

Insects and Mites Affecting Ornamentals

Many different kinds of insects and mites feed on trees and shrubs. Generally, the greater the variety of plants in the landscape, the more insect and mite species will be encountered. However, the mere presence of an insect or mite on a tree or shrub does not mean there is a problem that has to be controlled with insecticides or miticides.

Wasps, lady beetles and other biological and environmental forces play an important part in keeping many insects and mites under control. These protective forces break down during some seasons, and insecticide and other control measures may then be needed. Some insects and mites thrive under Arkansas climatic conditions, and natural forces seem to exert little pressure on them. These insects and mites may be troublesome almost every year. Some plants are more susceptible to specific insects or mites, and they require constant attention, while others are relatively insect- or mite-free almost every year.

The following is a discussion of insect and mite management of ornamental shrubs and trees in Arkansas. The insects and mites are grouped according to the kind of injury they cause.

General Considerations

Dealing with insect pests on plants involves a procedure similar to dealing with human ills. You should have some knowledge about the situation and then use this knowledge in the proper sequence to achieve the best results. In general, the procedure for dealing with insect and mite problems is as follows:

1. **Examination of the situation.** Know what the normal or healthy condition of the plant looks like. If the plant deviates too far from this condition, look for possible causes. (See the Key to Common Tree and Shrub Pests located at the end of this chapter.)
2. **Identification and assessment.** If insects, mites or damage apparently caused by them are found, determine what the pest is and the severity of the problem. Not all insects are pests. Some may be incidental visitors, and some may be beneficial. On the other hand, some pests may be causing little

damage at the moment, but the problem may become serious in a short time. Even if the plant is healthy, it may be vulnerable to attack from pests, and thus it is important to know what insects or mites are likely to be pests on a given host plant.

3. **Management options.** This may involve preventive action, curative action or no action at all, depending on the identification and assessment of the situation.

Preventive action often involves maintaining plant vigor by proper site selection and good cultural practices. The sanitary practices of pruning out dead or unhealthy plant parts and cleaning up ground litter that may harbor pest insects are also helpful. In some cases, insecticides are used to protect plants from becoming infested.

Sometimes natural controls are sufficient to give the plant an advantage to overcome the pest attack. At other times, an insecticide may be needed. The most common of the points to consider when selecting and using an insecticide or miticide are:

- Is the insecticide/miticide registered with the EPA for this site/plant, and is the product labeled for the intended use?
- Is the use of this insecticide/miticide safe to you and others in the situation in which you want to use it?
- Is the insecticide/miticide likely to harm the plant you want to protect? If so, under what conditions?
- Will the insecticide/miticide also kill beneficial insects or other beneficial animals in this situation?
- Will the insecticide/miticide kill the pest?
- What is the proper time to use this insecticide/miticide for this particular pest?
- How and to what parts of the plant is the insecticide/ miticide applied?

No action is suggested when the pest is not a serious one or when the curative action probably would give rise to problems more serious than the one at hand. Sometimes a

pest may be causing extensive damage, but there are no practical methods of control during this particular stage of the insect's development.

4. **Insecticide/Miticide Application.** Knowing what the problem is and what to do about it does not solve the problem. Some of the common problems associated with insecticide application are:
 - Errors in mixing insecticides in the right proportion.
 - Inadequate coverage of the plant with the spray. Plants usually should be thoroughly wetted with spray.
 - Tendency of the spray to separate or settle out unless the spray solution is kept agitated. If the spray solution is allowed to settle during spraying, some plants will be overdosed and others underdosed.
 - Improper timing of sprays. If applied too early, the insecticide may have disappeared by the time the insect population is present. If the spray is delayed, the insects may have developed to a more resistant stage or may have bored in where the spray cannot reach them.
 - Adverse effects due to weather conditions. Rains following spraying may wash off the insecticide before it has accomplished its full effect. Temperature extremes combined with application of an insecticide may injure the plant, reduce toxicity of the insecticide, increase pest resistance or volatilize the insecticide.
5. **Evaluation.** Did the control work? Also, keeping records on the extent of infestations and the control actions taken will provide valuable historical reference for measuring success and failure of control efforts.

Diagnosing Plant Problems Caused by Insects/Mites

Most individuals recognize when a plant is unsightly, growing poorly or having some type of problem; however, determining the cause of poor plant performance can be difficult.

Insects and their relatives (arthropods) must feed to survive and reproduce. Most feeding

pests cause visible and predictable changes in the plant's appearance that narrow the possibilities when trying to identify the offending pest. Plant identification and the recognition of damage symptoms are the important first steps in the diagnostic process. For convenience, symptoms of insect damage can be grouped into five categories:

- Chewed or tattered foliage or blossoms.
- Stippled (flecked), yellowed, bleached or bronzed foliage.
- Distortion of plant parts.
- Dieback of plant parts.
- Presence of insect products.

Chewed or Tattered Foliage or Blossoms

The symptoms of chewed or tattered foliage or blossoms are, in most cases, caused by an insect that has chewing mouthparts. Thus, with these symptoms, one can normally dismiss from consideration the large group of pests with sucking or rasping mouthparts (where, except in unusual situations, the feeding of such insects does not result in tattered plant parts). The most important pests causing chewed or tattered foliage and blossoms are larvae (caterpillars) of moths, butterflies and sawflies; adult beetles; and grasshoppers.

Stippled (Flecked), Yellowed, Bleached or Bronzed Foliage

When a plant's foliage has this type of damage and no loss in the physical integrity of foliage surface is seen, the injury is caused by insects or mites with some form of sucking mouthparts. These symptoms often begin with stippling, or flecking, of leaves, resulting from the insertion of sucking mouthparts into the leaf. Plant sap is removed and chlorophyll is withdrawn or destroyed at the point of penetration. Tiny discolored (stippled) areas appear on affected foliage. With large numbers of attacking pests, these stippled areas coalesce, resulting in leaves that appear partly or mostly bleached, yellowed, bronzed or silvered. Pests that typically cause these symptoms are leafhoppers, plant bugs, lace bugs, aphids, mealybugs, psyllids and spider mites. Thrips have rasping mouthparts that the pest uses to rupture plant

cells and then suck up released fluids. The resulting damage is similar to that caused by pests with true piercing-sucking mouthparts.

Distortion of Plant Parts

Plant distortion may appear as curled or cupped leaves, twisted growing points or galls (swellings or abnormal growths) of various types on leaves, flowers, twigs or stems. In many cases, the arthropod responsible may not be readily visible on the surface of the affected plant part. Pests associated with this type of damage/symptom are aphids, thrips, cynipid (gall) wasps, larvae of certain types of moths, and eriophyid mites (cause galls, blisters, bud distortion, etc.). Also, extensive feeding by thrips can cause distortion of leaves, buds and flowers.

Dieback of Plant Parts

Leaf, twig or branch dieback characterizes this category of symptoms. In a few cases, death of the entire plant may occur. Twigs and branches of deciduous plants that die during the growing season often retain dead leaves well into the subsequent dormant season, because the leaf abscission layer will not have been formed before the plant part died. Parts of non-deciduous plants that die at any time will retain dead leaves for long periods. When these symptoms are seen, the following pests are suspect: scale insects, larvae of boring beetles or moths, and cynipid (gall) wasps.

Presence of Insect Products

Some insects' products are evidence of their presence beyond that of plant injury. Many of these products remain intact for weeks (or months) after the pest has completed its activities. The most commonly seen products and the pests responsible for them are:

- Honeydew (and often black, sooty mold growing on the sugary material) – aphids, soft scales, mealybugs, psyllids and whiteflies.
- Dark fecal specks (droppings) – thrips, lace bugs or larger pieces of fecal matter (frass) left by larvae (caterpillars) of moths.
- Tents, webs, silken material – tent caterpillars, webworms, leafrollers/tiers and spider mites.

- Spittle (spit-like material) – spittlebugs.
- Cast skins (from molts or shedding of the exoskeleton during growth) – aphids, leafhoppers, lace bugs and spider mites.
- Cottony, waxy material (flocculence) – mealybugs, certain scale insects and certain aphids.
- Sawdust, wood chips and pitch balls or tubes (usually found on or below the host plant) – wood borers, shoot borers, bark beetles and larvae of certain moths (e.g., pitch masses at the entrance of pine tips/shoots from Nantucket pine tip moth larvae).

Sampling and Monitoring for Pests and Their Natural Enemies

Various methods have been devised to sample, or estimate the numbers of, arthropods on trees and shrubs. Many of these procedures were first developed for use in agricultural crops, but several have resulted from investigations on landscape ornamental pests. The objectives of sampling or monitoring are to detect the presence or absence of pests, quantify abundance of pests and their natural enemies and follow the progress of an arthropod population through time by regular, periodic sampling. The goal of monitoring is to reach a decision as to whether, or when, a pest population requires control action. All sampling procedures share certain characteristics:

- They use a common sampling unit, such as leaves, terminals, beats or minutes.
- The unit chosen must be consistent with the feeding habits of the pest population under observation. Do not select leaves as the sampling unit for scale insects that occur predominantly on twigs. Similarly, do not count aphids on the younger leaves if they occur mostly on the older leaves.
- The number of samples taken must be adequate. What is “adequate” must be determined on a case-by-case basis and by time and equipment constraints. Pests are seldom distributed uniformly over a tree or shrub. Similarly, every tree in a group of trees of that species will not be infested to the same degree. Generally, the number of samples

taken from each plant at each interval is held constant over the entire sampling period and over the entire group of plant samples.

- The sampling procedure must be standardized. It helps if the same person does all the samplings. If two or more persons are involved, they should check one another in a preliminary sampling exercise to determine that their sampling methods and results are the same.
- Written records of arthropod counts are kept by date, location and person sampling, with a brief description of procedures used.

Because some insects and mites are quite small, the person sampling or monitoring pests and their natural enemies should carry and use a 10X hand lens.

Methods of Sampling

Counting Insects on Plant Parts

Each sample is pruned or pinched from the plant and the number of arthropods present is counted immediately without magnification or under magnification using a hand lens. The number of samples taken from each plant usually ranges from five to 25.

Variations include estimating pest numbers in 10s or 100s, when counts are high, or taking more samples (around 100) and recording only whether pests are present or absent on each unit.

Counting insects on plant parts is effective for sampling aphids, spider mites and other arthropods that do not readily fly or drop from the plant when the sampling unit is removed. Sometimes only the immature insect stages are counted, if the adults fly readily when the sample is taken.

Time Counts

The person responsible for sampling counts the number of insects seen during a one- or two-minute visual search of the plant. Several such aimed searches are made in different parts of the same plant (if large). This procedure is useful for large insects, such as caterpillars, or for egg masses of insects on tree trunks or limbs. The plant is not damaged, and the insects counted are available for re-counting at the next scheduled sampling. Because it is difficult to count insects and keep track of time simultaneously, two

persons are required for best results, unless an electronic alarm watch can replace the second person. The time-count is not a useful sampling method if the insect population is high because the insects can't be counted fast enough.

