earlier than trunk-injection treatments. However, treatments can and should be applied at other times (spring through fall) if you learn of nearby infestations of emerald ash borers.

Systemic insecticides that move through the tree to kill young larvae feeding in the cambium are the most effective treatments for emerald ash borers. Such treatments are applied in one of three ways: as soil drenches or soil injections around the base of the tree, as injections into the trunk of the tree, or as systemic trunk sprays. Soil drenches are most appropriate for homeowners. Trunk injections and trunk sprays are best applied by licensed commercial applicators, and commercial applicators can also use treatments that are applied as soil drenches or soil injections.

Soil-applied treatments available for use by homeowners and commercial applicators include imidacloprid or dinotefuran. These treatments must be reapplied annually in order to provide effective protection. Soil-applied treatments are somewhat less effective and consistent than some of the more effective trunk-injection treatments. For trees larger than 15 inches diameter at breast height, it is best to have trees professionally treated with an effective trunk-injection treatment.

Trunk-injection treatments that can be applied by licensed commercial applicators include imidacloprid or emamectin benzoate. Although more costly than other treatments, emamectin benzoate (Tree-age) is one of the more effective treatments, and a single application will provide control for 2 to 3 consecutive years. Thus, trees treated with emamectin benzoate must be re-treated every second year.

Systemic trunk sprays that contain dinotefuran (Safari 20 SG) can also be applied by commercial applicators. These treatments must be repeated annually.

Twig-Girdlers

Twig-girdlers usually attack pecan or hickory trees but sometimes occur on other hardwoods.

Adult twig-girdlers chew through pencil-sized twigs of hardwood trees, causing them to break off and fall to the ground. The larvae develop inside these fallen twigs.

Description
Twig-girdlers are large (about 1 inch long), gray-brown, long-horned beetles.

Damage
This insect does not attack the trunk of the tree. The female girdles pencil-sized twigs by chewing away a ring of wood and deposits her eggs in the girdled twig. These girdled twigs eventually fall to the ground, and the larvae complete their development inside the fallen twigs. Excessive damage can disfigure young trees and slow growth.

Control
Gather and burn fallen twigs, or place in plastic garbage bags and dispose of in the garbage. This prevents larvae from developing and reinfesting trees. No chemical control is recommended.

Gall-Forming Insects

Gall-forming insects attack oaks, dogwoods, maples, sugarberries, and many other species.

Many insects can cause galls or unusual growths on ornamental plants. Many of these are small wasps or tiny flies, but several other types of gall-forming insects and some species of mites also cause galls. Gall-forming insects are usually host-specific. The plant makes galls in response to chemicals released by the insect, resulting in the growth of plant tissue around the insect. Many disease organisms also cause galls, and careful identification is necessary to distinguish between galls caused by insects and galls caused by pathogens. Examples of a few of the more common insect-induced galls are discussed here.

Marble oak galls and oak apple galls are two common insect-induced galls of oak leaves.

Pecan phylloxera: See page 15 for information on this gall-forming insect.

Gouty oak galls: These are the large (golf ball-sized), knot-like growths on the twigs of oaks. A small, cynipid wasp causes these galls. There are two generations per year; the first causes small, blister-like galls on the leaves, and the second generation causes the knotty stem galls. Horned oak gall is a similar gall caused by a related species.

Oak apple galls: Oak apple galls are round, marble- to golf-ball-sized, spongy galls on the undersides of the leaves of various red oak species. They are caused by a small, cynipid wasp. Each gall contains only one larva that develops within a smaller, seed-like capsule in the center of the gall.

Dogwood club gall midges: These are the larvae of a small fly that deposits its eggs in very small, developing dogwood leaves at the tips of the terminal. The resulting larvae, or maggots, burrow into the tip of the developing shoot, causing the end of the twig to become enlarged and club-like. Several dozen of the small, orange maggots may be inside one club gall. Heavy infestations can result in stunted and malformed trees.

Yaupon psyllid galls: This small, aphid-like insect causes the leaves of yaupon hollies to become distorted, creating a folded, pouch-like leaf gall. Several developing nymphs may be inside one gall.

Erineum galls: Red or green, very small mites belonging to the group known as eriophyid mites cause these felt-like patches on the undersides of maple leaves. Other species of eriophyid mites cause various types of leaf-distortion galls, and there are many species of eriophyids that cause bud-proliferation galls and "witch's broom" galls.