Beating Samples

A sampling tray is held horizontally just beneath plant foliage, and the foliage above is struck sharply a standard number of times (two to five) with a short stick or the other hand. Arthropods falling to the tray are immediately counted and then shaken off. This process is repeated several times around the periphery of the plant. An attempt is made to standardize the density of foliage beaten. The tray may be 1 square foot in surface area or as small as a 5- or 6-inch circle (pads of paper or plastic disposable pie plates have often been used).

The trap surface is usually white to contrast with the insects being counted. This procedure has been used to sample such pests as psyllids, certain aphids, plant bugs and spider mites.

Fecal Pellet Collections

Lepidopterous larvae, like catalpa caterpillars, oakworms and datanas, produce relatively large, solid, dark fecal pellets, most of which fall to the ground beneath the plant. Using three to five shallow pans, paper cups or sticky cards deployed beneath the foliage of infested trees, counts of pellets give an estimate of the larval population in the tree. The size of the individual pellets indicates whether the caterpillars are young or more mature. Collection traps are usually deployed for a 24-hour period each week. Traps are put out at times when no rain or sprinkler irrigation is expected within the 24-hour period.

Some tent-making and leaf-rolling caterpillars tend to deposit their fecal pellets such that few fall to the ground. The fecal trap method is not useful for estimating the number of these pests.

Attractant Traps

Devices containing synthetic or natural attractants and that physically trap the insects attracted to the device are useful for sampling several moth and beetle pests of ornamentals. They will trap only the mobile adult stage and, in the case of most sex pheromone traps, only the male of the species.

Sampling and Monitoring Natural Enemies

When sampling for pests, the person sampling should also look for:

- Predators, such as ladybird beetle adults and larvae, syrphid fly larvae, lacewing larvae and spiders.
- Evidence of parasitism, such as aphid “mummies,” darkened greenhouse whitefly pupae and scale insects with exit holes of the parasites.
- Signs of insect diseases, such as blackened, dead caterpillars and dead, discolored aphids infected with fungi.

The impact of biological control can be estimated by counting the number of natural enemies per sampling unit, then calculating the ratio of affected pests to healthy ones. If signs of biological control are apparent, delay any insecticide treatment and sample again in a week for pests and natural enemies. If the natural enemy population is increasing faster than the pest population, consider no insecticide treatment. If natural enemies are still active but the ratio has increased in favor of the pest, and pest numbers or plant unsightliness are approaching unacceptable levels, then consider the following measures when an insecticide is applied:

- If possible, use a material that is selective to preserve natural enemies (e.g., *Bacillus thuringiensis* for caterpillars) or a material that is minimally disruptive to natural enemies (e.g., insecticidal soap, horticultural oil or systemic insecticides).
- If the use of selective or minimally disruptive materials is not possible, treat only the plants that are in immediate need of an application, leaving the untreated plants to serve as a reservoir for natural enemies.
- Various honeydew-producing insects, especially soft scales and aphids, are protected or guarded by ants, whose only interest is the honeydew food source. Ants interfere with parasite and predator activity. Therefore, the presence of ants on plants infested by honeydew-producing insects should suggest control of the ants by insecticidal treatment of the base of the plant only. This is another kind of selective

use of an insecticide. Sticky bands may be used instead of insecticide treatment, e.g., for walnut datana and spring cankerworm adults.

Methods of Managing Pests

Management options for existent or threatening pests of ornamental plants are biological control, cultural control, physical (or mechanical) control and insecticidal control.

Biological Control

Every insect and mite pest has its complement of natural enemies (parasites and predators) that serve to reduce populations of the pest. Most natural enemies of landscape pests are native species, but others have been deliberately introduced, usually from foreign countries, and then released into the environment for biological control purposes. Biological control, then, is the use of parasites and predators to suppress pest species.

Except in a few situations, the arborist or other landscape manager is seldom in a position to introduce new parasites and predators into the environment in which he or she works. The greatest opportunity is to preserve those organisms that are already there. This is best accomplished by:

- Learning to recognize important natural enemies of pests commonly encountered.
- Avoiding the use of insecticides when a cultural or physical control measure would reduce pest numbers to an acceptable level.
- Using an insecticide that has a minimal effect on parasites or predators.

Cultural Control

Plant growth-related practices useful in preventing or mitigating pest damage include thinning rank vegetation, maintaining high plant vigor, judicious pruning and planting resistant species or cultivars.

Thin Rank Vegetation

Remove dead or dying vegetation to create a physical environment less favorable to certain soft scale insects. For example, observations indicate that populations of black scale will decline if greater air circulation and more

sunlight are allowed to enter the interior parts of dense plantings of oleander. Part of the scale decline may be due to improved accessibility of natural enemies to the scales. It is likely that other soft scales are similarly affected and that vegetation control applies also to plants other than oleander.

Maintain High Plant Vigor

Bark beetles (family Scolytidae) of coniferous trees often attack trees in stress or in a reduced state of vigor caused by drought, root disease, root compaction, root damage done during construction, air pollution, a poor growing site or even old age. Several bark beetles of nonconiferous trees, such as the smaller European elm bark beetle in elm and the shothole borer in plants of the genus *Prunus* spp., similarly appear to preferentially attack weakened trees. Many flatheaded borers (family Buprestidae) and roundheaded borers (family Cerambycidae) prefer to attack weakened trees, as compared to apparently vigorous ones. Because control of most boring insects after they have infested plants is essentially impossible, preventing their attacks by using cultural practices that contribute to high plant vigor makes good sense.

In a few documented instances, high plant vigor actually has contributed to high pest levels. Most of these instances involve sap-sucking pests. For example, high populations of the oleander aphid can be prevented by reduced watering and pruning of plants. These practices discourage rank flushes of new growth preferred by the aphids. Yet, control of sucking pests is infinitely easier than control of established borers, and a strong case remains for the general principle of maintaining plants in good vigor.

Judicious Pruning

Prune trees judiciously at the proper time of the year to reduce attacks by certain boring insects. Conifers, in particular, are susceptible to attack by several species of borers after tree trunks have been injured.

To prune judiciously, avoid excess pruning, including topping, which results in poor balance between root and top growth, and avoid making flush pruning cuts. Conifers have often died from bark beetle attack soon after being excessively pruned.

For several boring insects, pruning (or otherwise opening wounds in tree trunks) during the late winter through spring and summer period has resulted in far more severe borer infestations than when pruning was done during the fall or early winter months. Adult borers are inactive in the fall and winter, and pruning at that time allows the tree to begin the wound closure process before adult activity resumes the following spring or summer. The application of wound dressing compounds is not a good alternative to judicious pruning at the proper time and in the proper manner.

Plant Resistant Trees and Shrubs

Pests do not attack equally every species and cultivar of all plants. Therefore, selecting and planting those least susceptible to pests, so long as they meet basic requirements of size, color and form, greatly reduces or negates the need for insecticide control of insect pests. The term resistant does not necessarily mean immune. Low numbers of pests often occur on resistant plants, but these levels would be considered insignificant under most circumstances.

Despite the huge benefits from using pest-resistant plants, this cultural practice has the following shortcomings and limitations:

- A plant resistant to an important arthropod pest may be susceptible to serious plant diseases or have other problems.
- If the landscape is already established, pest-resistant plants are of no use until new trees or shrubs are required.
- A plant that is resistant to an important pest today probably would not be resistant to a new pest entering the area at some later time.
- Eventually, some insect pests have shown an ability to adapt to resistant plants. These new strains or “races” of pests are called biotypes.
- If a little-used plant should become widely used because it has been found resistant to an important pest or for any reason, the chances are great that an increasing number of insects would become pests of that plant. The thornless honeylocust cultivars, when first developed, were advertised as pest-resistant. If they ever were, they are no longer.

You should become informed about pest-resistant and other low-maintenance plants by consulting with university researchers, attending seminars and workshops and reading various periodicals and other literature, looking specifically for information on resistant varieties that are adapted to Arkansas.

Physical (or Mechanical) Control

In some cases, a pest infestation may be controlled or averted by physical means. Examples follow:

Pruning

Prune off the tips of branches harboring colonies of caterpillars. Pruning branch tips when the larvae are young produces the best results. In the case of some tent-making caterpillars, the insects forage for foliage away from the tent on clear, warm days, but tend to return to the silken web before nightfall and remain there during cool, rainy weather. Therefore, the branch tip containing the caterpillar colony is best pruned off during inclement weather.

Larvae of the fall webworm feed from within the protection of their tent and build an increasingly larger tent, as more food is required for the colony. Their tents and colonies can be pruned from trees during any kind of weather, but results are best when the tents are small.

Some species of caterpillars that do not form tents tend to feed gregariously, especially when young. If caterpillars are found feeding together, the entire colony can be removed by pruning off the branch terminal on which it is feeding.

Control by pruning, however, is of limited use on tall trees or when infestations are large.

Reduce Infestations of Certain Boring Insects

Various scolytid bark beetles breed in stressed, dying or recently dead wood of conifers. Removing such wood from the vicinity of living conifers reduces the likelihood of living trees becoming infested. This action should be taken as soon as a potential breeding wood is detected, whether it is infested or not. The smaller European elm bark beetle (SEEBB), vector of the Dutch elm disease fungus, and the shothole borer similarly breed in declining or recently dead wood of elm and *Prunus* spp., respectively. Getting rid of such wood is recommended as a

physical means of protecting nearby susceptible living trees. Burning, chipping or burying dead trees to a depth of 18 inches or more, or physically removing the tree to a distance of at least one-fourth mile are effective means of disposal.

Prompt removal of the bark of freshly cut wood, a difficult task, will effectively negate its use as a breeding place for just about all insects and will safely allow the wood to be kept as firewood. The bark that is removed need not be destroyed, because boring insects will not breed in it. Covering freshly cut wood (without first de-barking it) completely with a sheet of clear ultraviolet ray-resistant plastic negates the wood being used as a breeding place for boring insects. Spraying freshly cut wood with an insecticide, if such wood will later be used as firewood, is not recommended. More detailed information on the SEEBB and its association with Dutch elm disease is provided later with the discussion of bark beetles.

Insecticidal Control

When confronted with a serious pest infestation, the landscape manager often has no choice but to apply an insecticide. Most are applied as sprays, but a few are used as liquid soil drenches or trunk injections.

Spray Application Methods

Sprays may be applied either by hydraulic or mist blower machinery. With the hydraulic sprayer, the insecticide is diluted in water and delivered to the target tree or shrub by high pressure and volume through a hose and gun. Mist blowers deliver a more highly concentrated insecticide by means of a high volume, high velocity air stream. The insecticide is diluted largely in the air rather than in water. Mist blowing is most effective when there is no wind. Large mist blowers can treat tall trees rapidly and thoroughly, with practically no runoff and little drift, if there is no wind. Backpack models are often used on smaller trees and shrubs. Generally, emulsifiable concentrate formulations, if available, should be chosen for use in mist blowers because the abrasive characteristics of wettable powders eventually cause mechanical problems.

Systemic Insecticides

When systemic insecticides are applied to the roots, leaves or bark or injected into the vascular system, they are absorbed and trans-

located upward to kill insects feeding primarily on the foliage. When applied as sprays, they also kill insects by contact action. Acephate (Orthene), dimethoate (Cygon/Defend), and imidacloprid (Merit/Marathon) are examples of systemics. Advantages of systemics are relatively long residual life; protection of newly expanding foliage not present at the time of application; protection of plant parts such as growing points, which are difficult to physically penetrate with sprays; and reduced kill of beneficial insects.

Systemics will not kill all insects living in or on plants, however. Regardless of how the insecticide is applied, it moves rather quickly to, or remains in, the foliage. Many sucking pests, such as aphids and thrips, and certain insects that chew foliage can be easily controlled with the proper systemics. Systemics are not effective against most woodborers or bark-feeding scale insects, unless the proper material is applied as a spray that results in kill by contact action.

Trunk Injection of Systemic Insecticides

The Mauget and Acecap systems are sold commercially for injection and implantation, respectively, of systemics into the trunks of specific ornamental trees for insect control. Treatments are normally made in the growing season. In the Mauget system, feeder tubes are inserted into each hole. Then, a plastic unit containing a prefilled small amount of insecticide is tapped onto the free end of each feeder tube, breaking a seal that allows the liquid to enter the feeder tube and then the tree's vascular system. After the plastic units have emptied, they and the feeder tubes are removed. In the Acecap system, the entire small plastic unit containing a dry insecticide product is placed into each hole, seated just beneath the inner surface of the bark, and left there. Sap within the tree dissolves the insecticide and translocates it upward in the tree.

Insecticide injection has much to recommend it, if trees accept the systemic quickly and if the insecticide is effective against pests for which it was intended. This type treatment can be beneficial for control of pests on trees in difficult to treat locations, e.g., long, busy streets and in or around malls. The equipment required is simple and inexpensive, trees can be injected during weather unsuitable for spraying, insecticidal drift is avoided, and negative impact on beneficial insects is believed minimal. Yet, the possible

chronic effects resulting from holes made in trees, which are required during the injection process, is not completely resolved, particularly for trees repeatedly treated.

Oils as Insecticides

Most oils available today as insecticides are termed superior-type horticultural oils, and are considered appropriate for use in the dormant season and in the growing (or verdant) season.

Oils are contact materials that kill certain insects and mites by intervening physically, rather than chemically, with respiratory processes. Research has shown that oils have essentially no residual life; that is, oils affect pests present at the time of application, but do not kill pests arriving after the application. Yet, there is some evidence that certain insects arriving soon after treatment may be repelled by the oil residue.

Depending on the pest involved, oils may kill the egg, larval, or adult stage. In the dormant season, oils have been useful against scale insects, mites, plant bugs, psyllids, and certain moths. Whether oils are used in the dormant or growing season, they should never be applied to trees or shrubs stressed by a soil moisture deficit. If used in the growing season, do not make application to plants pushing out the spring flush of growth, because tender foliage may be injured.

Some plants reportedly sensitive to oils include maple, hickory, walnut, and azalea. Those having a tendency toward sensitivity to oils include beech, Japanese holly, redbud, photinia, spruce, and Douglas fir. Oils will temporarily remove the glaucous bloom from such conifers as Colorado blue spruce.

Soaps as Insecticides

Several insecticidal soap products (such as Safer AgroChem's Insecticidal Soap and Acco Highway Spray) are available for landscape pest control during the growing season. They have some of the same characteristics as horticultural oils in that they kill principally by physical rather than chemical action. They also have essentially no residual life, meaning the application will have to be repeated if the target pest has a long period of activity during the growing season. Soaps have given good control of certain exposed pests, such as aphids, greenhouse thrips, spider mites, psyllids, and whiteflies.

Microbial Insecticides

Microbial insecticides are composed of microscopic living organisms (viruses, bacteria, fungi, protozoa or nematodes) or the toxins produced by these organisms. They are formulated to be applied as conventional insecticidal sprays, dusts or granules.

Microbial insecticides are an effective alternative for the control of many insect pests. Their greatest strength is their specificity, because most are essentially nontoxic and non-pathogenic to animals and humans. Although not every pest problem can be controlled by the use of a microbial insecticide, these products can be used successfully in place of more toxic insecticides to control some ornamental insects. Because most microbial insecticides are effective against only a narrow range of pests, and because these insecticides are vulnerable to rapid inactivation in the environment, users must properly identify target pests and plan the most effective application.

Insects and Mites That Are Damaging to Ornamentals

There are several kinds of insects and mites that you should recognize. They can be grouped as outlined previously in the section on diagnosing plant problems or as follows, according to the part of the plant on which they feed (leaves or shoots, twigs, trunks and roots) and the kind of injury they cause (chewing, rasping or sucking).

Note: See the seasonal appearance calendar at the end of this chapter. It lists ornamental and shade tree pest activity by month of average first occurrence.

Leaf Feeders – Chewing Injury

Deciduous trees and shrubs usually can tolerate considerable defoliation without affecting tree vigor. Generally, late season defoliation of deciduous trees and shrubs is less important than early season defoliation, because food necessary for growth has been produced and stored. However, late season defoliation of evergreens can be important. Evergreens can be seriously affected by heavy defoliation. This is because evergreens replace only a portion of their total complement of foliage each year. (Pines, for example, replace about one-third, and if the new needles are eaten, the tree will be missing about one-third of its needles for

three consecutive years.) Also, evergreens usually use their leaves or needles to produce growth regulators (hormones) and to store food reserves for the next year. If these leaves or needles are destroyed, so are sites for growth regulator production and food storage. New foliage is the most efficient producer of photosynthate (plant food). If this foliage is lost to defoliators, the current year's food production can be reduced considerably.

The two most common types of leaf-chewing insects are caterpillars and leaf beetles.

Caterpillars

Caterpillars feed on the foliage of trees. Some form webs or tents on branches and some have more than one generation per year. Several important caterpillars in Arkansas are bagworm, mimosa webworm, fall webworm and cankerworm. **Note:** These pests can be controlled with bacterial products (*Bacillus thuringiensis*). Where environmental and personal safety are critical considerations, you might wish to consider B.t. products in lieu of "classical" synthetic insecticides in your control program.

Bagworms

Bagworms will attack and defoliate most evergreen and deciduous trees and shrubs, but prefer arborvitae, red cedar, juniper, bald cypress, several species of pine, and boxelder. Bagworms live inside a spindle-shaped bag which they construct while they are in the larval or caterpillar stage. The bags are dragged with the caterpillars wherever they go and are made of silk and bits of foliage. The front part of the larvae protrude from the bag for feeding movement. Full-grown larvae are three-fourths to one inch long, dark brown with white to yellowish heads and a black spotted thorax (**Figure 1.4.1**).

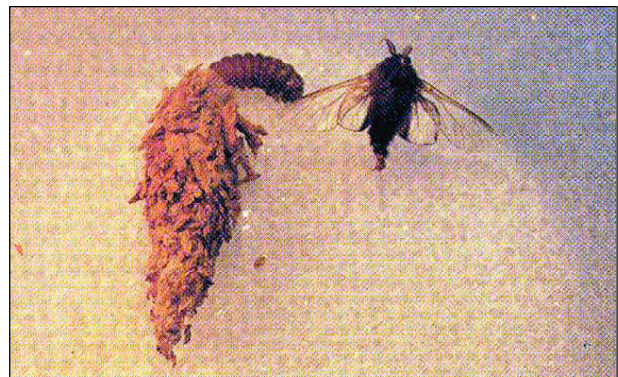


Figure 1.4.1. Bagworm larva and adult male.



Figure 1.4.2. Bagworm eggs.

Life History. Bagworms overwinter as eggs inside the bags of the females (**Figure 1.4.2**). The eggs hatch in late spring (May to early June) and the larvae begin feeding and constructing their protective case. As the caterpillars grow in size, the bag is constantly enlarged. The larvae pupate in late summer and the males emerge from their bags as black moths with furry bodies, feathered antennae and clear wings with a wingspan of almost one inch. The female is a wingless moth that remains in a wormlike form and never leaves the bag. She is fertilized by the male, lays 500 to 1,000 eggs inside the bag and then dies. There is one generation per year.

Management. Light infestations, particularly on small shrubs and trees, can be effectively controlled by hand-picking all the bags from the infested plants and destroying the bags before the eggs hatch.

Half grown to nearly full-grown bagworm caterpillars can be difficult to kill with insecticide. The key to successful control with insecticide sprays is to spray when the bagworms are small (late May to mid-June, when their cases are a half inch or less in length). To be able to time sprays exactly so they will do the most good, collect a few bags before the eggs hatch in late May and place them outdoors in a fine-screen cage. When the newly hatched larvae are seen leaving the caged bags, it is time to spray. When collecting bags for this purpose, keep in mind that male bags will not have any eggs, so collect enough bags to ensure that at least some of them have eggs.

Mimosa Webworm

Mimosa webworm attacks honey locust and mimosa (**Figure 1.4.3**). The many varieties of thornless and seedless honeylocust are subject

to attack. Larvae are ravenous feeders, and they feed mainly on the upper surface of the leaflets but may feed on both leaf surfaces. The leaflets soon turn brown and die, leaving unsightly nests due to dead leaves and webbing scattered over the tree. Damage to the foliage develops rapidly. By mid-July and August, much of the foliage may be destroyed. Small trees may be completely defoliated. Mimosa webworms live inside irregularly shaped webs made of silk and webbed-together foliage. While in the larval stage, the webworms do not leave the webbing, unless disturbed or to draw more foliage into the web. The adult moth is silver-gray with black specks or dots on the wings. The wingspan is about one-half inch. Larvae are dark brown to green with five longitudinal white stripes. Full-grown larvae reach about one-half inch in length.



Figure 1.4.3. Mimosa webworm.

Life History. Mimosa webworm overwinters in the pupal stage inside a cocoon in the soil or other protected area. The moths emerge in May, mate and lay pearly gray eggs on leaves by late May or early June.

If feeding larvae are disturbed, they generally twist violently and frequently drop from the feeding site on a silken thread. The larvae reach maturity in early July, with a new generation occurring in July and August. There are three generations per year – the third occurring in September and October.

Management. The webbing of the larvae makes it difficult to get adequate penetration of the webs with insecticidal sprays. As a consequence, many control failures are reported. To be successful, insecticides must be thoroughly applied over the entire tree shortly after the eggs hatch and before the leaves are webbed together. Close examination of the trees is necessary to detect newly hatched larvae.

Insecticide control may be needed for each of the three generations of larvae. However, exact timing of sprays will depend on the locale within the state and the growing season.

Fall Webworm

The fall webworm is the larval stage of a moth that is responsible for unsightly webbing seen on shade and nut trees from mid-summer to fall (**Figure 1.4.4**). These webs should not be confused with tent caterpillars, which appear on fruit trees in the spring. The larvae feed on the leaves of more than a hundred kinds of fruit, ornamental and woodland trees (**Figure 1.4.5**). Favored trees in Arkansas include persimmon, pecan, English walnut, black walnut and hickory. Larvae confine their feeding to leaves they have covered with webbing. Larvae characteristically web only the outer ends of branches. One or more branches may be defoliated, often with no damage to the tree other than appearance.