Management
Pruning and destroying galls before the developing insects have time to emerge is an effective control method on small plants, but this is obviously not feasible for large trees. Although galls may be unsightly, they rarely cause severe economic damage, and chemical control is generally not recommended.

Control
Insecticides are not practical or effective for most gall-forming insects. Soil drenches containing imidacloprid may be effective against certain species of gall-forming sucking pests, such as yaupon psyllid galls. Foliar sprays can reduce gall incidence, but timing is very critical, since there is only

a very narrow window of time when susceptible adults are present.

Choosing and Purchasing Insecticides

When buying an insecticide to control an insect problem in your home landscape, you must consider several important factors. The time spent considering these factors and reading insecticide labels before making the purchase is time well invested! Purchasing the wrong product can lead to many undesirable consequences, including poor control, plant injury, application difficulties, or time spent returning the product. **Always read the label at least two times, once before purchasing the product and again before applying it.** Following are some of the key points to consider when purchasing insecticides.

What is the active ingredient in the product?

When purchasing insecticides, think in terms of active ingredient rather than brand name. Granted, the names of these active ingredients sound somewhat technical in nature (examples: permethrin, carbaryl, imidacloprid), but they are much shorter, less confusing, and easier to remember than brand names (examples: Hi-Yield Kill-A-Bug II, Garden Tech Sevin Concentrate Bug Killer, Bayer Advanced Season-Long Grub Control). Quite often, the same active ingredient may be sold under dozens of different brand names. Knowing the active ingredient makes it easier to find an alternative product if the brand name you are seeking is not available. Also be aware that the active ingredient in a product with a given brand name may change over time. Do not assume that Mo-Betta Bug-Bopper 33 contains the same active ingredient now as it did when you used it 5 years ago.

Is the product labeled for the intended site and use?

If you need a product to control tea scales on camellias, be sure to read the label and verify the insecticide you are purchasing is labeled for home landscapes, that it is safe to use on camellias, and that it is effective against tea scales. All of this information should be on the product label, and it should also tell how much product to use and how to mix and apply it. If you do not find this information on the label, don't buy that product! Look for products with labels that are easy to read and understand.

How is the product formulated?

In many cases, the same active ingredient is available in products formulated as granules, as wettable powders, as liquid concentrates, and as dilute ready-to-spray products. Be sure you are buying the formulation best suited for your intended use. If you purchase a wettable powder formulation that is designed to be mixed with water and applied as a liquid spray, but you do not have the necessary spray equipment, you won't be able to apply the product. Also, be sure to consider what type of formulation is best for the intended use, and be sure you have the necessary equipment to apply that formulation before purchasing the product. Granular products are useful and effective for controlling many pests of the home lawn, but, except for a few systemic insecticides, granular formulations are not appropriate for treating landscape plants.

What is the percent active ingredient in the product, how much is in the container, what is the use rate, and how much product do you need to do the job?

If you buy a quart of ready-to-spray formulation containing 0.002% active ingredient when you really need a 25% liquid concentrate, you may not be able to apply the rate of insecticide needed to control the target pest.

Be sure to communicate clearly to the salesperson the active ingredient you are seeking and its intended use.

"I am looking for an insecticide containing acephate that can be used to control caterpillars on my cannas" or "I want to buy an insecticide containing permethrin that is labeled for use on ornamental plants." Having the name of the active ingredient(s) written down and spelled correctly makes this communication much easier. Be wary of substitutions. Always read the label closely, and be sure you understand what you are purchasing and how it must be used before you leave the store.

Applying Insecticides to Plants in the Home Landscape

There are several different methods of applying insecticides to landscape plants, and, in many cases, you may have a choice of application methods. Regardless of the method of application you choose, it is important to read the label carefully and calibrate equipment properly to be sure that you are applying the correct amount of insecticide. Avoid applying excessively high rates. Not only is this wasteful, but it increases the risk of plant injury, poisoning, injury to nontarget organisms, and other undesirable consequences. Conversely, using too little insecticide is likely to result in poor control.

Be Safe

Before using any insecticide, always be sure to read the label carefully and follow all label directions for personal protection equipment and instructions for mixing and applying the product. The label is the law. The use directions it specifies are for the safety of the applicator, the

environment, and those using the area. Handle insecticides with the respect they deserve. They are poisons, and overexposure can result in acute and/or chronic health problems.