Life History. The moth is satiny white and may have black or brown spots on the forewings. They have a wingspan measuring slightly over one inch. Moths emerge from overwintering



Figure 1.4.4. Fall webworm webs.

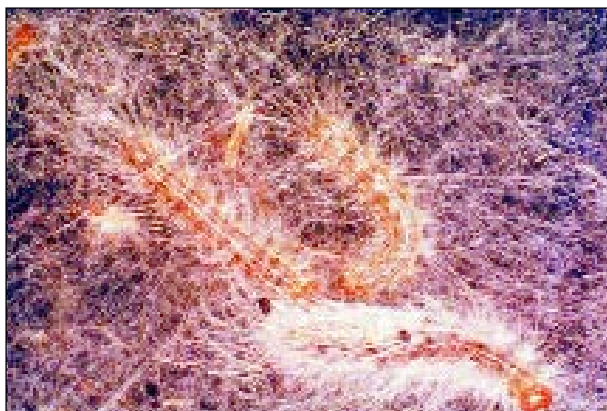


Figure 1.4.5. Fall webworm larva.

pupae in late spring (late April to May) and lay clusters of up to 500 greenish eggs on leaf surfaces of host trees. The eggs are partly covered with white hairs or scales and usually occur on leaves near the ends of branches.

Depending on the weather, tiny larvae hatch from eggs in early June. Larvae immediately begin weaving their webbing over the leaves at the end of branches. The web is small at first but soon becomes large as the larvae extend the web to cover more leaves. Feeding is done entirely in the protection of the web. Only the tender portions of leaves are eaten, leaving the veins intact. As the larvae grow, the web becomes filled with dead leaves, cast skins and feces. The larvae are about one inch long when full-grown and are pale yellow with dark spots down the back. The body is covered with long, silky, gray-white hairs. When full grown, they crawl down the tree to spin a cocoon and pupate in the ground litter in July. There are two generations a year – the first in early June (into July) and the second and normally the largest and most damaging generation of larvae present in August and September (sometimes into early October). Larvae from the second generation remain in the pupal stage until the next spring, when the moths emerge to begin the cycle again.

Management. When pruning out webs is not practical, insecticidal sprays, including bacterial sprays, will give excellent control if sufficient pressure is used to penetrate webbing. Control will be most effective if treatment is made while the webs are still small.

Cankerworms

Cankerworms are known also as measuring worms, inchworms or loopers (**Figure 1.4.6**). They attack early in the spring just as the leaves are beginning to appear, or they sometimes attack the buds before the leaves open.



Figure 1.4.6. Cankerworm.

Life History. The spring cankerworm adult emerges in late February and March as winged male and wingless female moths.

The females crawl up the trunk of the tree to deposit eggs. Eggs hatch in April or early May and the larvae devour developing leaves for three to five weeks. Dispersal is accomplished when small caterpillars are blown from one tree to another. There is one generation per year. Defoliation is often not readily apparent, although trees may appear dead because they are late in leafing out. **Note:** Even if this pest causes virtual defoliation of new spring foliage, trees normally recover and “re-leaf.”

Caterpillars first chew holes in leaves, then progress to eating the whole leaf as the larvae get bigger. Elms, hackberry, oaks and apple are favorite hosts. These caterpillars are often seen dangling from the foliage of infested trees on fine strands of silk (as from being dislodged by wind or disturbed foliage); however, the worms quickly climb the silk strands back up into the foliage.

Management. Applying bands of sticky material to the trunks of individual trees to catch the wingless females as they crawl upwards to lay their eggs is an old technique that can work. However, because large numbers of the small caterpillars are dispersed to other trees by the wind, the use of sticky bands works best when done on a community-wide basis.

Insecticides including bacterial (B.t.) products are effective in reducing damage to trees from this pest, if applied in April or early May to kill the newly hatched caterpillars.

Leaf Beetles

The most damaging leaf beetle in Arkansas is the elm leaf beetle (**Figure 1.4.7**). The elm leaf beetle is an introduced pest from Europe that feeds only on elm. Although most elm species are subject to attack, the beetles usually prefer Siberian elm, *Ulmus pumila* (commonly called Chinese elm) and hybrid elms. The true Chinese elm, *U. parvifolia*, is seldom attacked, and the American elm, *U. americans*, seldom suffers any significant damage from this pest.

Elm leaf beetle feeding damage may result in partial or complete defoliation of the tree. Severely damaged/eaten leaves will turn brown and often drop prematurely. Sometimes the entire tree may be defoliated by mid-summer. Most of the damage is caused by the larvae as they feed on the lower side of the leaves. Trees

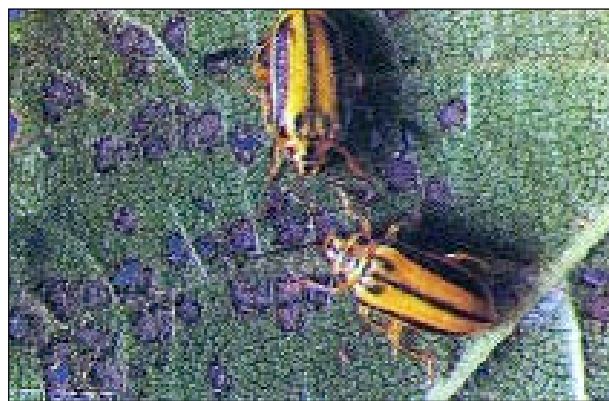


Figure 1.4.7. Elm leaf beetle adults.

that lose their leaves as a result of elm leaf beetle damage commonly put out a new flush of growth that may also be consumed by the insects on the tree or later generations of larvae.

Feeding damage by elm leaf beetles seldom kills an elm tree. However, severe feeding will weaken a tree, making it more susceptible to attack by other pests.

Life History. Elm leaf beetles overwinter as adult beetles in houses (where they are a nuisance), sheds and protected places out-of-doors (under loose bark or house shingles). Adults are about one-fourth inch long, yellow to olive green, with dark stripes along the outer edge of each wing cover. Adults emerge from their overwintering quarters during late April to early May, fly to nearby elms, mate and lay eggs. The adults eat small, circular holes in the expanding leaves. The orange-yellow, spindle-shaped eggs are laid on end in groups of five to 25, always in parallel rows on the underside of



Figure 1.4.8. Elm leaf beetle eggs.

leaves (**Figure 1.4.8**). A female will lay 600 to 800 eggs in her lifetime. Small black larvae feed on the undersurface of the leaves for about three weeks. Mature larvae are about one-half inch in length, dull yellow, with two black stripes down the back.

Larvae feed in groups, eating the undersides of the leaves, leaving only the upper leaf surface intact, resulting in a skeletonized appearance (**Figure 1.4.9**). At the end of the feeding period (larval stage), the larvae move to the lower parts of the tree to pupate in cracks, crevices or crotches on the trunk or larger limbs. Adults emerge in about eight days and lay second-generation eggs. In Arkansas, there are three full generations and sometimes a partial or complete fourth generation of elm leaf beetles.



Figure 1.4.9. Elm leaf beetle larva.

Management. Spraying infested trees should be timed to kill the young first brood larvae in May. Other treatments will likely be needed as later generations of larvae appear. Rain within 24 hours of treatment may result in having to retreat the tree to ensure sufficient insecticide residue to kill larvae. Also, properly labeled systemic insecticides can be applied to the soil to control elm leaf beetles. (Check product labels for specific application procedures.) **Note:** New varieties/strains of *Bacillus thuringiensis* (var. *tenebrionis*) are available for control of this pest.

Leaf Miners

Leaf miners are larvae of certain species of small flies, wasps, moths or beetles. They feed inside the leaf between the upper and lower surface. Damage appears as brown or discolored blotches or winding trails in leaves (**Figure 1.4.10**). There may be more than one generation per year, depending on the species of mining insect. Leaf miners are difficult to control after

they have entered leaves. A systemic insecticide will best reduce leaf miner numbers in hawthorn, birch, oak, holly and other infested plants. Treatment should be made when miners first appear in new foliage (in late spring or early summer).



Figure 1.4.10. Leaf miner damage.

Leaf Feeders – Sucking Injury

Aphids

Few plants exist, cultivated or wild, that are not hosts to one or more aphid species. Aphids, scale insects and the true plant bugs obtain their food by sucking the sap from plant tissue. Some species feed only on foliage, others on twigs, branches, flowers or fruit and still others on roots. Many live on several distinct hosts, spending part of their seasonal development on one host and the remainder on another.

Appearance and Damage – Aphids are small (seldom over 1/8 inch in length), soft-bodied, pear-shaped insects of many colors, such as green, black, gray or red. They usually can be distinguished from other insects by the presence of cornicles– a pair of “tail pipe” or tubelike structures projecting upward and backward from the upper surface of the abdomen. (One group of aphids, the most common member of which is the wooly apple aphid, does not have these structures). Cornicles may be long and narrow, short and broad or somewhere in between, depending upon the species.

Most aphids attack en masse, preferring young shoots or leaves. The feeding of large numbers of aphids can cause serious damage to plants by 1) robbing plants of sap, 2) the toxic action of their salivary secretions injected during feeding, and 3) serving as vectors of viruses which cause plant diseases. Aphid damage stunts growth, deforms leaves and fruit or causes galls on leaves, stems and roots.



Figure 1.4.11. Aphids.

Besides this damage, many aphid species excrete a sticky substance known as “honeydew.” This material falls onto the leaves, twigs and fruit, and a black, sooty mold soon begins to grow in it. This mold not only mars the appearance of the plant, but also restricts certain physiological functions, such as photosynthesis. Honeydew attracts ants and flies and is a nuisance on cars, chairs, tables or other objects that happen to be under infested plants.

Biology of Aphids – Much variation is found in the biology of aphids; however, there are certain general biological facts that may be applied to the group as a whole. Aphids usually reproduce without mating and give birth to living young. Species of aphids are usually rather restricted to specific host plants, feeding on a group of more or less related plants. Some species have alternate hosts on which they are found at different seasons.

Aphids are frequently held in check by natural forces, primarily adverse weather conditions such as beating rains and high and low temperatures, fungus diseases, and naturally occurring insect predators and parasites.



Figure 1.4.12. Winged Aphid.

The natural insect enemies of aphids are lady beetles, syrphid fly larvae, lacewing larvae and small wasp parasites known as Braconids.

Foliage-feeding Aphids – These aphids constitute a large group of small, soft-bodied insects frequently found in large numbers sucking sap from stems or leaves of plants. Such aphid groups often include individuals in all stages of development. This group contains a number of serious pests of cultivated plants. Many species affect particular plants (host specific), but a few can be found on many different types of plants. These aphids cause a curling or wilting of plant foliage, and they serve as vectors of a number of important plant diseases.

Woolly Aphids – Aphids in this group vary in color from shades of brown to purple. However, they all have in common a white, woolly, waxlike covering. Generally, the cornicles are reduced or absent, the sexual forms lack mouthparts and the fertile female produces only one egg.

Nearly all members of this group of aphids alternate between host plants, with the primary host (on which the overwintering eggs are laid) usually being a tree or shrub and the secondary host an herbaceous plant. These aphids may feed either on the roots of the host plant or on the part of the plant above ground.

Damage resulting from their feeding is characterized by prematurely opened leaf buds, distorted leaf edges curled or rolled in a gall-like manner, “clustered” leaves or enlarged or knotty growth on twigs and branches.

Managing Aphid – Beneficial insects play an extremely important role in natural aphid control. Frequent inspections will acquaint the observer with the presence of beneficial insects, their relative population level, efficiency in reducing aphid numbers and degree of parasitization. Insecticide applications for aphid control destroy beneficial insects as well as pests, leaving trees or shrubs unprotected if aphid resurgence occurs. Where practical, try washing aphids off with a forcible stream of water rather than using insecticidal sprays. (Apply water or insecticides during early morning or late afternoon to avoid sunscald of foliage or other tender plant parts.) When aphid populations are large and causing damage as previously noted, insecticides may be needed.

Spider Mites

Several species of mites attack trees and shrubs and cause the plants to become an off-green color as a result of these sap-sucking pests. Severely infested plants lose their vigor, become unsightly, and may even be killed. Mites are close relatives of insects, but mites differ in that they only have two body regions, no antennae and the adults have eight legs.

Two-spotted Spider Mites – This mite is perhaps the best known of the mite species and is often called the common red spider mite. It feeds on the lower surface of leaves on deciduous trees and shrubs. The mites suck sap from the foliage. Infested leaves become stippled with gray and may be covered with strands of silken webs.

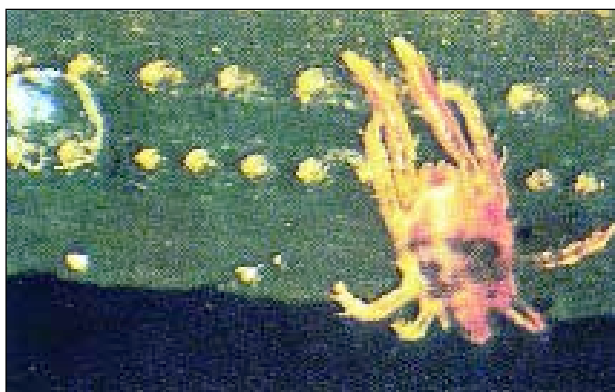


Figure 1.4.13. Spider mites.



Figure 1.4.14. Spider mite webbing.

Two-spotted spider mites overwinter as adults in protected places (soil, debris, etc.). The overwintering mites are bright orange, whereas the summer forms are usually cream to green color with two dark spots on their backs. Females deposit eggs on the lower surface of the leaves. The length of the spider mite life cycle varies greatly, but in warm weather it may

require only two weeks from egg to adult. This is why a mite population may build up rapidly.

Checking for Mites – If plant foliage begins to become an off-green color and mites are suspected, one way to determine if mites are present is to make a foliage check. This is done by holding a piece of white paper under a branch suspected to have mites and striking the branch hard against the paper. The mites are only about 1/50 of an inch in diameter. That's why they may not be seen on the plant foliage. If 10 mites or more are seen at each site, management procedures need to be considered.

Management – In general, cool, humid and rainy weather will hold mite development and numbers down to nondamaging levels so that no control measures are needed. Hot, dry weather is ideal for development. Certain mite predators feed on the destructive mites and, when abundant, they keep the population in check.

If natural controls fail to reduce mite populations below damaging levels, miticide (acaricide) sprays will likely be needed. One should consider rotation of products (pesticide classes) to reduce the chance of pesticide resistance developing in the mite population.

Lace Bugs

Lace bugs are small, broad, flat insects with clear, lacelike wings (**Figure 1.4.15**). Eggs, nymphs and adults all may be on a plant at the same time. Both adults and nymphs suck sap and cause leaves to be off-colored, speckled and yellowed and to drop. Many small, black, varnish-like spots of excrement on the underside of leaves are evidence of lace bug infestation. Lace bugs are common on pyracantha, hawthorn, quince, sycamore, oak and American elm. Control should be considered when infestations are causing obvious damage.



Figure 1.4.15. Lace bugs.

Plant Galls

Plant galls, abnormal tumorlike plant growths, are quite abundant in both rural and urban areas. They attract attention because of their unusual shapes and colors and because many homeowners prefer damage-free ornamentals in their yards.

Large numbers of galls can appear one year and few the next, or galls may be abundant year after year on the same plant. The abundance of galls is related to the abundance of the insect or mite causing the gall. Unfortunately, there is not enough knowledge about most gall-forming organisms to predict their abundance.

How Galls Are Formed – The young of insects or mites initiate the formation of most galls through their feeding activity. Certain chemicals produced by these young cause the living plant cells to increase rapidly in size or numbers. The exact mechanism for gall formation is not fully understood, but it is most remarkable that galls produced on specific plants by a given insect or mite are similar in shape and size year after year.

Species of aphids, midges, wasps and psyllids are the main insects that form galls. Eriophyid mites are also prominent gall formers. In addition, some galls are produced on plants by nematodes, fungi, bacteria and viruses. With most insect-caused galls, you should be able to see the insect(s) inside galls that are cut open.

Leaf galls can appear as curling of leaf margins, shriveling of the leaf or wartlike growths on leaf blades or petioles. These wartlike growths may be smooth, spiny or velvety.

Bud galls deform buds in various ways. Flower structures may be altered to look like spines, leaves or shapeless masses. Such growths can be numerous enough to destroy the aesthetic value of a tree.

How Injurious Are Galls? Galls are rarely abundant enough to seriously affect the normal growth of most plants. However, bud galls on conifers can lead to deformed growth of the tree, and occasionally twig galls can kill affected twigs.

In young trees, large numbers of galls can reduce growth. Control of the causal organism may then be necessary. On mature trees, however, leaf gall control is rarely justified.

Management – For plants such as roses, galls can be pruned out when they are discovered. Gall material should be removed from the premises so that reinfestation is less likely to occur. The same is also true for leaf galls. Removing the leaves in the fall also can help reduce the numbers of gall-forming organisms. However, by the time many galls are seen, the insect or mite has left the gall and will not be back until next year.

Some simple procedures are necessary when considering using pesticide controls (including oils). The insect or mite causing the gall must be vulnerable. Once the gall is formed, insecticides will not control the pest. Insects or mites which affect new plant growth require treatment just before bud development begins. Late applications have minimal value, although they may slow the development of additional galls. Some reduction in gall formations can normally be achieved if treatments are applied in the spring (e.g., at bud swell, a second application when leaves are one-fourth grown and a third treatment when leaves are one-half to three-quarters grown).

Common Galls

Hackberry Nipple Gall – A small, mottled, jumping plant louse (or psyllid) is responsible for this gall. The adult lays its eggs on the developing leaf buds or the undersides of the leaves. As soon as the egg hatches, the resulting nymph begins to feed, thus initiating the development of this gall. Mature psyllids emerge from the various galls at about the same time. These are sometimes enormous in number. Their small size permits them to go through 14-mesh window screen where, because of their abundance, they cause concern to homeowners. The galls do not harm the tree. Fine mesh screens will keep them from entering houses.

Petiole Gall of Poplar – Aphids feeding at the base of the newly developing leaf cause the leaf stem to fold back on itself, forming a closed cup. If the cup is opened during the summer, a large number of aphids are usually observed. A poplar or cottonwood tree may lose a few leaves from this gall but is not otherwise affected. No control is suggested.

Oak Galls – A variety of oak galls on the leaf blade, petiole and twigs are formed by flies, mites and tiny wasps. They vary in size, shape and color. Most are harmless, but they can occasionally make a tree unsightly. A few, such as

the fly-caused veinpocket gall, may distort the foliage to such an extent that, from a distance, the tree appears to be suffering from herbicide injury. Two other common galls caused by flies are the midrib and marginal fold galls. The succulent oak gall, one of the most common galls on pin oak in Arkansas, is caused by a tiny wasp and appears as green, grapelike galls. The previous comments on galls can be applied to oak galls (**Figures 1.4.16 and 1.4.17**).

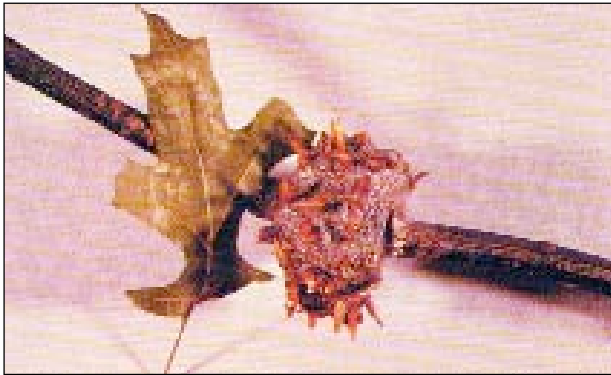


Figure 1.4.16. Horned oak gall.



Figure 1.4.17. Oak gall.

Shoot, Twig, Trunk and Root Feeders – Chewing Injury

Many kinds of insects attack ornamental plants and shade trees, but the woodborers are among the most injurious. Damage by these insects is often overlooked during summer months because the immature borers (larvae) feed in tunnels constructed in twigs, shoots, branches or trunks. Generally, plants lacking vigor are more susceptible to borer attack than are vigorous, healthy trees and shrubs. **Note:** Pheromone traps (male attractants) are available for monitoring the activity of some borer species. You may wish to consider integrating trapping into your IPM programs as a predictive “tool” to assist with proper timing of control efforts.

Borers can be classified in several ways; however, it is more convenient to list them by family groups, rather than by parts of the host plant attacked or by emergence periods. There are two groups of boring insects: beetles and moths.

Wood Borers – Beetles

The true beetles that attack woody tissues can be extremely injurious. Members are easily recognized because the adult insect body is hard and the wing covers meet in a straight line down the middle of the back. Two families of woodborers will be discussed: flatheaded woodborers and roundheaded woodborers.

Flatheaded Wood Borers

Adults of the flatheaded woodborers generally are brightly metallic colored, boat shaped and one-third to one inch long. Adults are commonly called metallic wood-boring beetles because of their color (**Figure 1.4.18**). These borers are destructive to newly transplanted trees.



Figure 1.4.18. Metallic wood-boring beetle.

The larvae or grubs are one-half to two inches long, yellowish white, legless and have a pronounced flattened enlargement just behind the head. This enlargement bears a hard plate on both the upper and lower sides.

Adult beetles emerge from host trees in the early spring and summer months and lay eggs near cracks and wounds in the tree bark. The larvae hatch from the eggs and bore first beneath the bark and then enter the sapwood. Their tunnels are packed with borings arranged in concentric layers, so that arclike bands appear when the galleries are exposed. Most species complete their life cycle in one year, while others may require two to three years. The flatheaded appletree borer is a common flat-headed woodborer in Arkansas.