Application Methods
The following sections discuss some of the more common methods of applying insecticides to landscape plants.

Ready-to-use sprays: Many insecticides are formulated as ready-to-use sprays and sold in small-volume containers equipped with trigger-pump sprayers. The insecticide has already been diluted to the right end-use concentration and is ready to use. These are an easy and convenient method for treating small plants or isolated insect problems.

Systemic soil drenches: Some insecticides are formulated for use as soil drenches. These are not applied to the foliage; they are mixed and applied to the soil around the roots of the plant. The use rate normally depends on the size and type of plant being treated, and the appropriate amount of insecticide is normally diluted in water and poured uniformly over the soil around the plant. Because they must be taken up by the roots and translocated to the sites where the pests are feeding, systemic insecticides often require time to work, but they also distribute the insecticide thoroughly through the plant. This method of application can be very useful in controlling sucking insect pests, such as aphids, whiteflies, and scales.

Granular systemic insecticides: Many insecticides are formulated as dry granules. This is a popular means of formulating insecticides for home lawns because they are convenient to apply using granular spreaders. However, granular insecticides have little use for treating landscape plants. An exception to this is systemic insecticides formulated as granules. Systemic granules are usually applied to the soil around the plant and watered in. Application rate normally varies with the size and type of plant. As with systemic soil drenches, granular systemics are relatively slow acting.

Single-nozzle hand sprayers: Single-nozzle hand sprayers are one of the more common tools for treating landscape plants. They are very useful for treating individual plants or small plantings. These sprayers are designed for applying liquid concentrate, wettable powder, and wettable granule insecticides, as well as horticultural oils. These sprayers are powered by air pressure generated by a hand-operated pump. The tank capacities of these types of sprayers typically range from 1 quart to several gallons. Typical directions on the label of a product intended for this method of application will indicate "mix ____ fl. oz. (or tablespoons) per gallon of water and spray to run off."

Power sprayers: Power sprayers operate on the same principle as hand-pump sprayers. The insecticide is diluted in a carrier, usually water, and applied according to label directions. They can be used to apply insecticides formulated as liquid concentrates, wettable powders, or wettable granules, as well as horticultural oils. The capacity of power sprayers can range from only a few gallons to large commercial sprayers with capacities or more than 100 gallons. The smaller power sprayers used by homeowners are most commonly powered by an electric pump and can reach only relatively low pressures. CO_2 pressurized sprayers would also fit in this category. Large, commercial-sized sprayers are normally operated by mechanically powered pumps that can reach relatively high pressure.

Hose-end sprayers: Hose-end sprayers are a common and effective tool for applying insecticides to the home lawn, but the large droplets produced by these types of sprayers are less than optimal for treating the foliage of ornamental plants. Despite this limitation, the hose-end sprayers designed for treating trees and large shrubs are often the only practical method available to homeowners for treating large shrubs and small- to medium-sized trees. Depending on available water pressure, "tree and shrub" hose-end sprayers can treat plants 15 to 25 feet tall. You must recognize the coverage limitations of hose-end sprayers and the adverse effect this may have on control.

It is important to install a backflow-prevention device between the hose and faucet when using hose-end sprayers. This prevents insecticide from being sucked into the water system in case of a sudden loss of pressure in the water system. When using hose-end sprayers, begin spraying the area farthest away from the faucet, and apply the spray in a pattern that keeps you from having to walk over recently treated areas.

Hire a commercial applicator: One final treatment option available to homeowners is to hire a commercial applicator. Commercial applicators have special licenses that allow them to apply pesticides for a fee. Most have large-volume, commercial-quality equipment that lets them treat large plantings or large plants. This can be important when it is necessary to treat large trees. Few homeowners have the equipment needed to treat large trees effectively. The high-pressure sprayers available to commercial applicators can make such applications. Before applying such treatments in

an urban setting, both the homeowner and the commercial applicator should carefully consider the potential for drift onto neighboring properties and other nontarget sites. Take all necessary precautions to avoid drift-related problems. In many urban settings, the potential for problems from spray drift may be so great that you won't want to make such treatments.

Commercial applicators are also licensed to apply certain insecticides homeowners can't buy and use. This can be an important consideration when dealing with hard-to-control pests, such as wood-borers, scales, or whiteflies, especially when infestations are widespread or involve large plantings or high-value plants.

Insecticides for the Home Landscape

Although hundreds of different insecticide products are labeled for the home landscape, there are only a few dozen different active ingredients. When purchasing insecticides for use in the home landscape, it is important to think in terms of active ingredient rather than brand name. Brand names can be confusing and even misleading. This section provides some general information about some of the more commonly used insecticides.

Use insecticides safely! Before using any insecticide, always be sure to read the label carefully and follow all label directions regarding personal protection equipment and instructions for mixing and applying the product. The label is the law, and the use directions are for the safety of the applicator, the environment, and those using the area. Handle insecticides with the respect they deserve. They are poisons, and overexposure can result in acute and/or chronic health problems. Also be sure to observe pollinator protection requirements.

Be sure the insecticide is labeled for use on the plant(s) being treated. Some insecticides may actually cause injury, or phytotoxicity, to certain landscape plants. Before applying an insecticide to a particular species of plant, be sure to read the label and verify that the product is labeled for use on that particular species/variety.

Insecticides by Active Ingredient

acephate: Acephate is sold as Orthene Turf, Tree, and Ornamental 97 Spray. Acephate is a systemic insecticide that is effective against sucking insects such as aphids, whiteflies, scales, and lacebugs, as well as thrips and many caterpillars and beetles. Because acephate is absorbed by plant leaves and translocated within the plant, it often provides better control of insects that feed on the undersides of leaves than insecticides that kill only by direct contact.

acetamiprid: Acetamiprid is sold as Ortho Flower Fruit and Vegetable Insect Killer Concentrate, which is a concentrated formulation that must be diluted with water in the spray tank before use, as well as Ortho Flower, Fruit, & Vegetable Insect Killer RTS, which is a pre-diluted, ready-to-use formulation. Acetamiprid is especially effective against whiteflies and mealybugs and controls many other insect pests, as well. Although acetamiprid is a neonicotinoid insecticide, it is much less toxic to bees when applied as a foliar spray than other neonicotinoid insecticides.

azadirachtin: Suitable for organic gardeners. Azadirachtin is a botanical insecticide that acts as a contact insecticide and insect growth disruptor. It is most often used to control soft-bodied insects such as aphids, whiteflies, and thrips. Azadirachtin is also somewhat repellent to Japanese beetles and other insects. Azatrol and Azera are two examples of brand name products that contain azadirachtin and are approved for organic gardening.

chlorantraniliprole: Chlorantraniliprole is sold as Acelepryn. This is a commercial insecticide that may be difficult to find and costly to buy, but it is not restricted use and can be purchased by homeowners. Chlorantraniliprole is highly effective on caterpillars and a variety of other pests, including adult Japanese beetles. It is especially useful as a protective trunk spray to control caterpillar pests, such as dogwood borer and ash borer, and as a foliar spray to control bagworms. Acelepryn is also effective for white grubs and billbugs in home lawns. Pay careful attention to formulation and package size when purchasing.

malathion: Malathion is an older insecticide that controls a wide range of pests and is labeled for many different species of plants. It is especially useful to control aphids, bugs, and certain beetles. Malathion can also be used to control spider mites, but it is important to apply two or more successive applications at 4- to 5-day intervals.

Bt kurstaki: Suitable for organic gardeners. *Bacillus thuringiensis* is a bacterium that produces compounds toxic to certain insect species. There are different species and strains of this bacteria that produce different toxins. *Bt kurstaki* produces a compound that is toxic to certain caterpillars but does not affect other insects. Thuricide is one of the more common brand names under which this product is sold. It is most effective against leaf-feeding

caterpillars but is not effective against boring caterpillars, such as dogwood borers and pine tip moths. Bt is most effective against small larvae; attempts to control large caterpillars with Bt products may give disappointing results.

imidacloprid: Imidacloprid is a systemic insecticide labeled for homeowner use. It is sold under the brand name BioAdvanced Tree & Shrub Insect Control, Landscape Formula, as well as many other generic formulations. Most of the homeowner formulations of imidacloprid are intended for application as a soil drench around the roots of ornamental plants, rather than as a foliar spray. Imidacloprid is especially effective against sucking pests, such as aphids, whiteflies, soft scales, and lace bugs, as well as emerald ash borers when applied as a soil drench. It is relatively slow acting but provides long-term control, usually lasting several months or more. When treating large numbers of plants, it may be easier and more economical to purchase a commercial formulation of imidacloprid, such as Merit or one of the many generic imidacloprids, that is appropriate for the job and not classified as restricted-use. Be sure to observe pollinator protection requirements. Do not apply imidacloprid as a foliar spray to plants that are in bloom.