Flatheaded Appletree Borer. This flatheaded woodborer attacks newly transplanted trees. Hard and soft maple, apple, sycamore, oak, hickory, pecan, linden, poplar and willow are preferred hosts, but several other species may be attacked. Newly planted trees, those that have been pruned to expose the trunk to sun, and weakened trees are the most susceptible to borer infestations. A single larva may girdle a small tree. Larvae are about one inch long at maturity. They overwinter as mature larvae, and adults emerge in May, June and July. Eggs are deposited in crevices of the bark during June and July. Hatching extends over several months so that all stages of larval development may be observed on a single tree. There is one generation per year. An effective method of protection is to wrap the trunks of newly planted or pruned trees with a good grade of wrapping paper or newspaper. Apply the paper to give continuous coverage from the ground to the first branches.

Insecticides can be applied on the trunks in May, June and July to kill newly hatched larvae.

Roundheaded Wood Borers

Adult beetles are cylindrical, hard-shelled and sometimes colored in contrasting bands, spots or stripes. Adult beetles are commonly referred to as longhorned beetles because their antennae are usually at least half as long as the body (**Figure 1.4.19**). In some species, it is nearly one and a half times as long. The larval stages of the beetle have no legs, are white to yellowish in color and are fleshy and rather round-bodied.



Figure 1.4.19. Longhorned beetle.

Adult beetles emerge from infested trees from late spring to early fall. Mated females then seek egg-laying sites, often under bark scales, in crevices or in tree wounds. Some of the longhorned beetles cut elliptical niches in the inner bark to lay eggs. After hatching, the larvae of some species may feed beneath the bark prior to entering the wood. Other species remain under the bark. Life cycles of the different species vary from one to four years. An example is the cottonwood borer.

Cottonwood Borer. This longhorned woodborer will attack cottonwood and other poplars. The adult is large, about one and a half inches long, with a black and white patch and cross stripe design. Eggs are laid in the tree trunk at the soil surface in July to August. Larvae live for two years in the trees. They bore both beneath the bark and into the wood and exude considerable frass. Larvae may completely girdle the bases of trees, cutting off sap movement and killing the trees. Lombardy poplars may be damaged so severely that they break off near the soil surface. Barriers constructed of wrapping paper or burlap and placed around the bases of young trees will help prevent oviposition. Such barriers are needed for several years. All factors that promote good growing conditions will help in reducing losses from borers. Borers can often be cut out of their tunnels with a pocketknife if done in early September of the first season of attack.

Insecticidal control is based on preventing attacks. Spray the lower trunk and saturate the soil around the tree base with insecticides in July and/or early August.

Borers Associated With the Pinewood Nematode

There are several species of longhorned woodborers in the genus *Monochamus* which attack and breed in various conifers. The larvae (roundheaded woodborers) are commonly known as sawyers or pine sawyers. The name sawyer has been used to describe the larvae because they frequently make loud noises while they are feeding.

The adults and larvae are most commonly associated with or infest freshly cut, felled, stressed, dying or recently dead trees. Young larvae feed on the inner bark, cambium and outer sapwood, forming shallow excavations (surface galleries). These galleries are filled with coarse fibrous borings (saw dust) and frass. As

they grow older, growing larger with each larval molt, they start to bore back toward the surface, thus forming a U-shaped tunnel. After the last stage of larval development, they form a pupal cell at the outer end of the tunnel near the surface of the wood. After pupation, the adult emerges by chewing a hole through the remaining wood and bark.

Pine sawyers (*Monochamus* spp.) are secondary invaders that lay eggs in conifers that are declining as a result of any kind of stress. The pine sawyers are nondiapausing insects and do not have a synchronized emergence. Thus, there can be larval feeding and adult emergence during warm periods year-round. Research in Missouri indicates that the beetles average two and a half generations per year. Thus, during any warm period, some of the population that is in the pupal stage (or ready to pupate) can emerge as adults. During midsummer, it is estimated that the beetles complete a life cycle (egg to adult beetle) in 50 to 60 days. The majority of the adults emerge and are active from May through late September. However, since there is staggered emergence during this period (non-synchronized emergence), all life stages can be present over the summer, and during warm periods in the winter some adults may emerge. For this reason, it is virtually impossible to ensure control or limit spread of these beetles by pesticidal means.

The emerging adults exhibit two behaviors: visiting healthy pines and feeding on the bark and/or visiting stressed/dying trees and feeding, mating and laying eggs in small cavities the females chew in the bark.

Association with Pine Wilt Disease

Pinewood nematodes (pine wilt disease) have caused the decline and death of numerous pines in Arkansas and throughout much of the rest of the U.S. The disease is unique in its complexity, since it involves a plant-parasitic nematode, one or more insect vectors (primarily pine sawyers), wood-staining fungi and possible other organisms. The most serious problems are occurring in introduced species of pine (non-indigenous species, e.g., Scotch, mugho and Virginia). It is believed that native species of pines have defense mechanisms that provide them protection from the pinewood nematodes, such that even if they become infected, they are not as seriously affected.

The adult beetles that emerge from pinewood nematode-infected pines usually pick

up some of the nematodes on their bodies (body hairs, legs and antennae), and many of the nematodes enter the beetles' respiratory openings (or enter the spiracles and are thus carried in the tracheal system). The infested pine sawyers that visit healthy trees to feed on bark can introduce nematodes into the feeding wounds, thus infecting the pine (and introducing pine wilt disease). In this type of introduction, it usually takes one month or longer for the nematode population to feed and reproduce such that the tree expresses symptoms or shows signs of decline.

Pine sawyers that are attracted to stressed or dying pines both feed and lay eggs in the bark. This provides two entry paths for nematodes that may be on or in the beetles' bodies. Experience has shown that these pines usually have already been infested by other woodborers or bark beetles that have introduced fungal diseases (such as blue stain), and this provides an excellent early food source for newly introduced pinewood nematodes.

Observations in Missouri have been that trees 12 feet or more in height (or 12 to 15 years old) are most commonly infected with pinewood nematodes or show signs of pine wilt disease. Indications are that the disease is far more common or readily expressed in the fall following a drier than normal summer.

Most of the pine wilt disease problems are reported in landscape pines rather than in plantation or nursery plantings. It is likely the large pine plantings are subjected to less stress by extensive cultural/pesticide maintenance, and they are normally younger than those pines in landscapes that are typically infected with the nematodes.

Positive identification of pine wilt disease can be made by submitting large sections from recently killed pines suspected of being infected. Sections placed in plastic bags can be submitted to the Arkansas Plant Disease Diagnostic Clinic for pinewood nematode extraction and identification. Most of the diseased trees have been Scotch, Japanese red, Japanese black and Austrian pines.

Unfortunately, there is no effective control for the nematodes that are in infected pines. As previously noted, insecticide control of the vectors (the pine sawyers) is not very feasible because of the possibility for almost year-round emergence of adults during warm periods. Products labeled for "borer" control can provide

some protection to landscape pines. The sprays would have to be applied preventatively to otherwise healthy pines from May through late September at about 30-day intervals. These applications can be of some help in killing the pine sawyers that occasionally visit healthy trees to feed on the bark. The only suggestion for pines showing rapid decline and for dead trees is to remove and destroy them by burning. This will kill beetle larvae and pupae in the infected trees before they can emerge and spread the nematodes to other pines.

Wood Borers That as Adults Are Moths

Moths are most readily recognized by the powdery scales on the wings and by their long, coiled mouthparts. This order of insects contains a number of injurious borers which are not as easily recognized as the beetles. Only the caterpillar stage is destructive. One family of this order will be discussed – clearwinged moths. These insects are more likely to attack healthy trees and shrubs.

Clearwinged Moths – Members of this family are known as clearwinged moths because the greater parts of one or both pairs of wings are without scales, thus leaving them clear or transparent. Many species bear a striking resemblance to bees or wasps. (However, the moths do not have pinched/constricted waists like most wasps.) Also, unlike most moths, they are active during daylight hours. The larvae are ivory white and usually have a light brown head. They bore into roots, trunks or branches of trees and shrubs, vines or the stems and roots of herbaceous plants. One member of this group is the lilac borer/ash borer.

Lilac Borer – This is a very destructive borer on ash. Look for boreholes in rough canker-like areas on stems. Moist sawdust oozing from these holes indicates active feeding. Eggs are laid on rough bark near scars or wounds in May or early June. Larvae bore into the stems during the summer and overwinter there. Insecticides applied on tree trunks in May and June help control adult lilac borers and newly hatched larvae.

Signs of Borer Activity. Look for sawdust-like material at the base of the plant. This material comes from the tunnel made by the borer. If sawdust is present, look for small punctures in the branches and trunk. Generally, there is a discharge of sap from the tunnel opening which wets and discolors the bark below it.

Borer damage should not be confused with woodpecker damage. Woodpeckers make small V-shaped impact holes. There is no tunnel and the holes do not bend, turn or “go anywhere.” The yellowbellied sapsucker, a type of woodpecker, makes a series of such horizontal marks and, upon superficial examination, may give the “shot hole” appearance of some borer damage.

Borer holes are round or oval and generally turn and go through the inner bark and cambium area beneath the outer bark. Some borers tunnel into sapwood or heartwood. Probing the hole helps to determine if there is a tunnel.

Reducing Borer Attack. Because borers are not usually recognized until extensive damage is complete, it is necessary to implement tree management practices that aid in reducing borer attack. These practices include:

- **Water and Fertilizer.** Be sure trees have plenty of water throughout the season, especially during drought periods. Also, have the soil analyzed and apply the correct kind and amount of fertilizer.
- **Pruning.** With established or newly transplanted trees, remove and destroy only dead and dying wood.
- **Mowing.** When mowing lawns, do not injure roots or other parts of the plant at ground level.
- **Plant Selection.** Select trees and shrubs that are suited to the local climate and not as susceptible to borer attack. Ash, cottonwood, poplar, linden and soft maple are especially susceptible to borer attack.
- **Wrapping.** Wrap trunks of young or transplanted trees with wrapping material to prevent egg laying by adult borers. Wrapping may also aid in preventing sunscald and mechanical damage.
- **Management in Infested Trees.** Once borers have entered the wood of a tree, control is extremely difficult. There is no quick or easy way of controlling established infestations; however, the following methods can be helpful:
 - Where only a few trees are involved, borers often can be controlled by hand worming. Locate and clean out borer tunnels with a sharp knife or wire probe. Remember, when borers are deeply established, even the wire probe is

ineffective because deep tunnels often are plugged with wood shavings.

- In situations where oviposition and hatch can be accurately determined, conventional sprays with insecticides may be of value. **Note:** Systemic insecticides (soil or foliar applied) have not been very successful in controlling borers already active in woody tissue.

Shoot Borers

Insects in this category feed on the surface or inside of shoots, causing shoot malformations and death. Moths and beetles cause most of the damage. The pine tip moth is the most serious borer in Arkansas.

Pine Tip Moths

The Nantucket is the primary damaging species in Arkansas (**Figure 1.4.20**). Pine tip moths destroy new growth of pines. The damage often deforms small, young trees up to 15 feet tall, slowing their growth and detracting from their normal symmetrical form. In some cases, repeated attacks can cause trees to die. Most species of two- and three-needle pines are subject to attack, except slash, Austrian and long leaf pines, which generally suffer no significant damage. Young pines growing in full sunlight have a tendency to be most heavily infested.