dinotefuran: Dinotefuran is a soil-applied systemic insecticide that is especially useful against armored scales, whiteflies, and mealybugs, as well as emerald ash borers. Currently, dinotefuran is not available in small-package homeowner formulations, but there are commercial formulations that are not classified as restricted-use products and do not require special licensing to purchase (Safari 20 SG and Zylam are examples). Packages of such products can be costly and may contain more product than you need. Before purchasing such products, read a specimen label carefully to be sure you understand how to apply the product and how to determine the amount to use per plant. Then count and measure the plants that require treatment and make careful calculations to determine the amount of product needed. Use rate is based on inches of circumference around the main stem for trees, or on height in feet for shrubs. Dinotefuran is slow acting but can provide many months of residual control. Be sure to observe pollinator protection requirements. Do not apply dinotefuran as a foliar spray to plants that are in bloom.

spinosad: Suitable for organic gardeners. Spinosad is a microbial insecticide that is very effective against most caterpillar pests. Two commonly available brand names that are labeled for use in the home landscape are Monterey Garden Insect Spray and Fertilome Bore, Bagworm, Leafminer, and Tent Caterpillar Spray. Spinosad is very effective against most caterpillar pests, but it is not effective against most other types of insects. However, it is also effective against thrips and certain types of leafminers. Some formulations of spinosad are acceptable for use by organic gardeners.

insecticidal soap: Suitable for organic gardeners. Insecticidal soaps are potassium salts of fatty acids. They control insects they contact by disrupting cell membranes. They are most effective against soft-bodied pests such as aphids, mites, and thrips. Direct contact with the pest is necessary for control. Safer Insect Killing Soap is an example of one brand name. Many plants can be injured by insecticidal soaps. Be sure to read the label carefully before treating.

neem oil: Suitable for organic gardeners. Neem oil is a botanical product primarily useful against aphids, mites, whiteflies, and scale crawlers. It is labeled for use on most landscape plants and is sold under several brand names (Monterey 70% Neem Oil is one example). Thorough coverage of the pest is necessary for control.

horticultural oils: Horticultural oils are highly refined paraffinic oils used to control scale insects, spider mites, and other small insects. They work through contact activity. Horticultural oils may be applied as dormant sprays as well as during the growing season. Be sure to read and follow the label carefully to avoid plant injury. Horticultural oils can be especially useful against infestations of hard-to-control armored scales. Commonly available brand names include Bonide All Seasons Horticultural Spray Oil and Monterey Horticultural Oil.

pyrethrin: Suitable for organic gardeners. Pyrethrin or pyrethrum is a botanical insecticide used primarily by organic gardeners. Monterey Take Down Garden Spray is one common brand name. It provides rapid knockdown of most insects, but insects often recover. Piperonyl butoxide (PBO) is often mixed with pyrethrin to act as a synergist. Bonide Pyrethrin Garden Insect Spray is one example. This increases the overall effectiveness and helps prevent pests from recovering. Pyrethrin or pyrethrum + PBO is active against a wide range of insects and is labeled for use on most ornamental plants. However, its efficacy is limited by its very short residual activity.

pyrethroids: The term *pyrethroids* refers to a group of synthetic insecticides that are modeled after the botanical pyrethrum molecules but are much more effective because

they provide greater efficacy and increased residual control. These products are effective against a wide range of insect pests and are used at very low rates. The following pyrethroid insecticides are currently labeled for use in the home landscape:

permethrin: Permethrin is the oldest and most common of the pyrethroid insecticides. It is widely available and is sold under many different brand names (Bonide Eight Vegetable, Fruit, and Flower Concentrate, and Hi-Yield Lawn, Garden, Pet, and Livestock Insect Control are two examples). Permethrin is labeled for many different ornamental plants and is effective against a wide range of pests. Note that permethrin is often confused with pyrethrin, but there are considerable differences in their overall effectiveness and residual control.

cyhalothrin: Gamma-cyhalothrin is a pyrethroid insecticide that is effective against many insect pests and is labeled for use on most ornamental plants. Spectracide Triazicide Insect Killer Concentrate is the most common brand name.