Life History. The moth overwinters as a pupa in terminal buds or just under the bark near the tips of other infested shoots. Emergence of first generation adults begins early in March and is completed by late April.



Figure 1.4.20. Pine tip moth damage.



Figure 1.4.21. Pine tip moth larva.



Figure 1.4.22. Pine tip moth adult.

Larvae that develop from the overwintering generation usually enter pine shoots during April (**Figure 1.4.21**).

The adult is a small gray moth with patches of reddish brown or copper on the forewings and buff hind wings. Wingspread is about one inch. It remains concealed among needle fascicles where it is well camouflaged by similar coloration. It is a weak flier, flying only short distances from tree to tree during evening hours. In daylight it flies only when disturbed (**Figure 1.4.22**).

Mating takes place soon after emergence, and the female begins to lay eggs during the evening the second day after emergence. Some eggs are laid on the buds and twigs, but most are laid on needles. An adult moth lives about eight days; each female lays about 25 eggs.

The egg is small, yellow and usually found on the upper surface of the needle about one inch above the base. Emergence from the egg begins in seven to eight days. An emerged larva is cream colored, but gradually turns light brown or orange. The head is dark brown to black.

Immediately upon emerging, the small first-instar caterpillar burrows into the needle. It continues to mine toward the base of the needle, where it tunnels to the outside and spins a web around itself and the needle fascicle. The larvae then continues to chew its way toward the terminal of the shoot, sometimes feeding only on the fascicles of needles but at other times on materials just under the bark of the twig. Larvae per infested shoot vary from one to ten. In most years, there are four generations in Arkansas.

Larval feeding causes the needles to yellow and infested shoots to die. New branches then develop diffusely from live buds below, resulting in poorly shaped trees with multiple leaders.

Larvae will leave the shoot and tunnel into a bud when one is present. Otherwise, they will pupate in the burrow in the shoot. Occasionally, a larva will accept a needle fascicle as a substitute for a bud and partially tunnel into it before pupating. Where larvae leave the shoot, they spin a web between the needles and the bud or the fascicle. All are soon covered with resin that oozes from the injured bud or shoot and hardens into a solid white mass.

Pupation takes about 10 days (resulting in a naked, dark brown pupa).

Survey Methods. In certain cases, sprays are the most practical means of controlling the pine tip moth. Since sprays are most effective when properly timed, you need to know when adults are active. The simplest method is the use of pheromone traps. **Note:** Sex pheromones are chemical substances that adult insects secrete to lure members of the opposite sex. The pheromone traps contain an artificial sex attractant that lures male moths inside the trap. The traps are placed among or near the pine trees and checked every day or two for moths that stick to an adhesive material inside the trap. Peak emergence can occur from 3 to 6 weeks after the first moth is collected in early spring.

If populations are very large, one trap for every 2 acres is sufficient. More traps are suggested when smaller numbers of moths are encountered. Depending on temperature, most pheromones (lures) will remain effective for 4 to 6 weeks. Traps are not control methods for pine tip moths. It would take several hundred traps per acre to provide any chance of reducing the moth population, and this would not be economically feasible.

In Arkansas, pheromone traps should be in place by March 1. Moths of the overwintering generation begin emerging sometime during

March in most locations during most years. However, moths can sometimes emerge in late February in southern Arkansas.

Management. The most effective method of management in most situations is provided by systemic insecticides. Research has shown labeled granules applied per label directions to the soil around each tree in November are very effective. This application usually provides good protection from the first generation larvae.

The best chance of protection by use of sprays is with a treatment program from late March through early August. Treatments can be applied at about 20-day intervals from late March through the end of June. Following this, monthly treatments in late July and late August should provide protection from later generations.

Sprays are effective only against adults and newly hatched larvae; therefore, control can be improved by treating at the proper time.

Sprays should be timed in accordance with peak emergence of adult moths so maximum control of young larvae is achieved before they penetrate tree shoots. Generally, sprays should be applied 10 days after an emergence peak has been identified. However, grower experience suggests that this 10-day lag should be reduced in later generations as temperatures decrease the time needed for egg hatch – 4 to 5 days after peak emergence in June and 2 to 3 days in August. Retreatment may be necessary if heavy rainfall occurs within a week of a timed treatment.

Bark Beetles

Bark beetles are so named because most of them live and mine between the bark and wood of trees and shrubs. (These cause the scars or sculptured runs or tunnels one sees if the bark is peeled off.)

Adult beetles lay their eggs in tunnels that they make between the bark and wood. After the eggs hatch, the larvae mine the area, making runs that radiate out from the egg tunnels. Larval tunnels are always packed with their feces.

Extensive tunneling of this kind can girdle stems, branches or the trunk and thus kill parts of or the entire tree or shrub. When adults bore out through the bark, they leave the surface as though riddled by buckshot (thus sometimes referred to as “shot holes”). Adults are small cylindrical beetles, reddish to dark brown or black, from one-sixteenth to one-fourth inch

long. The larvae are grub-like, thick-bodied, legless, generally broadly C-shaped, white or cream colored and have a distinct head. Adult egg laying habits and life cycles vary extensively with the different species.

In Arkansas, one of the most destructive bark beetles is the smaller European elm bark beetle that transmits Dutch elm disease to American elms.

Smaller European Elm Bark Beetles – Smaller European elm bark beetles (SEEBB) first entered the United States in 1909. Since that time, it has become widespread and is now the most important carrier of Dutch elm disease.

This beetle is about one-eighth inch long (**Figure 1.4.23**). A concave area is at the rear of the abdomen, and a noticeable projection points toward the rear. The female lays her eggs in niches in the side of simple, unforked egg tunnels under the bark of dead or recently cut elm wood. The egg tunnels run with the grain of the wood. After the eggs hatch, the larvae bore small tunnels around the trunk or branch and away from the centrally located egg tunnel (thus the larvae feed across the grain).



Figure 1.4.23. Smaller European elm bark borer.

Adult beetles emerge in late April or May, fly to healthy trees and feed in crotches of the twigs. It is during this time, if they emerged from the bark of diseased trees or wood, that they can introduce the fungus spores from their bodies into healthy trees.

Beetles emerge from under the bark of dead or dying elms in the spring and move to and feed on tender bark in twig crotches. Feeding injuries are most numerous in twig crotches near the outside crown of the tree. The beetles that emerge from late April to the first of July (overwintering and first generation

adults) are the ones most likely to vector the disease to healthy elm trees. At this time, the long vessels of the elm's springwood are open and functioning. Feeding beetles will cut into these vessels, and they can introduce Dutch elm disease spores. The vessels that are produced later in the year are shorter, and the movement of materials throughout the tree will be slower. Dutch elm disease transmission is most likely if beetles feed in one-year-old or older twig crotches in spring or early summer (**Figure 1.4.24**).



Figure 1.4.24. Smaller European elm bark beetle damage.

After feeding, the adults tunnel into the inner bark of weakened, dying or recently dead elm trees. They lay their eggs in galleries, which are parallel with the grain of the wood. The larvae hatch and feed in the layer under the bark of the tree. The life cycle may be completed in 35 to 40 days. The spring-flying adults produce a generation that emerges in June. These first generation adults also feed in twig crotches and can transmit Dutch elm disease. They then produce a second generation of larvae. Many of these larvae enter a developmental diapause and overwinter, but some continue to develop and begin to emerge in August. These adults produce a partial third generation. Second and third generation adults also feed in twig crotches, but they usually do not transmit Dutch elm disease since the trees are not as susceptible at this time. Due to overlapping of

generations, adults may be present almost continuously from April to October. Thus, this insect has three full generations per year and sometimes a partial fourth.

Control of SEEBBs with respect to their potential spread of Dutch elm disease should be timed such that treatments coincide with the spring emergence of adults (usually May).

Shoot, Twig, Trunk and Root Feeders-Sucking Injury

Scales

Scale insects derive their name from the scale, a shell-like or waxy covering on their bodies. Generally, scale insects can be divided into two categories – soft scales and armored scales. Soft scales can be bare (or without shell) or covered, but they are commonly covered in a soft, cottony or powdery substance. Armored scales have a protective covering of wax under which they feed. Depending on the species involved, scale insects feed on plant stems, twigs, foliage or fruit.

Damage – Scale insects feed by sucking sap from trees and shrubs and are capable of killing the entire plant or parts of the plant. Scale insect feeding can also reduce the plant's vigor, making it more susceptible to injury caused by drought, severe winters, attack by other insects (particularly borers) or infection by diseases.

Life Cycle – The scale insects most commonly found in Arkansas overwinter either as eggs or immatures. In most species, the female deposits eggs under her shell or scale. When the eggs hatch, “crawlers” (or nymphal scales) move away from the maternal scale to locate new feeding sites. When the crawlers settle and begin to feed, the characteristic soft or armored scale covering is developed. Good scale control is generally best accomplished if treatments are applied immediately after eggs hatch (when crawlers are active).

Monitoring Suggestions for Scale Insects

When scale insects increase to levels that create a nuisance (unsightly, honeydew, etc.) or are causing extensive damage to a tree, insecticide control of the infestation can best be achieved at two different times of the year. Horticultural oils may be applied in the dormant season (per label directions) to smother overwintering scales and/or eggs, or an insecticide may be applied when the crawlers are active.

Monitoring scales in the dormant season is easy, since the insects are half-grown or larger and their coverings quite visible. In contrast, monitoring crawlers can be tedious because of their small size and because our interest is in their numbers in relation to the entire crawler emerge profile for the specific scale species (so we can time application with a reasonable certainty that virtually all are hatched and would be exposed to the insecticide).

Monitoring crawlers can be accomplished by visual observation with the aid of a hand lens; however, monitoring for the mobile immature can be facilitated by the use of two-sided sticky tape. Wrap strips of it tightly around scale-infested twigs or branches. Crawlers seeking a place to settle down will be stuck fast as they attempt to cross the sticky surface. **Note:** Try to select smooth bark as a place for bands. It is suggested that one collect the bands at least weekly and count the numbers of crawlers per band under magnification. New bands should be put back in the same place after each collection. (It helps to place a tag or indicator near each band for ease in finding it.)

The best control of the scales will normally result when treatment is made at or slightly after the peak of crawler emergence. Differences in peak crawler emergence can always be expected between years and locations because of varying environmental conditions.

If one uses some type of monitoring for crawler activity, a great deal of the “guesswork” of timing scale crawler applications will be eliminated.

Euonymus Scale

The euonymus scale is an armored scale that can infest most species of euonymus. It can attack both the leaves and stems (**Figure 1.4.25**). Often, stems or leaves will become



Figure 1.4.25. Euonymus scale.

heavily encrusted with the male scales which are small, slender and chalky white in color. Heavy infestations make the plant appear white. The female euonymus scales are pear-shaped, brown and about twice the size of males.