cyfluthrin: Cyfluthrin is a pyrethroid insecticide that is effective against many insect pests and is labeled for use on most ornamental plants. BioAdvanced Vegetable and Garden Insect Spray is one example.

bifenthrin: Bifenthrin is one of the more effective pyrethroid insecticides. It is labeled for use on most ornamental landscape plants. Ortho Bug B Gon and Hi-Yield Bug Blaster Bifenthrin 24 Concentrate are two common brand names. Bifenthrin is a broad-spectrum insecticide that has more activity against aphids and spider mites than most pyrethroids.

zeta-cypermethrin: Zeta-cypermethrin is a pyrethroid insecticide that is labeled for use on most ornamental landscape plants and is also useful in home vegetable gardens. GardenTech Sevin Insect Killer Concentrate is one example. Note that older formulations of "Sevin" contain carbaryl, which is not a pyrethroid. Zeta-cypermethrin is effective against a wide range of insect pests.

Common Insect Pests of Ornamental Plants in Mississippi

PLANT	INSECT	SCOUTING
Arborvitae	Bagworm	Check for small larvae in May and June. Early detection and treatment can help prevent damage. Spring egg hatch often begins about the same time crape myrtles begin to leaf out.
Azalea	Azalea lace bug	Check for adults, spiny nymphs, or shiny fecal droppings on undersides of leaves. Stippling or bleaching of leaves indicates infestation.
	Azalea caterpillar	Check for clusters of small, yellow- and red-striped caterpillars skeletonizing leaves in late spring through midsummer. Treat promptly to avoid defoliation by larger caterpillars.
	Azalea bark scale	Check for large, white scales at crotches of twigs and branches.
	Azalea leafminer	Check for mines, leaf tying, and tattered defoliation of leaves at tips of branches.
Boxwood	Spider mite	Be alert for stippling, yellowing, or bleaching of leaves. Use a hand lens to check for mites.
	Boxwood leafminer	Leaves appear yellow to rust-colored. Closer examination reveals mines containing small, yellow to orange larvae.
Bradford pear	Asian ambrosia beetle	Curved, toothpick-sized columns of tightly packed frass extruding from the trunk of the tree are signs of attack by the Asian ambrosia beetle. This beetle also attacks many other species of hardwood trees.
	Fall webworm	These caterpillars produce large, unsightly webs that enclose the leaves at the end of a branch. They are most abundant beginning in late summer.
Camellia	Tea scale	Check for yellowing leaves and scales on undersides of leaves. First-generation crawler hatch often coincides with blooming of Chinese wisteria and tulip poplars.
	Southern red mite	Found on undersides of leaves. Causes leaves to turn gray or brown and fall off. More common in cool spring and fall.
	Camellia bud mite	Scales of flower buds turn brown, and buds fail to develop properly or produce distorted blooms. Mites are too small to be seen without significant magnification.
Canna	Lesser canna leafroller	Infested leaves fail to unroll properly and are damaged by larvae feeding inside the leaf roll. Activity begins shortly after canna leaves emerge in the spring.
Crape myrtle	Crape myrtle aphid	Check for aphids on undersides of leaves. Be alert for accumulations of honeydew or sooty mold. More common on older, “indica-type” varieties.
	Crape myrtle bark scale	Be alert for accumulations of honeydew or sooty mold. Check for patches of white, felt-like scales on trunk, limbs, and/or twigs. This is a serious, nonnative scale that has recently invaded the state.
	Flea beetle	Be alert for small, metallic blue-green beetles feeding on leaves in midsummer.
	Asian ambrosia beetle	Curved, toothpick-sized columns of tightly packed frass extruding from the trunk of the tree are signs of attack by the Asian ambrosia beetle. Also attacks many other hardwoods.
Dogwood	Dogwood borer	Loose, scaly bark is often the first sign of borer infestation.
Elm	Elm leaf beetle	Skeletonizing defoliation is often the first sign of infestation. Check for adults and larvae feeding on leaves.
Euonymus	Euonymus scale	Check for scales on leaves and twigs. Occurs year-round. Hatching of first-generation crawlers often coincides with blooming of dogwoods and Oregon grape hollies.

PLANT	INSECT	SCOUTING
Gardenia	Citrus whitefly	Be alert for honeydew or sooty mold. Clouds of small, white, moth-like adults fly out when foliage is disturbed. Scale-like immatures occur on undersides of leaves.
	Mealybug	Concentrations of white, cottony or powdery material in crotches of twigs and terminals may indicate mealybugs. Check for small, oval, soft-bodied insects.
Hibiscus	Hibiscus sawfly	Be alert for first signs of defoliation. Check for small, green larvae on undersides of leaves.
Holly	Tea scale	Check for yellowing leaves and scales on undersides of leaves. First-generation crawler hatch often coincides with blooming of Chinese wisteria and tulip poplars.
	Holly leafminer	Causes winding or serpentine mines in leaves of hollies.
Hosta	Slug	Be alert for feeding injury on leaves, especially as leaves are emerging in spring.
Lantana	Lantana lace bug	Bleaching or browning of leaf margins may indicate infestation. Check for the spiny nymphs and small, elongate, gray-brown adults on undersides of leaves.
	Whitefly	Be alert for honeydew or sooty mold. Clouds of small, white adults fly out when foliage is disturbed. Scale-like immatures occur on undersides of leaves.
Ligustrum	Whitefly	Be alert for honeydew or sooty mold. Clouds of small, white adults fly out when foliage is disturbed. Scale-like immatures occur on undersides of leaves.
Magnolia	Tulip tree scale	Especially common on deciduous magnolias. Honeydew and sooty mold are often the first signs of infestation. Check for scales on small twigs.
	Yellow poplar weevil	Mostly occur on southern magnolias. Larvae cause blotch-shaped mines near tips of leaves. Adults feed on buds and tender young leaves, causing holes and distorted leaves. Adult weevils begin emerging when eastern redbuds and dogwoods are blooming.
	False oleander scale	This armored scale occurs on the upper and lower surface of leaves and attacks many other plants. The females are brown and oval-shaped with a larger white covering extending from one end. Yellow, chlorotic spots appear at the feeding site.
Ash	Emerald ash borer	Be alert for reports of emerald ash borer infestation within 15 to 30 miles of ash trees that you do not wish to lose (this is the time to begin preventive treatments). Crown dieback; bark splitting; sprouting from trunk; small, D-shaped emergence holes in bark; and woodpecker feeding are symptoms of possible emerald ash borer infestation.
	Ash borer	Watch for sunken, swollen, or cracked bark or cankers accompanied by sawdust or other signs of boring activity. Empty pupal skins protruding partway out of the bark are a sure sign of ash borers. Ash borer emergence holes are irregularly round, which helps distinguish them from the D-shaped emergence holes left by emerald ash borers.
Pecan	Pecan phylloxera	Pea- to marble-sized knotty galls form on terminals in the spring. Egg hatch coincides with bud break on pecans.
	Yellow aphid	Honeydew and sooty mold accumulate on lawn furniture and other items beneath trees. Large numbers of small, yellow aphids occur on undersides of leaves.
	Black pecan aphid	This small, black aphid causes angular-shaped, yellow spots on leaflets. Trees shed leaves prematurely.
	Fall webworm	These caterpillars produce large, unsightly webs that encase the ends of entire branches.

PLANT	INSECT	SCOUTING
Pine	Pine tip moth	Infests pines under 15 feet. Check for larvae feeding in developing terminals. Activity begins in very early spring and may be as early as mid-February in the southern portion of the state.
	Black turpentine beetle	Watch for popcorn-sized masses of resin and pitch tubes on the lower trunk area of large pines. Attacks may occur from May through September.
	Red-headed sawfly	Red-headed, caterpillar-like larvae chew needles of young pines.
	Pine tortoise scale	Black sooty mold on needles indicates infestation of scales or aphids. Check for presence of tortoise-shaped adult scales.
Pyracantha	Lace bug	Check for adults, spiny nymphs, or shiny fecal droppings on undersides of leaves. Stippling or bleaching of leaves indicates infestation.
Rose	Aphid	Check for heavy infestations on leaves and stems, especially in spring and fall. Causes wilting of terminals.
	Flower thrips	Check for feeding injury and distortion on flower petals, especially on light-colored blooms. Large numbers of thrips may move to roses as wild hosts dry in spring. Often found at the base of flower petals.
	Spider mite	Found on undersides of leaves. Be alert for stippling of leaves or small webbing. Mites are more common in hot, dry weather.

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