Life History. Scales overwinter as fully-grown, fertilized females. Eggs are deposited in early spring beneath the dark colored female scale covering. The eggs can hatch over a two-month period from mid-April to mid-June. Nymphs, or crawlers, move to other parts of the host plant or are blown to susceptible hosts by wind. During the summer, all life stages of the scale can be found, and in most years, there are four or five overlapping broods. Control of the first/overwintering generation crawlers can be achieved if you will check for their activity in early to mid-May before treatment.

Brown Elm Scale

The brown elm scale is one of the most common soft scale insects infesting elms in Arkansas (**Figure 1.4.26**). Brown elm scale is a soft scale that is also known as the European fruit lecanium because of its origin and the fact that it infests fruit trees in some parts of the country. Brown elm scale has been found in Arkansas on ash, mulberry, plum, pecan, maple and occasionally on other trees, but it is chiefly a pest of elm. On elm, injury is usually noticed in April and May when the female scales are conspicuous and the trees are visibly injured by the insects. Heavy infestations kill smaller branches, stunt tree growth and weaken the tree until it is susceptible to attacks of borers and diseases. Heavy infestations result in large quantities of honeydew (a gummy, sticky secretion that is produced by aphids) that often coats leaves or falls on sidewalks, buildings or cars parked under the trees.

Life History. The mature female is brown with a smooth, hemispherical-shaped covering that is one-eighth to one-fourth inch in diameter. During growth, the body is soft and plastic, but at death becomes a hard, brown shell fastened loosely to the bark that may serve as a covering for several hundred white eggs. Eggs are laid in late April and early May and hatch into tiny lice-like creatures from early to mid-May. The nymphs (crawlers) come out from beneath the scale covering and migrate to the leaves and small limbs. Large numbers attach



Figure 1.4.26. Brown elm scale.

themselves on the lower leaf surfaces and to small limbs. As they grow during the summer, their bodies become opaque, and they attach along the veins of leaves as well as twigs and limbs.

Before the leaves fall in autumn, brown elm scales migrate to the bark of smaller branches, where they remain all winter. At this stage they are brown, oval shaped and about 1 mm in length. With the beginning of sap flow in the spring, the scales start to feed. The adult male is small, brown and gnat-like (1 1/4 mm long). It is incapable of feeding and lives only a short time.

Management of Scales

Dormant Oil – A superior dormant oil, applied according to label instructions just prior to “bud break,” will help control many of the scales found in Arkansas. It can be applied to most evergreen and broadleaf woody plants (but check the label prior to application). Bud break will vary with the species of plant and the severity of the spring season, but superior dormant oil sprays usually should not be applied after early April in Arkansas. Dormant oil sprays kill scale insects by suffocation.

Sprays – Insecticides applied thoroughly according to label instructions are effective in controlling the common soft and armored scales found in Arkansas. However, since these sprays will not penetrate the waxy scale covering, spraying must be timed to coincide with the presence of the crawlers. The presence of the crawler stage will vary with the species. Thus, repeated applications may be needed to kill crawlers if the species of scale encountered has multiple generations over the growing season.

Key to Common Tree and Shrub Pests

Leaves are mottled, discolored or curled.

- Numerous soft, bodied, slow-moving, tiny, winged or wingless insects are feeding on the undersides of leaves or on the bark. The foliage may be wet, sticky and dripping Aphids
- Wedge-shaped, tiny, hopping insects are feeding on foliage, giving the leaves a mottled appearance, or leaf tips may be yellowish brown. In severe cases, the leaves turn brown Leafhoppers, treehoppers
- Small, flattened insects are feeding on the undersides of leaves. White cast skins/moltings and black shiny specks are often present on undersides of leaves. The adults have lace-netted wings Lace bugs
- Microscopic, eight-legged insects are feeding and forming webs on the undersides of leaves Mites
- Wedge-shaped, nonhopping insects are feeding on new shoot growth. Leaves are first mottled, then turn brown from severe feeding Plant bugs
- Immobile insects are attached to leaves or stems. Their protective covering may be almost any shape or color. The foliage may be covered with sticky, shiny material. Tiny, aphid-like young hatch and move out from adult sites Scale insects
- Leaves have meandering lines, runs or mines Leaf miners

Leaves show evidence of chewing; parts or all of leaves are missing.

- Dull green and black adults and yellow-and-black-spotted larvae are feeding on elm leaves, most commonly on Siberian elm. Leaves are skeletonized Elm leaf beetle
- Brown to dark reddish brown, three-fourths inch long beetles are feeding on foliage June or May beetles
- Caterpillars are living in small, spindle-shaped bags constructed of foliage and attached to twigs Bagworms
- Looping, measuring caterpillars are feeding on foliage (caterpillars may be noted to occasionally be hanging or suspended from foliage by silken threads Cankerworms
- Caterpillars are constructing tents in crotches of trees and feeding on foliage Tent caterpillars
- Webs are spun around masses of leaves and worms are feeding inside them Fall webworms, mimosa webworm

Limbs are dead or dying; bark is raised and wounded; tunnels are evident under bark.

- Tunnels are evident under bark of newly set maples and fruit trees Flatheaded appletree borer
- Sawdust is pushed out of holes in wet areas of bark (part of pupal case may be noted sticking out of emergence holes) Locust borer, ash borer, lilac borer
- Borers are feeding under healthy bark at the edges of wounds on flowering fruit trees Peach tree borer
- Trunk of limbs have numerous small holes (shot holes as if hit by shotgun pellets) and numerous sculptured runs or mines under bark Bark beetles

Miscellaneous Symptoms

- Twigs have deep slits in somewhat of a symmetrical pattern. Branches are broken off Periodical cicadas
- Abnormal growths or swellings can be seen on leaves, twigs or limbs Plant galls
- Twigs are girdled by feeding of beetles Twig girdlers

Seasonal Appearance of Some Ornamental and Shade Tree Pests in Arkansas

Few insects are active during January and February; during these months one can apply dormant oils for control of scale insects, e.g., on oak, elm, and fruit trees.

(A) indicates adults, (L) indicates larvae.

Early-March		Mid-March		Late-March	
Host:	Pest:	Host:	Pest:	Host:	Pest:
crab-apple	San Jose scale	coneweed	tent caterpillars	crab-apple	tent caterpillars
		dogwood	tent caterpillars	flowering peach	tent caterpillars
		flowering peach	tent caterpillars	hawthorn	tent caterpillars
		hawthorn	tent caterpillars	wild plum	tent caterpillars
		pecan	tent caterpillars		
		pyracantha	tent caterpillars		
		eribotiae orange	tent caterpillars		
		wild plum	tent caterpillars		
Early-April		Mid-April		Late-April	
Host:	Pest:	Host:	Pest:	Host:	Pest:
elm	elm leaf beetle (A)†	ash	redheads-d ash borer	arbutus	Juniper scale
hackberry	gall psyllids (A)	black locust	cowpea aphid	crab-apple	wooly apple aphid
hickory	painted hickory borer (A)	black walnut	European fruit lecanium	craps myrtle	craps myrtle aphid
oak	gall wasps (A)	elm	European fruit lecanium	elm	May beetles (A)
pine	pine cone scale		elm calligrapha (A)		spring cankerworm
	Manure's pine tip moth (A)		elm bud sawfly (L)†		elm leaf aphid
redbud	redbud aphid	hackberry	European fruit lecanium		wooly elm aphid
		ilac	harkness bug (A)		smaller European bark beetle (A)
		mulberry	European fruit lecanium	flowering peach	spring cankerworm
		oak	obscure scale	hackberry	spring cankerworm
		pecan	oak lecanium	hickory	giant bark aphid
			obscure scale		hickory bark beetle
		pine	European fruit lecanium	Juniper	Juniper scale
			ips beetles (A)	oak	spring cankerworm, forest tent
			southern pine beetle (A)		caterpillar, May beetles (A)
			pine needle aphids		giant bark aphid, oak leaf aphid
			Manure's pine tip moth (L)	pecan	May beetles (A), giant bark aphid,
		redbud	European fruit lecanium		phytophaga
		willow	willow leaf beetle (A)	sumac	sumac leaf beetle
				sycamore	giant bark aphid
				wild plum	ruzy plum aphid
					spring cankerworm

(Table continued on next page.)

Early-May		Mid-May		Late-May	
Host:	Pest:	Host:	Pest:	Host:	Pest:
eucalyptus-hawthorn	eucalyptus scale (krawlers), oystershell scale.	elm	carpenter worm, elm calligrapha (L), elm leaf beetle (L).	juniper	bagworm (L), spider mites, sawflies (L).
honey locust	honey locust pod gall.		elm scaly scale, elm borer (R).	pecan	black pecan aphid.
oak	indian looper, pinkish sawfly (L).	flowering quince-honeysuckle	spider mites, hornworms.	pine	sawflies (L).
pecan	black imagined aphid, whistlers.	juniper	juniper webworm.	rebut	rebut leafhopper.
prince	Forbes scale.	hick	hick borer (R).	spruce	spruce aphid.
pyracantha	sycamore lace bug.	maple	paired maple aphid, woolly alder aphid, carpenterworm.		
sycamore	giant willow aphid, sawflies (L).	mimosa	mimosa webworm.		
willow	willow leaf beetle (L).	oak	leafhoppers, carpenterworm, kermes scale.		
		pine	black turpentine beetle (R), pales weevil (R).		
Early-June		Mid-June		Late-June	
Host:	Pest:	Host:	Pest:	Host:	Pest:
birch	birch aphid.	black walnut	fall webworm.	black walnut	walnut casepilar.
black walnut	flathheaded apple-ree borer (R).	commonwood	commonwood leaf beetle (R), fall webworm.	commonwood	cloudywinged leaf aphid.
boxelder	boxelder bug.		fall webworm.	hickory	walnut casepilar.
casalpa	casalpa sphinx (L).		commonwood borer (R).	pecan	walnut casepilar.
coconiastr	hawthorn lace bug.	dogwood	dogwood twig borer (R).		
crabapple	flathheaded apple-ree borer (R).	eastern redcedar	minute cypress scale.		
dogwood	flathheaded apple-ree borer (R).	hickory	fall webworm.		
elm	flathheaded apple-ree borer (R), elm sawfly.	Lombardy poplar	commonwood borer (R).		
flowering peach	peach-ree borer (R).	oak	oak grasshopper.		
goldenrain tree	boxelder bug.	pecan	fall webworm.		
hawthorn	hawthorn lace bug.	persimmon	fall webworm.		
hickory	flathheaded apple-ree borer (R).	pine	pine needle scale, southern pine sawyer (R).		
holly	leafminer (L).	sumac	sumac aphid.		
Lombardy poplar	poplar borer (R).	sweetgum	sweetgum pit scale.		
maple	comony maple scale.	willow	commonwood borer (R).		
	flathheaded apple-ree borer (R).				
oak	flathheaded apple-ree borer (R), oak lace bug.				
pecan	flathheaded apple-ree borer (R).				
persimmon	false comony maple scale.				
pyracantha	hawthorn lace bug.				
rebut	flathheaded apple-ree borer (R).				
sycamore	flathheaded apple-ree borer (R).				
willow	black willow aphid.				

(Table continued on next page.)

